Technical Specifications
for the
Lake Arrowhead Well #3
Pump Station
Project

Lake Arrowhead Community

North Waterboro, Maine

Dirigo Engineering
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Project #48202

Contract Documents

For The

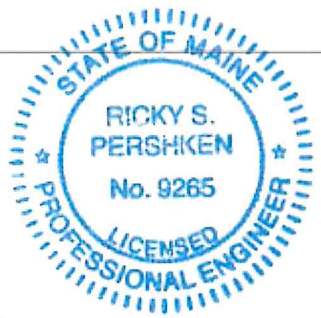
Lake Arrowhead Well #3

Pump Station Project

For The

Lake Arrowhead Community

North Waterboro, Maine



Prepared By

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2/21/24

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SECTION 01010
SUMMARY OF WORK

01010.01 LOCATION OF WORK

All work under this contract is located in **Limerick, Maine.**

01010.02 SUPPLY OF MATERIALS

The Contractor shall supply all materials required for the completion of this project.

01010.03 WORK UNDER THIS CONTRACT

Work under this contract is generally described as **installing new primary electric service, secondary electric service, connecting existing well, constructing a pumping station with piping, electrical, controls and chemical feed systems, SCADA system integrated with owner's current system, water main installation, stand-by propane generator and site work.**

SECTION 01106
SUBSTITUTIONS OR "OR-EQUAL" ITEMS

01106.01 GENERAL

This specification supplements the substitutions section of the general conditions.

01106.02 MATERIALS AND EQUIPMENT

Whenever materials or equipment are specified or described in the contract documents by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other suppliers may be accepted by ENGINEER if sufficient information is submitted by CONTRACTOR to allow ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named.

The procedure for review by ENGINEER will include the following as supplemented in the general conditions. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The application will state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the contract documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish at CONTRACTOR's expense additional data about the proposed substitute.

01106.03 MEANS, METHODS, TECHNIQUES AND PROCEDURES

If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the contract documents, CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to ENGINEER, if CONTRACTOR submits sufficient information to allow ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the

contract documents. The procedure for review by ENGINEER will be similar to that provided in paragraph 01106.02 as applied by ENGINEER and as may be supplemented in the general conditions.

01106.04 ENGINEER'S REVIEW OF SUBSTITUTIONS

ENGINEER will be allowed a reasonable time within which to evaluate each proposed substitute. ENGINEER will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute. ENGINEER will record time required by ENGINEER and ENGINEER's consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the contract documents occasioned thereby. Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's consultants for evaluating each proposed substitute.

SECTION 01150
MEASUREMENT AND PAYMENT

01150.01 GENERAL

This section shall supplement the Payments to Contractor section of the General Conditions. If a conflict exists between the two sections, the General Conditions shall take precedence over this section.

01150.02 SCOPE OF PAYMENT

The Contractor shall accept compensation, as herein provided, in full payment for furnishing all materials, labor, tools, equipment, testing, cleanup and incidentals necessary to the completed work and for performing all work contemplated and embraced by the contract; also for all loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work and until its final acceptance by the Engineer, and for all risks of every description connected with the prosecution of the work, except as provided herein, also for all expenses incurred in consequence of the suspension of the work as herein authorized.

Contractual costs for work not specifically mentioned under a payment item and which are incidental to the overall conduct of the work shall be included in individual items at the Contractor's option. No additional charges shall be made to the Owner for items not specifically mentioned under individual payment items. Examples of these types of costs are, but not limited to, the following: bonds, insurance, mobilization, demobilization, permits, licenses, temporary offices, restoration of disturbed areas, traffic control, temporary facilities, temporary connections, cleanup, erosion control, temporary drainage, temporary utilities, temporary water and sewer utilities, surveying, layout, handling of water, erosion during construction, signs and other items similar to the above. This includes incidental work items noted on the drawings but not specifically mentioned under a pay item.

All units of measurement shall be standard United States convention as applied to the specific items of work by tradition and as interpreted by the Engineer.

01150.03 PARTIAL PAYMENTS

As the work progresses, partial payments shall be made to the Contractor as described in the General Conditions. All partial invoices and payments shall be subject to correction in the final quantity invoice and payment. Applications shall be made on the forms in 01160 or on other forms approved by the Engineer.

The partial payments will be based upon invoices approved by the Engineer for the value of the work performed, and materials complete in place in accordance with the contract. The total amount so ascertained will be reduced as described in the General Conditions. The reduced amount will be certified for payment, and the balance will be retained by the Owner until after completion of the entire contract.

The payment of any partial estimate or of any retained percentage shall not affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damage due to such defects.

01150.04 PREPARATION OF PARTIAL PAYMENT ESTIMATES

At the end of each partial payment period, the Contractor's authorized representative shall meet with the Engineer's representative and determine and agree upon quantities of unit price work accomplished and/or completed during the partial payment period.

For payment once each month the Contractor will prepare a monthly requisition form which shall be signed by both the Engineer and the Contractor's representative indicating complete agreement and approval of quantities listed. These completed forms will provide the basis of the Engineer's monthly quantity estimate upon which payment will be made.

01150.05 MATERIALS STORED ON SITE

Partial payments may be made to the Contractor for major materials delivered to the project site and properly stored. The Contractor's requisition for materials payment shall be accompanied by: 1.) Itemized invoices listing the materials delivered during the current pay period and the price paid for each item; and 2.) An itemized list showing the materials used during the current pay period and the materials currently remaining unused on site (per the form in 01160).

Partial payments for materials stored will only be made for materials that have been paid for by the Contractor. Proof of payment must be supplied to the Owner in the form of signed waiver of liens, listing the specific invoices and check numbers paid, before payment for materials will be made by the Owner.

Partial payments for materials stored shall not include miscellaneous small items such as water service materials, sewer service materials, fittings, glands, gaskets, lubricants, bolts, nails, etc. Partial payments for materials stored shall not include any borrow stockpiles. The Contractor shall be responsible for proper storage and protection of the materials at all times. The Contractor shall carry insurance protecting the materials from loss.

01150.06 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

When alterations are made in the quantities of work which do not require supplemental agreement, the Contractor shall accept payment in full at the contract price for the actual quantities of work done. No allowance will be made for anticipated profits. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

Payments to the Contractor will be made for the actual quantities of contract items performed and accepted in accordance with the plans and specifications. Upon completion of the construction, if these actual quantities show either an increase or decrease from the quantities given in the Bid Form, the contract unit prices will still prevail, except as provided hereinafter.

01150.07 ELIMINATED ITEMS

Should any items contained in the Bid Form be found unnecessary for the proper completion of the work contracted, the Engineer may eliminate such items from the contract. Such action shall in no way invalidate the contract. An allowance may be made at the discretion of the Engineer for items so eliminated in making final payment to the Contractor. No allowance will be made for minor quantity changes requiring supplemental deliveries or returns.

01150.08 FINAL PAYMENT

All payments including final payment shall be inaccordance with the conditions and requirements of the General Conditions.

In addition to the provisions of the General Conditions Final Lien Waivers shall be submitted from all subcontractors and suppliers prior to Final Payment.

01150.09 DESCRIPTION OF PAY ITEMS

Section 01151 describes the measurement of and payment for the work to be done under the respective items listed in the BID SCHEDULE.

Final Lien Waiver

Project Owner : _____

Address : _____

Project Name : _____

_____

Subcontractor/Supplier : _____

Address : _____

Contractor : _____

Address : _____

The undersigned hereby certifies to the following:

1.) Subcontractor/Supplier has been employed by the Contractor listed above to supply work, materials or equipment for the above described project.

2.) Subcontractor/Supplier has received final payment from Contractor for all work, materials or equipment for the above described project.

3.) Subcontractor/Supplier has no liens against Contractor or Owner.

The undersigned hereby waives any and all liens or rights thereto arising out of said work, materials or equipment.

Date : _____

Signature : _____

Printed Name/Title : _____

Subcontractor/Supplier : _____

STATE OF MAINE

_____ , SS. _____, 20____

Personally appeared the above-named _____, and acknowledged the foregoing instrument to be his/her free act and deed.

Before me,

_____

Notary Public/Attorney-At-Law

Print Name: _____

Commission Expires: _____

SECTION 01151
BID ITEM DESCRIPTIONS

01151.01 GENERAL

This section supplements Section 01150 and contains a description of the respective items listed in the BID SCHEDULE. If a conflict exists between this section and any Technical Specification (Divisions 2-16) the Technical Specifications shall take precedence over this section.

Each unit or lump sum price stated in the BID SCHEDULE shall constitute full compensation, as herein specified, for each item of the work completed.

Definition – For the purpose of this specification section **"site work"** is defined as: layout, coordination with all utilities, traffic control, erosion control, site preparation, pavement cutting, excavation, shoring, dewatering, bedding material, backfilling, compaction, geotechnical and/or compaction testing, surface grading, gravel surface restoration where applicable, loam and seed surface restoration where applicable, cleanup, site restoration including reinstallation and resetting of any structures or vegetation disturbed during construction, and compliance with all applicable environmental permit conditions and related regulations.

01151.02 BID ITEM DESCRIPTIONS

Item 1 – Pump Station Construction (Complete)

This item includes all labor, materials and equipment required to complete all work to build the pump station as shown on the contract drawings and as specified in the contract documents. This includes: site work, well pump site piping, foundation work, concrete, building work, mechanical work, coordination with electric utility, electrical work, buried conduits, electrical, controls, telemetry, painting, interior piping and equipment, chemical feed systems, standby propane generator, startup and all other work shown in the contract documents

Payment for this item shall be at the lump sum price agreed upon in the bid schedule. Partial payment shall be made according to the percentage of work completed on this item. A complete schedule of values for this item shall be submitted to the Engineer prior to any payment requests. Final payment for this item shall not be made until satisfactory startup including disinfection and bacteriological testing has been accomplished and all work complete.

Payment shall be at the lump sum price in the bid schedule.

PAYMENT APPLICATION NO.
Project - _____

Page ___ of ___
Date _____

Owner: _____
_____
_____

Contractor: _____
_____
_____

SUMMARY OF APPROVED CHANGE ORDERS

No.	Date	Amount
1		
2		
3		
Total		

I certify the amounts stated on this Application for work completed and materials stored are true and in accordance with the Contract, and that the current payment shown herein is now due. I further certify that I have paid all amounts stated on previously certified applications for which payment has been received from the OWNER.

By: _____ Date : _____
_____

In accordance with the Contract Documents (based on on-site observations and the data comprising this application) the ENGINEER states that he has reviewed this application and that to he best of his knowledge, information and belief the work is in accordance with the Contract Documents and the CONTRACTOR s entitled to the Current Payment Due.

By: _____ Date : _____
Dirigo Engineering

The review and acceptance of partial pay estimates by Owner or DWSRF does not attest to the correctness of the quantities shown or that the work has been performed in accordance with the ontract documents.

By: _____ Date : _____
_____
By: _____ Date : _____
DWSRF
By: _____ Date : _____

STATEMENT OF THE CONTRACT ACCOUNT

Pay Period _____ to _____

Contract Signing Date _____
Contract Completion Date _____

Original Contract Sum _____

Total of Change Orders _____

Adjusted Contract Sum _____

Previous Applications
- Work Completed _____
- Retainage _____
- Total of Payments _____

Current Application
- **Work Completed** _____
- **Retainage** _____
- **Current Payment Due** → _____

Total of All Applications
- Work Completed _____
- Retainage _____
- Total of Payments To Date _____

SUMMARY OF PROJECT PAYMENTS

No.	Date	Amount
1		
Total		

PAYMENT APPLICATION NO. Page ___ of ___

Project - ________________________________ **Date**____________________

No.	Item Description	Est. Qty.	Unit Price	Contract Value	Prior Applications Units	Prior Applications Cost	This Application Units	This Application Cost	Total To Date Units	Total To Date Cost	Balance To Finish Units	Balance To Finish Cost
Subtotal												
Retainage												
Total												

PAYMENT APPLICATION NO. **MATERIALS ON SITE SUMMARY** **Page ___ of ___**

Project - ______________________________ **Date** ____________________

Item Description	Mat. Price	Prior Applications Units	Prior Applications Cost	This Application Delv.	This Application Used	This Application Chng.	This Application Cost	Mat. Remaining Units	Mat. Remaining Cost
Total									

CHANGE ORDER NO. **Page ___ of ___**

Project - _____ **Date** _____

Owner: _____ Contractor: _____

_____ _____

_____ _____

The CONTRACTOR is hereby directed to make the following changes to the above named contract:

Total Change this Change Order **$ -**

CONTRACT STATUS	CHANGE ORDER ACCEPTANCE
Contract Signing Date Current Completion Date	By:_____ Date :_____ Owner: _____
Days added this Change Order The new date of completion is	By:_____ Date :_____ Contractor: _____
Original Contract Sum	By:_____ Date :_____ Engineer : Dirigo Engineering
Total of Prior Change Orders	
Current Contract Sum Prior	By:_____ Date :_____ ~~DWSRF~~
Change this Change Order	By:_____ Date :_____
New Contract Sum	

SECTION 01300
SUBMITTALS

01300.01 GENERAL

Submit to the Engineer shop drawings, project data and samples for all products, materials and equipment proposed for the completed project. A 14-day review period will be required for all submittals. Review of submittals is for general compliance with the contract documents. No responsibility is assumed by the Engineer for the correctness of dimensions or details.

Review of submittals by the Engineer shall not relieve the Contractor from responsibility for any variation from the requirements of the contract documents unless the Contractor has in writing called the Engineer's attention to each such variation at the time of submission and the Engineer has given written approval of each such variation by a specific written notation thereof. The Engineer's review of submittals shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings.

Electronic copies of submittals are acceptable if they are in pdf format and legible. If submitting paper submittals, four (4) copies are required. Illegible copies will be rejected.

01300.02 SHOP DRAWINGS, PROJECT DATA, SAMPLES

All submittals shall bear a note and signature indicating that they were reviewed by the Contractor and found to be in conformance with the contract documents.

Any material or equipment submitted for review which is arranged differently or is a different physical size from that shown or specified shall be accompanied by shop drawings indicating the different arrangements of size and the method of making the various connections to the equipment. The final result will be compatible with the system or structure as designed.

Submittals for minor materials and equipment may be waived with the written approval of the Engineer.

01300.03 REQUIRED SUBMITTALS

A. Schedule of Values:

When requested by Engineer, submit a schedule of values for each bid item for use in determining partial payments for various bid items.

B. Construction Schedule:

Submit a time schedule, showing complete sequence of construction by activity, prior to commencement of work. Update the schedule monthly showing changes occurring since previous submission.

Distribute copies of reviewed schedules to subcontractors and other concerned parties. Instruct recipients to report any inability to comply and provide detailed explanation with suggested remedies.

C. Erosion and Sediment Control Plan:

Submit a detailed erosion and sediment control plan showing materials, methods, and locations of proposed erosion and sediment control measures.

D. Temporary Water Main Plan:

Not Used

E. Temporary Sewer Main and By-Pass Pumping Plan:

Not used

SECTION 01400
QUALITY CONTROL

01400.01 GENERAL

The Contractor shall at all times be responsible for maintaining all disturbed areas of the job site. This is to include periods of work suspended due to cold weather. When the Owner recognizes defective conditions he shall notify the Engineer who will in turn notify the Contractor. The Contractor will be given a reasonable amount of time, depending on the degree of the problem, to correct the condition. Examples of defective conditions shall include, but not necessarily be limited to, trench settlement, erosion, pot holes, washouts, etc.

01400.02 CONSTRUCTION MATERIALS

It is the Contractor's sole responsibility to provide and use only new materials, new products and new equipment that meet the requirements of the plans and specifications and will result in a completed project that is durable and of high quality in all respects. The Engineer may request samples of any material that the Contractor proposes to use. Such samples shall be of sufficient size and quantity to allow appropriate testing of the sample. The Owner shall bear all cost of obtaining and providing such sample. The Owner shall bear all cost of testing the sample. However, if testing shows that a sample does not meet the requirements of the plans and specifications, the Contractor shall reimburse the Owner for all costs incurred by the Owner as a result of testing the sample.

The Contractor shall provide equipment and parts from a single manufacturer to the greatest extent possible. This is to facilitate ease of service, maintenance and parts replacement. Engineer reserves the right to reject proposed equipment from various manufacturers if suitable materials are available from fewer manufacturers, and to require that source of materials be unified to the maximum extent possible.

01400.03 CONSTRUCTION REVIEW

The Owner or Engineer or his representative will provide whatever Construction Review that he feels is necessary. Such Construction Review in no way reduces the Contractor's responsibility for supervision or quality control. The Contractor shall cooperate fully in the Owner's or Engineer's Construction Review efforts. The Contractor shall keep the Engineer informed of work in progress as well as the schedule of work to be done. The Contractor shall allow complete access to the project by the Owner, Engineer, and any representatives of any regulatory or funding agencies. The Engineer will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

01400.04 TESTING

The Contractor shall perform all testing specified in the contract documents unless the test is specifically noted to be done by the Owner or Engineer. The Contractor shall notify the Engineer at least 48 hours in advance of any proposed testing or disinfection, and obtain approval for the proposed testing time. Testing and disinfection times must be coordinated with the Engineer so that samples can be delivered to labs and tested properly. In general, Fridays and weekends are not acceptable times for testing and sampling.

The Engineer shall collect all bacteriological samples and deliver them to the lab.

SECTION 01650
PROJECT DRAWINGS

01650.01 GENERAL

The drawings contained in the list on the Title Sheet of the Project Drawings are a part of these contract documents. If a conflict exists between the drawings and the specifications, the specifications shall take precedence. This specification is intended as a guide to interpreting the drawings. Reference made elsewhere in the contract documents to Contract Drawings, Plans or Drawings shall all be taken to mean Project Drawings.

01650.02 LEGENDS

Standard drawing symbols are used where possible on the drawings. The drawings may contain both general and specific legends. A specific legend on a drawing will take precedence over a general or project-wide legend.

01650.03 SCALES

The scale of the drawings will be marked on the individual drawings. Profile drawings are typically drawn with a different horizontal and vertical scale. This will provide for more detail in the profile, however there will also be some distortion and minor direction changes will look much sharper in the profile than they actually are.

01650.04 CONTOUR LINES

Existing contour lines will be shown in the plan view as dashed (or lighter) lines. New or final contour lines will be shown as solid (or darker) lines. The work in the contract includes all cut, fill, and grading required to bring the site grades to the new contour lines.

01650.05 EXISTING UTILITIES/STRUCTURES

The location of all existing structures and utilities shown on the plans are approximate. The structures and utilities were located using reasonable methods such as locating pipes at manholes, catch basins, gate valves and daylights. The location of pipes shown between these points shall be considered approximate and care shall be exercised when working near them or when excavations approach them.

Existing Utilities are covered in detail in Section 02020.

SECTION 01655
AS-BUILT RECORDS

01655.01 GENERAL

Maintain accurate as-built records throughout the construction project. A complete bound copy of these as-built records shall be delivered to the Engineer before final payment is made. The Engineer will supply the Contractor with the needed plans and forms. The Contractor shall complete the drawings and records.

01655.02 AS-BUILT DRAWINGS

The Contractor shall maintain a set of the construction drawings on the site at all times for the purpose of recording the actual configuration of the final work. The drawings shall show in a neat and legible fashion the final configuration of the constructed project, existing utilities, ledge, etc.

01655.03 MANUFACTURER'S LITERATURE

The Contractor shall submit copies of manufacturers' literature to the Engineer for inclusion in the project Operations and Maintenance Manual. The literature shall include installation instructions, warranty certificates, operating instructions, maintenance instructions, maintenance schedules and other relevant data.

01655.04 UTILITY LOCATIONS

The Contractor shall maintain a neat and accurate bound utility location book on the site at all times for the purpose of recording the location and arrangement of all manholes, catch basins, valves, tees, bends, fittings, service corporations, curb stops, couplings, sewer service tees, ends of sewer services, repairs, etc. The type of pipe and depth shall be noted. Before payment for any work shall be authorized, Utility Location Sheets shall be supplied to the Engineer for any work for which the Contractor is requesting payment.

The Engineer will supply the Contractor with a bound book containing the attached form. The Contractor shall be responsible for all labor to complete the utility locations.

UTILITY LOCATION SHEET

Utility: _____ Street: _____

Project: _____ Dwelling No.: _____

Project Contractor: _____ Occupant: _____

_____ Date: _____

Located By: _____ Station _____

LOCATION DIAGRAM

Remarks: Depth of cover: _____ Type & Size: _____

_____

_____

_____

_____

DIVISION 2
SITE WORK

SECTION 02001
POTABLE WATER CONTACT

02001.01 GENERAL

All components and materials that will be in contact with the finish water when the project is complete shall be certified to be in compliance with ANSI/NSF Standard 61. This includes but is not limited to piping, valves, fittings, pumps, tanks, meters, and other appurtenances, etc.

SECTION 02020
EXISTING UTILITIES

02020.01 DEFINITIONS

"utilities" - is defined in Section 02020 as physical property such as pipes, cables or structures used for water, sewer, storm drain, electrical, telephone, communications, cable TV, etc. This also includes signs, sign posts, light posts, fences, etc. This does not include individual house sewer services or water services.

"Association" - is defined in Section 02020 as public or private organizations which own, maintain or service "utilities."

02020.02 GENERAL

The Contractor is required by law to contact Dig Safe and local water/sewer "Associations" at least 3 business days prior to beginning any excavation work. The Dig Safe telephone number is 1-888-DIG-SAFE.

The Engineer has made a careful attempt to locate all existing "utilities" that are in the area of the project. These are shown on the Contract Drawings. Interferences that are shown on the Contract Drawings shall be corrected at the Contractor's expense. The locations of the existing utilities shown on the plans were compiled from field survey and various other sources. Locations are approximate and not guaranteed to be accurate nor is it guaranteed that all utilities are shown.

02020.03 WATER MAINS, SEWER MAINS AND UNDERGROUND CABLES

Prior to starting work on any portion of the project the Contractor shall give sufficient notice to all applicable "Associations" so that they may mark the location of their "utilities." The Contractor shall also inspect the area to verify the location of "utilities" shown on the plans and to check for any oversights or discrepancies. If "utilities" are located which are not shown on the plans, the Contractor shall notify the Engineer so that adjustments can be made if necessary to eliminate any conflict with the new work.

The Contractor shall follow responsible excavation practices at all times. When approaching a buried "utility," manual excavation shall be used to locate them. It is the Contractor's responsibility to provide undisturbed maintenance for all structures that may be affected by the excavation. This includes structures both above and below grade. In instances where excavations are made in close proximity to utility poles or other structures, it shall be the contractor's responsibility to notify the "Associations" and to provide support for the poles while the excavation is being done. Any costs associated with this shall be borne by the Contractor.

If "utilities" are interrupted, the Contractor shall immediately notify the "Association." The "Association" shall inspect the damage and make suitable repairs or instruct the Contractor

to make suitable repairs. If a "utility" is shown on the drawings, located by an "Association" or could have been located by the Contractor by a simple inspection of the site, then the cost of any needed repairs, including materials and labor shall be borne by the Contractor. If a "utility" not shown on the plans, not located by an "Association" or not able to be located by the Contractor by a simple site inspection is accidentally damaged, the cost of repairs shall be borne by the Owner.

In all cases, satisfactory backfilling and maintenance of the trench is the Contractor's responsibility. The Engineer and the "Association" shall inspect all repairs by the Contractor to broken or damaged "utilities." Approval of the repairs must be obtained by the Contractor prior to covering the work. The Contractor shall remain responsible for the integrity of broken "utilities" even after the work has been backfilled. The Owner has complete authority to stop work if the Contractor is doing excessive damage to "utilities," appropriate repairs are not being made, or other precautions are not being taken to minimize damage to existing "utilities."

The Contractor shall not make any claims against the Owner for delays in the progress of his work that are less than one day in duration and are caused by an interference not shown on the Contract Drawings. A delay shall exist when the work cannot progress because of an interference and no other work on the project is available for the men and machinery at that time. If the delay lasts more than one day, the Contractor may be compensated, based on hourly payroll and equipment rental rate, by the Owner for the actual costs for each day after the initial day. Compensation will not be based on the amount of work that might have been accomplished.

02020.04 OVERHEAD UTILITIES, UTILITY POLES, SIGNS AND SIGN POSTS

The Contractor shall follow responsible excavation practices at all times. When approaching an overhead "utility", caution shall be used to avoid damage. It is the Contractor's responsibility to provide undisturbed maintenance for all structures that may be affected by the excavation. This includes structures both above and below grade. In instances where excavations are made in close proximity to utility poles or other structures, it shall be the Contractor's responsibility to notify the "Associations" and to provide support for the poles while the excavation is being done. Any costs associated with this shall be borne by the Contractor.

Do not remove structures without receiving approval of party having jurisdiction. Reinstall structures to satisfaction of party having jurisdiction.

02020.05 INDIVIDUAL SERVICES

No effort has been made by the Engineer to show existing individual "utility" services. The Contractor shall assume that each structure along the route of the work has at least one set of "utility" services. The Contractor shall make no claims against the Owner for services not shown on the Contract Drawings.

The Contractor shall be responsible for locating all existing sewer and water services prior to excavating. All equipment needed to locate services, including detectors and locators, shall be provided by the Contractor. The Contractor shall take every reasonable precaution to protect and preserve the integrity of these services.

The Contractor shall ask the "Association" to provide assistance in locating the individual services. However, the Contractor shall still have complete responsibility for their location. Assistance provided by the Owner, Engineer or "Association" shall not relieve the Contractor of his responsibility for their location. Exploratory excavations done to attempt to locate individual services shall be done at the Contractor's expense. This includes locating existing service lines that are to be connected to new service lines.

If services are interrupted, the Contractor shall immediately notify the "Association" and make suitable repairs to the service.

The Engineer and "Association" shall inspect all repairs to broken or damaged services, and approval of the repairs must be obtained by the Contractor from the Engineer prior to covering the work. The Contractor shall remain responsible for the integrity of broken services even after the work has been backfilled. The Owner has complete authority to stop work if the Contractor is doing excessive damage to the services and appropriate repairs are not being made or other precautions taken to minimize damage to existing services.

02020.06 REPAIRS TO EXISTING UTILITIES

The methods and equipment to complete repairs must be approved by the Association and Engineer. In general, the following methods of connecting and repairing pipes shall apply:

Gravity Sewer and Storm Drain Mains:

Straight and transition couplings for mains shall be non-shear sewer couplings; Romac Style "501" (ductile iron) as manufactured by Romac Industries , or approved equal.

Gravity Sewer and Storm Drain Services:

Series 5000 Strong Back Repair Couplings by Fernco, Inc. or approved equal. Shear ring shall be 0.012" thick stainless steel. Coupling shall be made specifically for the pipe size and materials used.

Water Mains and Sewer Force Mains:

Cast couplings, MJ solid sleeves; fittings made specifically for the pipe materials used.

Water Services:

Brass compression couplings; cast couplings; fittings made specifically for the pipe materials used. Connections to PE tubing shall utilize SS inserts and brass compression couplings.

Culverts:

Approved connecting bands; flexible rubber compression couplings; fittings made specifically for the pipe materials used.

SECTION 02101
EARTH WORK

02101.01 GENERAL

Supply all labor, materials and equipment necessary to perform all earth work for the project.

The following subsections are included in this specification:

02101.02	Construction Methods
02101.03	Site Preparation
02101.04	Excavation
02101.05	Borrow and Bedding Material
02101.06	Backfilling
02101.07	Cleanup
02101.08	Erosion Control

02101.02 CONSTRUCTION METHODS

The Contractor shall use responsible and safe construction and excavation practices. The Contractor shall verify the condition of the site and neighboring properties and structures prior to beginning work. The Contractor shall use construction methods and equipment of the appropriate size so as to not produce damage, excessive noise, or vibrations on neighboring properties.

Monitoring of vibrations from site work, excavation, and compaction procedures shall be done by the Contractor. It is recommended that the Contractor complete a pre-work survey of the site and neighboring properties to document their condition and determine what construction methods are appropriate.

02101.03 SITE PREPARATION

A.) General

Supply all labor, materials and equipment necessary to prepare the site for excavation and/or construction. Site Preparation includes layout, clearing, grubbing, and stripping. Before removing any structure or vegetation, the Contractor shall obtain approval of the party having jurisdiction. Prior to beginning any excavations in paved areas the pavement shall be cut at the limits of the excavation.

B.) Clearing

Cut and remove all trees, brush, and undergrowth in areas designated for clearing. Protect all vegetation outside the limits of the areas designated and any trees or vegetation so designated within the area. The Engineer shall be contacted prior to removal of any trees within the site boundaries. Any branches which must be removed from standing trees shall be removed in accordance with established arborists' practices. All scars and cuts in standing timber shall be painted with tree paint. Dispose of all removed vegetation in a satisfactory manner.

C.) Grubbing

Remove all material, both natural and man-made, in the areas designated on the plan for excavation and/or construction. This includes roots, stumps, rocks, boulders, pavement, curbing and other structures.

Material which is amenable to reuse shall be stored. Unsuitable or excess material shall be removed and properly disposed of by the Contractor.

D.) Stripping

In areas to be stripped, the Contractor shall strip the surface and top soil to a sufficient depth to expose a uniform subgrade of soil.

Top soil which is amenable to reuse shall be stored. Unsuitable or excess top soil shall be removed and properly disposed of by the Contractor.

02101.04 EXCAVATION

A.) General

Furnish all labor, equipment and materials necessary to provide all excavation for trenches, construction, utility installation, foundations and subsurface structures. All excavation shall be classified as either earth excavation or ledge excavation.

Earth excavation shall consist of removal of all grades of soil and rock sufficiently friable to be worked with an excavator. This shall include any other material less than three cubic yards in volume.

Ledge excavation shall consist of blasting, removal, and replacement of all material not classified as earth and greater than three cubic yards in volume.

B.) Excavation Practices

The Contractor is responsible for establishing and practicing safe construction and excavation practices at all times. The Contractor shall keep himself informed of all safety regulations and comply with them at all times. The Contractor shall provide all sheeting, shoring, bracing, and coffer damming necessary to insure the stability of the sides of the excavation.

Information on underground structures and utilities shown on the plans is not guaranteed for accuracy nor completeness, therefore, when excavation approaches such utilities, manual excavation shall be used to locate them. The Contractor shall be held liable for responsible excavating practices throughout the project. This responsibility shall include the undisturbed maintenance of all structures and utilities, above or below grade, which may be affected by the excavation.

C.) Excavation Methods

Excavate all trenches to the depth required for the installation of the utility and appropriate bedding. All structure excavation shall provide sufficient working area to construct the structure. Excavated material shall not be placed on pavement. The Contractor shall at all times keep the excavation free of water and saturated soil. Water removed from the excavation shall be disposed of in accordance with all applicable environmental regulations and so as not to interfere with adjacent areas. The bottom of the excavations shall be kept dewatered and firm at all times. No excavations shall be continued into fill material which has been on-site less than 12 months without review and approval of a Geotechnical Engineer.

The Contractor shall not have any right of property on any excavated material. The Contractor shall remove and properly dispose of excess excavated material. When requested by the Owner (prior to final disposal), this material shall be delivered to an Owner specified site within a three (3) mile radius of the loading point. Otherwise it shall be the Contractor's responsibility to find and utilize a proper disposal site. Removal, transportation and disposal of excess excavated material or unwanted abandoned utilities shall be done at the Contractor's expense.

All trenches shall be closed at the end of each construction day and the surface restored, unless specifically authorized by the Engineer.

D.) Over Excavation

Any excavation beyond the prescribed limits for construction or utility installation shall be filled with crushed or screened stone to the necessary grade at the Contractor's expense. This shall include the removal of over blasted ledge.

E.) Unsuitable Material

The Engineer shall have the right to reject material as unsuitable for backfill. Any such material shall be transported from the site and disposed of properly. Cost of the transportation and disposal of unsuitable earth excavation shall be at the supplemental unit price for Disposal (per Section 02150). Cost of material, installation and compaction of replacement material shall be at the unit price for the borrow specified by the Engineer (per Section 02150). No additional amounts will be paid for excavation of unsuitable material that is in the normal excavation area.

All ledge excavation shall be classified as unsuitable material. Cost of the removal, disposal and replacement of unsuitable ledge excavation shall be incidental to the price for Ledge Excavation.

Excavated old utility materials (pipe, fittings, valves, culverts, wire, conduit, manhole or basin pieces and covers) shall not be utilized in backfill. Such materials shall be removed from the site by the Contractor and disposed of properly (unless specified otherwise on the plans). Cost of removal, disposal and replacement material for these items shall be incidental to the cost of the project.

When so directed by the Engineer, the Contractor shall excavate unsuitable material below the bottom of the trench and backfill to grade with the specified borrow. Cost of excavation, disposal and borrow shall be at the supplemental unit prices (per Section 02150).

F.) Blasting and Ledge Excavation

The Contractor shall remove all overburden from any ledge encountered and shall not remove any ledge until the Engineer has measured its volume. At the Engineer's option, the Contractor may be allowed to predrill trench ledge for measurement and blasting. Ledge that has been previously fractured and broken shall not be classified as ledge excavation.

All blasting shall comply with all federal, state, and local regulations. The blasting contractor shall have a pre-blast survey completed of all structures within 300 feet of the work area prior to beginning work. Prior to blasting a site plan showing all properties surveyed shall be delivered to the Engineer. Vibration monitoring shall be done by the blasting contractor during all blasting. Warning signs shall be posted whenever blasting occurs. No blasting shall be permitted without blasting mats or sufficient soil overburden.

All ledge shall be classified as unsuitable material for backfill. All ledge shall be replaced with borrow (per Section 02101.05) and the cost of this replacement material shall be considered incidental to the ledge removal cost.

G.) Rights-of-Way

The Contractor shall maintain clear passage along all rights-of-way affected by the construction. No permanent rights-of-way shall be closed without prior written approval of the proper civil authorities.

H.) Protection of the Public

Improved streets, roads, driveways and sidewalks shall be kept open over or around all trenches and excavations and the use of these rendered safe for public use, as required by OSHA. All open excavations, if allowed, equipment and materials encroaching on rights-of-way shall be clearly marked by barricades and flashing yellow lanterns from dusk to dawn.

02101.05 BORROW AND BEDDING MATERIAL

A.) General

Furnish all materials, equipment and labor necessary to place and compact all required borrow and bedding. Optimum moisture content shall be as determined by the modified proctor test.

All borrow and bedding shall be free of frozen material, peat, rubbish, and other debris and other material described as unsuitable in Division 2.

B.) Common Borrow

Common borrow shall consist of earth suitable for fill or embankment construction. It shall meet the following criteria:

Moisture content	less than 4% above optimum
Particle size	75 mm - .005 mm
D 10(effective size)	.06 mm - .04 mm
Uniformity coefficient	6 - 10

C.) Sand Borrow

Sand borrow shall be sand of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation shall meet the grading requirements of the following table.

Sieve Designation	% by Weight Passing
3/8 inch	85-100
No. 200	0-5

D.) Gravel Borrow

Gravel borrow shall consist of uniformly graded granular material and shall be free from vegetable matter, lumps or balls of clay and other deleterious substances. The maximum stone size is 6". The gradation of the part that passes a 3 inch sieve shall meet the requirements of the following table.

Sieve Designation	% by Weight Passing
1/4"	<70
No. 200	<10

E.) Base Gravel

Base gravel shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The maximum stone size is 6". The gradation of the part that passes a 3 inch sieve shall be an even gradation and meet the requirements of the following table.

Sieve Designation	% by Weight Passing
1/4"	25-70
No. 40	0-30
No. 200	0-5

F.) Surface Gravel for Gravel Roads

Surface gravel for gravel roads shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The maximum stone size is 3/4". The gradation shall meet the requirements of the following table.

Sieve Designation	% by Weight Passing
3/4"	100
No. 4	50-78
No. 8	37-67
No. 40	13-35
No. 200	4-15
Plasticity Index (PI)	4-12

G.) Surface Gravel for Paved Areas

Surface gravel for paved areas (crushed gravel) shall be gravel that has been screened or crushed. Crushed gravel shall consist of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation shall meet the requirements of the following table.

Sieve Designation	% by Weight Passing
3/4"	90-100
No. 4	40- 65
No. 10	10- 45
No. 200	0- 7

H.) Screened Stone

Screened stone shall consist of clean, hard, durable stone particles. It shall be screened and contain uniformly graded stone particles ranging in size from 10 to 20 mm unless otherwise specified. Screened stone shall be free of fine gravel, sand, dirt, vegetation, disintegrated or laminated soils, and other unsuitable material.

I.) Crushed Stone

Crushed stone shall consist of clean, hard, durable stone fragments. It shall be crushed and contain uniformly graded stone fragments ranging in size from 20 to 30 mm unless otherwise specified. Crushed stone shall be free of fine gravel, sand, dirt, vegetation, disintegrated or laminated soils, and other unsuitable material.

J.) Flowable Fill

Flowable fill (controlled low strength material) shall be a cementitious backfill mixture with low strength, flowable characteristics. The late age strength of the flowable fill shall be in the range of 50 to 150 psi to allow it to be excavatable at a future time, if necessary. The flowable fill shall have early setting and strength additives to allow for traffic and construction loads. The flowable fill shall be delivered in ready mixed concrete trucks and placed by chute in a flowable condition into the prepared void or trench.

K.) Concrete Fill

Concrete fill shall have a minimum 28 day compressive strength of 2000 psi.

L.) Placement and Compaction

Crushed or screened stone shall be placed in lifts which will compact to a 6" maximum layer. Gravel and borrow shall be placed in 12" maximum lifts. All placement and compaction of borrow and bedding shall comply with Subsection 02101.06 Backfilling.

02101.06 BACKFILLING

A.) General

Furnish all labor, equipment, and material necessary to completely fill all excavations. Backfilling shall be defined as replacement and compaction of soil in excavation for the purposes of protecting underground construction, maintaining grades, or providing stable foundation material for above ground construction.

B.) Material

Generally the excavated soil shall be suitable as backfill and shall be replaced in the excavation. Exceptions include frozen fill, fill containing large stones, stumps or other rubble, and any material deemed unsuitable by the Engineer. Unless noted otherwise on the plans, all backfill within 3 feet of all foundation/frost walls shall be clean gravel (6" max stone size; 1" minus max. stone within 12" of walls & slabs).

Replacement material for ledge shall be considered incidental to the ledge removal cost.

C.) Backfilling Methods

Backfilling shall proceed as soon as possible after underground construction has been completed. Backfill shall be extended to the grade indicated on the plans, compacted and graded.

Fill material shall be placed in layers not to exceed 12" and compacted to a density equal to at least 95% of the optimum density determined by the modified proctor test. Compacting may be done by vibrating compactor or roller.

The Contractor shall take care not to damage or disturb any structure, including his own, during backfilling and compaction. The Contractor shall be held liable for any such damage.

Excavations in paved areas shall be paved according to specifications as soon as possible. Other areas shall be loamed and seeded or otherwise restored to a condition equal to or better than that of adjacent areas as soon as possible.

The Contractor shall not withdraw any sheeting without the approval of the Engineer. All voids created by such removal shall be filled and compacted. Any backfilling which does not conform to these specifications, or which settles differentially, shall be excavated to a depth sufficient to correct the problem and refilled as required. Any pavement or structure which is damaged due to settlement of backfill shall be repaired by the Contractor at his expense.

02101.07 CLEANUP / SITE RESTORATION

Maintain all work areas and all haul routes in a neat and orderly condition. Cleanup/site restoration is incidental to the appropriate items of the contract.

Remove all debris and surplus material resulting from the work, and maintain all property, both public and private, in a condition acceptable to the party having jurisdiction.

Cleanup/site restoration includes; removal of all debris and surplus material; replacement and repair of all removed or damaged structures, properties and vegetation to their pre-construction condition; restoration of areas to final grade and contour.

Cleanup of trench areas shall be done concurrently with pipe installation (on a daily basis). When notified by the Owner and/or Engineer that cleanup is not acceptable, pipe installation shall cease and all efforts shall center on cleanup. No compensation shall be paid the Contractor because of the stopping of the pipe installation for cleanup.

02101.08 EROSION CONTROL

A.) General

Furnish all labor, equipment and materials necessary to prevent erosion and sedimentation from occurring on or adjacent to the construction site and areas disturbed by construction. Erosion and sedimentation control measures shall be in conformance with Maine DOT and Maine DEP Best Management Practices.

Develop and submit copies of project work plan and proposed Erosion and Sediment Control Plans.

Provide erosion control measures as required for the construction activity whether or not they are shown on the design plans or Contractor's work plans. Any measures shown on the plans shall be considered minimal only. Provide measures to comply with the applicable Best Management Practices.

The Contractor shall be responsible for providing erosion and sediment control during construction and for establishing permanent measures (surface restoration). Erosion control shall be considered incidental to appropriate items of the Contract.

Erosion and sediment control shall be done concurrently with construction (on a continual basis). When notified by the Owner and/or Engineer that erosion and sediment control is not acceptable, construction shall cease and all efforts shall center on erosion and sediment control. No compensation shall be paid the Contractor because of the stopping of construction for erosion and sediment control.

B.) Regulations and Permit Conditions

Comply with all applicable regulations and permit conditions for work in the Saco River Corridor. If additional permits are needed for proposed work or work methods, obtain them and comply with all requirements.

C.) Minimum Material Specifications

Erosion control blankets, when required, shall be as specified in Section 02675. Hay bales shall have minimum dimensions of 18" x 18" x 3'-6" and shall weigh at least 40 lbs. Erosion control fence shall be Envirofence by Mirafi, Inc., Charlotte, NC, or approved equal. The fencing shall have the following properties: grab strength of 120 lbs., grab elongation of 30% (max), water flow rate of 40 gal/min/S.F., and ultraviolet stability of 90%. The fabric width shall be 3 ft. and post length shall be 4.5 ft. The post spacing shall be 7.7 ft. The fence fabric shall be securely stapled to the stakes. Stone for stone check dams shall be as specified by Maine Department of Transportation for trench drain construction. Catch basin inserts shall be Hi-Flow Siltsack by ACF Environmental, or approved equal.

All materials on the project shall be new per Section 01400. The Engineer may accept erosion control fence that has been used on previous projects if it meets this specification and the fence is in good and serviceable condition.

D.) Erosion Control Methods

Install erosion control methods as shown on the design plans and on the Contractors Erosion Control Plan. Install methods according to Best Management Practices and manufactures latest recommendations.

E.) Trench Water

Prevent erosion and sedimentation when discharging trench water. Utilize control structures and Best Management Practices when discharging trench water. Utilize sedimentation control basins, sediment containment devices, filtration socks, filtration bags, or other appropriate control methods. Do not directly discharge to surface water or drainage systems.

F.) Work on Submerged Lands

Whenever submerged land is disturbed, or work is done within water bodies, appropriate turbidity curtains (with top flotation and bottom ballast) shall be utilized. Select and install curtain appropriated for conditions, current, velocities, etc. Install and maintain per manufacturer's latest recommendations.

G.) Maintenance and Removal

Maintain erosion control measures until final surface restoration has been established. Provide additional measures as project progresses if existing measures are inadequate. Carefully remove materials that are not intended to be permanent (such as erosion control fence) when they are no longer needed.

SECTION 02551
TRENCH INSULATION

02551.01 GENERAL

Furnish all labor, materials, equipment and appurtenances necessary to install the trench insulation as specified in the Contract Documents Trench insulation refers to insulation board installed between mains and storm drains or where cover is insufficient.

02551.02 MATERIALS

Trench insulation shall be extruded polystyrene plastic foam insulation board equal to STYROFOAM brand as manufactured by the Dow Chemical Company and as meeting ASTM C-578 Type IV. Insulation shall be Dow STYROFOAM T&G, or Owens Corning Foamular 250 T&G, or equal. Insulation shall be 2" thick and have a minimum compression strength of 25 psi (ASTM D-1621).

02551.03 INSTALLATION

The insulation shall be a minimum of 2 feet wide and shall extend a minimum of 6" beyond the outside edge of the pipe. The insulation thickness shall be 2 inch unless otherwise specified on the drawings or required by the Engineer. In general it shall be used where the top of the pipe is less than the minimum cover specified in the contract drawings.

The insulation shall be installed on top of a smooth, flat surface of compacted select backfill or bedding. The insulation shall be 6 inches above the top of the pipe. Joints shall be butted tightly for maximum protection. Backfilling over the insulation shall be done by hand for the first 8 inches and compacted before remaining backfill is applied.

Installation for each type of insulation shall be according to the manufacturers' recommendations. In general, backfill shall be clean, dry, and be free of any material which can dissolve or harm the plastic such as petroleum products.

SECTION 02670
LOAM AND SEED

02670.01 GENERAL

Supply all labor, materials and equipment necessary to provide healthy vegetative cover over areas disturbed by construction and any other such areas designated to be loamed and seeded in the contract documents. The Contractor shall be responsible for the vegetative cover (except for routine mowing) for 12 months from project completion.

Full payment shall not be made for loam and seed until after a firm sod with healthy grass growth has developed.

02670.02 MATERIALS

A. Grass Seed -- Grass seed mixture shall be as specified on the project Plans.

B. Lime -- Lime shall be agricultural ground limestone containing not less than 90% total carbonate. At least 90% shall pass through a No. 20 mesh sieve and at least 50% shall pass through a No. 100 mesh sieve.

C. Fertilizer -- Fertilizer shall be commercial fertilizer with the following minimum percentages:

12% available nitrogen (75% organic)
12% available phosphoric acid
12% available potash

D. Hay Mulch -- Hay mulch shall be long-fibered hay or straw, reasonably free of noxious weeds and other undesirable material. Hay mulch shall be less than one (1) year old. No material shall be used which is so wet, decayed or compacted as to inhibit even and uniform spreading. No chopped hay, grass clippings or other short-fibered material shall be used.

E. Alternative Mulch -- Other materials may be accepted for mulch following submittal of samples by the Contractor and demonstration that performance is similar to hay mulch.

F. Topsoil -- Topsoil shall be natural, friable loam soil possessing the characteristics of representative soils in the vicinity which produce heavy growths of crops, grass, or other vegetation. Topsoil shall be reasonably free from subsoil, brush, objectionable weeds, other litter, large stones, stumps, roots, and other objectionable material. Topsoil shall be free of toxic substances which might be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations. Topsoil shall be from naturally well drained areas. Topsoil shall be screened (1" maximum for lawns; 2" maximum for areas that are not expected to be mowed).

The Contractor shall submit invoices and copies of labels to the Engineer certifying that the above specifications have been met for all seed, lime and fertilizer.

02670.03 SEASONAL AND WEATHER CONDITIONS

Do not place or spread topsoil (or loam/compost) when the subgrade is frozen, excessively wet or dry, or in any conditions otherwise detrimental to the proposed planting or to proper grading. The recommended seeding time is from April 1 to October 1. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.

02670.04 CONSTRUCTION METHODS

A. Topsoil -- Prior to placing topsoil, it shall be tested for recommended fertilizer and lime application rates. Soil tests shall be equal to those available from the University of Maine Soil Testing Laboratory. Soil tests shall be done for each three acres or fraction thereof to be loamed and seeded. Install topsoil uniformly so that final depth of topsoil is 4 inches. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions. Remove all objectionable material and form a finely pulverized seed bed. Thoroughly till to a depth of a least 2 inches by plowing, discing, harrowing, or other approved method to prepare a seedbed.

B. Fertilizer -- Install fertilizer uniformly at a rate determined by the soils tests over the areas to be seeded (12#/1000 sf typical). Incorporate fertilizer into the soil to a depth of at least 2 inches by discing, harrowing, or other approved methods. Installation of fertilizer may be a part of the tillage operation specified above. Installation by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

C. Lime -- Uniformly distribute lime immediately following or simultaneously with the installation of fertilizer. Install lime at a rate determined from the soils tests. Incorporate lime into the soil to a depth of at least 2 inches by discing, harrowing, or other approved methods.

D. Seeding -- Uniformly place seed (5 lbs/1000 square feet) by broadcasting, hydroseeding or drill seeding. With broadcasting, sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing. Then cover the seed to an average depth of 1/2-inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices. Do not perform broadcast seeding work during windy weather. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.

E. Mulching -- Install mulch evenly and uniformly over areas to be protected from erosion and after seeding. Install hay mulch at the rate of 1-2 tons per acre. Anchor

mulch by "wetting-down", applying approved liquid tackifiers (according to manufacturer's recommendations), or use of a serrated, straight disk. Within the low-flow area of drainageways, mulch should be anchored with erosion control matting or equivalent material and secured with staples.

F. Compacting -- Compact the area immediately following seeding and mulching by means of a cultipacker, roller, or other approved equipment weighing 60 to 90 pounds per linear foot of roller. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion.

02670.05 MAINTENANCE

The loamed and seeded areas shall be maintained by the Contractor until a firm sod with healthy grass growth sufficient to prevent any erosion of the soil develops. Areas that do not develop sufficient grass growth shall be scarified, re-seeded and mulched by the Contractor until healthy grass growth develops.

Responsibility for maintenance (mowing excluded) of the seeded areas shall extend for 12 months from the completion of the entire project.

SECTION 02701
DUCTILE IRON PIPE

02701.01 GENERAL

Furnish, install and test all ductile iron water mains and fittings as specified in the contract documents. The minimum depth of cover specified in the contract documents refers to cover relative to the pipe location not relative to the profile drawing. This specification is for buried pipe.

02701.02 MATERIALS

A. Pipe

Pipe shall be ductile iron, double cement lined, tar coated, 18-20 foot lengths. Pipe shall be in full conformance with AWWA C151 and AWWA C111 and AWWA C104. All pipe shall be push on unless indicated otherwise on the drawings. Push-on pipe shall be Class 52. Flanged pipe shall be flanged joint Class 53. Mechanical joint pipe shall be mechanical joint Class 52.

B. Fittings

Mechanical joint compact fittings shall be ductile iron Class 350, asphaltic coated with cement-mortar lining or fusion bonded epoxy inside and outside. Fittings shall include gaskets and corten bolts. Fittings shall be in accordance with AWWA C-153, AWWA C111 for joints, AWWA C104 for cement lining, and AWWA C116 for epoxy coating.

All fittings for buried service shall be mechanical joint. Fittings shall be manufactured by Tyler, U.S. Pipe, Griffin, Union, or approved equal.

C. Mechanical Joint Restraint

All mechanical joint fittings and connections shall utilize mechanical joint restraints. The restraining devices shall be of ductile iron construction and shall utilize standard MJ gaskets. Mechanical joint restrainers shall be Megalug (EBAA Iron Sales), Uniflange Series 1400, or approved equal. Conventional retainer glands with set screws are <u>not</u> acceptable.

The mechanical joint restrainers shall be installed according to AWWA standards and the manufacturer's latest recommendations.

D. Foster Adapter (or approved equal)

When shown on the drawings, mechanical joint valves and fittings shall be connected using a bolt-through positive restraining device manufactured of ductile iron conforming to ASTM A 80-55-06. Device shall be Foster Adapter (Infact Corporation), or approved equal, and shall be furnished with required accessories.

E. Push-On Joint Restraint

All push-on joints within 35 feet of elbows, caps and plugs shall be restrained. Also, when shown on the drawings, additional push-on pipe joints shall be restrained. Push-on joint restraint shall be Field-Lok 350 gaskets by US Pipe, Gripper Gasket by Gripper Gasket, LLC, or approved equal. Install according to manufacturer's latest recommendations.

02701.03 INSTALLATION

Installation shall follow the general AWWA standard for installation of ductile iron water mains - AWWA C600. The only exception is that backfill material for buried pipes shall have no stones larger than 6 inches in diameter. Installation shall also follow the manufacturer's latest recommendations.

When ductile iron pipe is installed in earth excavations it shall be laid on the undisturbed bottom of trench. Backfill from the trench bottom to 1 foot over the pipe shall be select excavated material with no stones larger than 1 inch. This material shall be placed in 6 inch lifts and compacted. Backfill to grade shall be per Section 02101.

All trench ledge excavations shall be extended to at least 6 inches below the bottom of the pipe and then brought to grade with screened base gravel (1" max. stone). The screened gravel is considered incidental to the ledge excavation. The pipe shall be placed on this compacted bed and bedded with compacted screened base gravel (1" max. stone) to 6 inches above the pipe.

Foreign material shall be prevented from entering the pipe at all times (including during storage, installation and while in the trench). No debris, tools, clothing, trench water, or other materials shall be placed in the pipe at any time. Immediately following installation of a pipe in the trench (prior to backfilling and moving of trench box) a secure cap or plug shall be installed in the bell end of the pipe. The cap or plug shall be steel or plastic and shall be gasketed and designed to prevent debris and water from entering the pipe during excavation work.

02701.04 LOCATING SYSTEMS

~~Conductive Tracer Wire and Warning Tape shall be installed in accordance with the Contract Documents. Conductive Warning tape shall be in accordance with Section 02420. Warning Tape shall be polyethylene warning tape for underground installation a minimum of 3" wide with Warning message specific for water mains.~~

02701.05 SEPARATIONS AND CROSSINGS OF WATER MAINS AND SEWERS

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer, force main, storm sewer or sewer manhole, per State of Maine Department of Health and Human Services Regulations. The distance shall be measured edge of pipe to edge of pipe.

Water mains crossing sewers (including force mains or storm drains) shall be laid to provide a minimum vertical distance of 18 inches of free earth between the water main and the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

SECTION 02704
POLYETHYLENE (PE) WATER MAIN

02704.01 GENERAL

Furnish, install and test all polyethylene (PE) water mains and fittings as specified in the contract documents.

Pipe fuser shall be certified by Pipe Manufacturer or Supplier as a certified pipe fuser. Submit a copy of certification to Engineer.

This specification shall also apply to the pipe used in Section 02420 Pipe Bursting (when applicable).

02704.02 MATERIALS

A. Pipe and Fittings

The terms PE, HDPE and PE 4710, PE3408 all refer to PE 4710 high-density polyethylene pipe.

Materials used for the manufacturing of polyethylene pipe and fittings shall be PE 4710 (PE3408) High Density Polyethylene (HDPE) meeting the ASTM D3350 cell classification of 345464C. The material shall have a minimum Hydrostatic Design Basis (HDB) of 1600 psi at 73 degrees F when tested in accordance with PPI TR-3 and shall be listed in the name of the pipe and fitting manufacturer in PPI TR-4. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet the requirements of this specification.

Polyethylene fittings shall be made from material meeting the same requirements as the pipe. Polyethylene fittings shall be molded or fabricated by the manufacturer of the pipe. Where applicable, fittings shall meet the requirements of AWWA C906. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be so marked.

Pipe shall be 8" DIPS SDR 11 with a 200-psi pressure rating with a minimum inside diameter of 7.305". Pipe color shall be solid black with blue stripe unless otherwise specified in these Contract Documents.

B. Mechanical Joint Fittings

Mechanical joint compact fittings shall be ductile iron Class 350, tar coated and shall include gaskets and corten bolts. Fittings shall be in accordance with AWWA C-153, AWWA C111 for joints and AWWA C104 for cement lining.

All fittings for buried service shall be mechanical joint. Fittings shall be manufactured by Tyler, U.S. Pipe, Griffin, Union or approved equal.

The mechanical joint restrainers shall be installed according to AWWA standards and the manufacturer's latest recommendations.

02704.03 PIPE AND FITTING FUSION

Connections from polyethylene to ductile iron shall utilize a mechanical joint, connected to PE pipe by butt fusion or electrofusion connection, as shown on the drawings.

Joints between plain ends of polyethylene pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipes shall have the same DR at the point of fusion.

When saddle connections are fusion welded the manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings (which are designed for, or tested and found acceptable for use with polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations, the recommendation of the mechanical fitting manufacturer must be followed. These procedures may differ from other pipe materials.

Contractor must utilize Data Logger for pipe fusion to record and document key parameters of the fusion process including heat soak times, heating pressure, open/close time, fusion time, fusion pressure, and cool time. Contractor shall check/verify the temperature gauge on the heating element of the fusing machine prior to every fuse. At the completion of construction Contractor shall provide Owner all fusion data.

Contractor shall submit a fusion testing plan to Engineer for approval prior to commencing any fusing work. Then, on each day butt fusions are to be made; the first fusion of the day shall be a trial fusion. Contractor shall test the trial fusion in accordance with the approved testing procedures. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test. Some acceptable testing procedures include the strap test, tensile testing performed with specialized testing equipment such as the McElroy In-Field Tensile Tester, or equal, etc.

Socket and saddle fusions shall also be tested by an approved testing method and in accordance with pipe manufacturer recommendations. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.

02704.04 INSTALLATION

Immediately following fusion of a pipe prior to moving or storage a secure cap or plug shall be installed in the end of the pipe. The cap or plug shall be steel or plastic and shall be gasketed and designed to prevent debris and water from entering the pipe during transportation or excavation work.

Installation shall follow the AWWA standard for installation of polyethylene water mains. The only exception is that backfill material for buried pipes shall have no stones larger than 6 inches in diameter. Installation shall also follow the manufacturer's latest recommendations. Installation by Pipe Bursting shall be in accordance with Section 02420.

All trench excavations shall be extended to at least 6 inches below the bottom of the pipe and then brought to grade with screened base gravel (1" max. stone). The pipe shall be placed on this bed and bedded with compacted screened base gravel (1" max. stone) to 6 inches above the pipe. Backfill to grade shall be per Section 02101. Sand Borrow per Section 02101 may be substituted for screened gravel bedding.

Foreign material shall be prevented from entering the pipe at all times (including during storage, installation and while in the trench). No debris, tools, clothing, trench water, or other materials shall be placed in the pipe at any time. Immediately following installation of a pipe in the trench (prior to backfilling and moving of trench box) a secure cap or plug shall be installed in the end of the pipe. The cap or plug shall be steel or plastic and shall be gasketed and designed to prevent debris and water from entering the pipe during excavation work.

Install pipe locating system in accordance with Section 02420.

Pipe shall be inspected following fusing, as it is installed, and where practical, after it is installed. HDPE pipe can be gouged during various actions such as pulling along the ground, pipe bursting, etc. Any gouges greater than 10% of the pipes wall thickness shall be considered defective. The Contractor shall cut out these sections of pipe and replace with new pipe. If gouges are found in the pipe installed by pipe-bursting the Contractor shall extend excavation to expose and remove the entire gouged section.

02704.05 SEPARATIONS AND CROSSINGS OF WATER MAINS AND SEWERS

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer, force main, storm sewer or sewer manhole, per State of Maine Department of Human Services Regulations. The distance shall be measured edge of pipe to edge of pipe.

Water mains crossing sewers (including force mains or storm drains) shall be laid to provide a minimum vertical distance of 18 inches of free earth between the water main and the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

SECTION 02710
GATE VALVES

02710.01 GENERAL

Furnish and install all gate valves and appurtenances as specified in the contract documents. **Obtain the direction which the gate valves will open from the Owner**. Valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects.

02710.02 MATERIAL

A. Gate Valves for Buried Service

Gate valves shall be Resilient Seat Type, mechanical joint, NRS. The valve design and construction shall meet or exceed AWWA C-515. Valves shall be UL listed and FM approved. The body and bonnet shall be ductile iron with a wall thickness which meets or exceeds the requirements of AWWA C-153. The body and bonnet shall be coated with a fusion bonded epoxy coating inside and out per AWWA C-550. The wedge shall be ductile iron and fully encapsulated in EPDM rubber per AWWA C-515 with delrin slides attached to the wedge. Wedge shall be symmetrical. Stem shall be sealed with o-rings. All exterior nuts and bolts shall be minimum 5/8" diameter and shall be 18-8 stainless steel. Acceptable manufacturers are:

Clow
American Flow Control
Mueller
Approved Equal

B. Valve Boxes

Valve boxes shall be cast iron, two piece, sliding type with a top flange and a minimum inside shaft diameter of 5-1/4". Boxes shall have the word "Water" clearly cast into the cover. Valve box bases shall be belled and valve box tops shall be flanged. Valve box covers shall be CI construction drop type, with pick holes for easy removal. Valve boxes of the appropriate length shall be provided for all buried service valves and are considered incidental to the valve bid item.

C. Valve Box Aligners

Valve (Gate) Box Aligners shall be a high strength, plastic device designed to be installed under the valve's operating nut and over the valve's stem. The aligners shall be designed to facilitate valve box base centering, to resist box shifting, to prevent backfill material from interfering with valve operation and to allow surface water to drain out. Valve box aligners shall be "Posi-Cap" or approved equal.

D. Gate Valve Wrench

Not used

E. Gate Valves for Non-Buried Service

Gate valves for non-buried service are specified in Division 15, when applicable.

F. Tapping Sleeves and Gate Valves

When shown on the plans tapping sleeves and gate valves (TS&V) shall be furnished and installed. Tapping sleeves shall be of ductile iron construction or stainless steel construction with ductile iron flange. Tapping valves shall be designed for connection to a tapping sleeve on one end and shall be MJ on the other end. Valves shall be as specified above. Prior to ordering the tapping sleeve and valve, the Contractor shall verify by test pit the size of the water main to be tapped.

Tapping sleeve and valve shall be installed while the main remains fully charged, avoiding the need to interrupt service to the water system. The tapping machine shall be properly disinfected prior to being used. The pipe coupon shall be retracted by the tapping machine.

Tapping sleeve and valves shall only be installed by experienced and approved specialty contractors with experience in this type of work.

02710.03 INSTALLATION

Installation shall follow the general AWWA standard for installation of pipe and fittings - AWWA C600 and manufacturer's latest recommendations. The only exception is that backfill material for buried valves shall have no stones larger than 2 inches in diameter. Installation shall also follow the manufacturer's latest recommendations. Care shall be taken to insure that the valve box base is supported by compacted select backfill rather than the valve body. Valve boxes shall be centered over the operating nut and installed plumb. Install a Valve Box Aligner device on valve prior to installing valve box.

SECTION 02717
COUPLINGS

02717.01 GENERAL

Furnish and install couplings (solid sleeves, cast couplings and two-bolt couplings) as specified in the contract documents. Couplings shall be used in new piping connections when shown on the drawings and to make repairs to existing utilities. Couplings shall be straight, transition, reducing or repair type couplings (as required). All components and materials that will be in contact with the finish water when the project is complete shall be certified to be in compliance with ANSI / NSF Standard 61.

02717.02 MATERIALS

A. Solid Sleeves

All ductile iron to ductile iron coupling connections shall be made with Solid Sleeves. Solid sleeves shall be ductile iron Class 350 mechanical joint fittings per 02701.02 B. Solid sleeves shall be "long" type (12" minimum length). Mechanical joint restrainers shall be utilized per "Section 02701 Mechanical Joint Restraint" on all connections to ductile iron pipe.

B. Cast Couplings

Cast couplings shall only be used where specified on the drawings or approved by the Engineer. Cast couplings shall have ductile iron sleeves and follower flanges per ASTM A-536. Sleeve ends shall have a smooth inside taper for uniform gasket sealing. Follower flanges shall be designed for a high strength/weight ratio. Nuts and bolts shall be 316 Stainless Steel. Gaskets shall be virgin SBR compounded for water service. Gaskets shall meet ASTM D2000 3 BA715. Sleeves and follower flanges shall be painted with shop coat enamel. When specified on the drawings, epoxy coated sleeves and flanges shall be provided.

Cast coupling center sleeves lengths shall be as shown in the following table.

Pipe Ø	4"	6" & 8"	10" & 12"	over 12"
Minimum Center Sleeve Length	5"	7"	10"	12"

C. Two-Bolt Couplings

Two-Bolt couplings shall be designed for connecting plain-end pipes. Two-Bolt couplings shall be designed to allow 5 degrees of deflection on each end and accommodate extended OD pipe range. Two-Bolt couplings (non-restraining) shall be used when specified on the drawings and for coupling connections to PVC, cast iron and AC mains.

All cast components (end rings, center ring, and bolt guides) shall be ductile iron, meeting or exceeding the requirements of ASTM A 536, grade 65-45-12. End rings shall be segmented and joined with a hinge. Gaskets shall be one piece and be formed from virgin Nitrile Butadiene Rubber (NBR) compounded for water and sewer service in accordance with ASTM D2000. Bolts and nuts shall be 304 stainless steel UNC carriage head bolts with heavy hex nuts. Fasteners shall be provided with anti-galling protection. Gaskets shall have heavy gauge 304 stainless steel bonded armor. Center ring shall be fusion bonded with epoxy. End rings shall be E-coated with epoxy. Two-Bolt couplings shall be rated for 305 psi working pressure.

Two-Bolt coupling lengths shall be 11.19" minimum for sizes 4" through 12".

02717.03 INSTALLATION

Install couplings as shown on the drawings and according to the manufacturer's latest recommendations.

SECTION 02720
HDPE WATER MAIN TESTING

02720.01 GENERAL

Furnish all labor, materials and equipment required to test all water mains as specified in the contract documents. All water mains, services (if required), and hydrant branch mains shall be tested prior to acceptance. The cost of testing is incidental to pipe installation.

02720.02 QUALIFICATIONS AND NOTIFICATIONS

The Testing Contractor and personnel shall be approved by the Owner and Engineer. All flushing and testing shall be done in the presence of the Engineer. The Contractor shall notify the Engineer at least 48 hours in advance of any testing.

02720.03 WATER PRESSURE TESTING

The testing methods described in this section are specific for water-pressure testing. These procedures should not be applied for air-pressure testing because of the serious safety hazards involved. Air-pressure testing is not allowed.

02720.04 TAPS AND APPARATUS

All taps and apparatus required for testing and disinfection shall be the responsibility of the Contractor per Sections 02720 and 02721. Provide taps at each high spot for expelling air. Provide taps as close to the beginning and end of the tested section as possible for injecting chlorine solution, flushing and sampling for chlorine residual.

Water for test pressure and flow shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner and Engineer. The pump, piping, connections and all necessary apparatus for conducting the test shall be furnished by the Contractor. The Owner may supply the gauges for the test. The Contractor shall furnish and install all necessary caps, plugs, taps, blowoffs, piping and valves needed to flush and test the pipe. The Contractor shall remove all tubing and piping from the main once all necessary testing has been completed.

02720.05 MAINTENANCE OF SYSTEM PRESSURE AND QUALITY

Coordinate with Owner regarding water system flow and pressure. Utilize approved methods to prevent backflow and cross connections. Pressure gauges shall be installed on existing pipes that are used to feed flushing water to the new main to allow for pressure monitoring. System pressure shall be maintained at a minimum of 20 psi, or as required by Water Utility.

All valves separating the new main from the existing system shall be kept closed at all times until the main is accepted. Valve operation for flushing, testing, etc. shall require approval of the Water Utility.

02720.06 PROCEDURE

After the pipe has been laid and completely backfilled the Contractor shall perform the water main test. The test shall be in accordance with AWWA M55 and ASTM F2146 except as herein specified.

Each valved section of pipe shall be slowly filled with water and all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporations at such points (per 02720.04) so the air can be expelled as the pipe is filled with water.

Flush all water mains and hydrants prior to testing. Flushing shall be accomplished by removing the main hydrant valves and bonnets and flushing water through the full open hydrant barrels. Water mains 6" and larger that do not utilize fire hydrants shall be flushed through an unrestricted 6" (min.) pipe. Water mains smaller than 6" shall be flushed through an unrestricted pipe no smaller than the main being flushed.

After expelling all air from the main and properly flushing it, the test can be performed. The test has 2 phases, the Expansion Phase and the Test Phase as described below.

Expansion Phase: Pressurize the pipe to 1.5 times the system design pressure at the lowest point in the pipe being tested. Engineer shall provide the system design pressure prior to the start of the test. Maintain pressure to within 5% of that pressure for 4 hours by adding makeup water as needed. If the test pressure cannot be attained, or it takes an unreasonably long time to reach test pressure, there may be faults such as leakage, entrapped air, or open valving, or the pressurizing equipment may be inadequate for the size of the test section. If such faults exist, discontinue pressurizing, and correct them before continuing.

Test Phase: Immediately at the completion of the Expansion Phase reduce the pressure by 10 psi and monitor pressure for 1 hour. Do not increase pressure or add makeup water.

Pass/Fail Criteria: If no visible leakage is observed, and pressure during the Test Phase remains steady (within 5% of the test pressure) for 1 hour, the section passes.

HOWEVER, in no event is the pipe to be under pressure for more than 8 hours. If you have failed to achieve a passing test in 8 hours from the time the Expansion Phase is started, release all pressure and let the pipe relax for 8 hours before repeating test.

All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered during the pressure test shall be repaired or replaced with sound material, and the test shall be repeated.

02720.07 FINAL CONNECTIONS

Any pipe section or connection that is longer than 18 feet shall be capped or plugged and tested per Section 02720.

Final connections shall be made, secured and restrained. Final connections shall be as short as possible but shall not exceed 18 feet in length. Leave final connections exposed until pipe has been pressurized for at least 10 minutes and examine carefully for any signs of leakage.

SECTION 02721
WATER MAIN DISINFECTION

02721.01 GENERAL

Furnish all labor, materials and equipment required to disinfect all water mains as specified in the contract documents. All water mains shall be disinfected prior to acceptance. All work under this Section shall comply with AWWA C-651 except as herein specified. The cost of disinfection is incidental to pipe installation.

02721.02 QUALIFICATIONS AND NOTIFICATIONS

The Testing Contractor and personnel shall be approved by the Owner and Engineer. All disinfection shall be done in the presence of the Engineer. The Contractor shall notify the Engineer at least 48 hours in advance of any disinfection.

02721.03 TAPS AND APPARATUS

All taps and apparatus required for testing and disinfection shall be the responsibility of the Contractor per Sections 02720 and 02721. Provide taps at each high spot for expelling air. Provide taps as close to the beginning and end of the tested section as possible for injecting chlorine solution, flushing, sampling for chlorine residual and bacteriological sampling. Taps to be used for collecting bacteriological samples shall be 0.5" to 1.0", discharges shall be setup to minimize splashing and spray, with smooth clean piping ends and with an accessible ball valve. Hydrants are not acceptable for bacteriological testing.

Chlorine solution for disinfection shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner and Engineer. The pump, piping, connections and all necessary apparatus for conducting the test shall be furnished by the Contractor. The Contractor shall furnish and install all necessary caps, plugs, taps, blow-offs, piping and valves needed to flush, test and disinfect the pipe. The Contractor shall remove all tubing and piping from the main once all necessary testing and disinfection has been completed.

02721.04 MAINTENANCE OF SYSTEM PRESSURE AND QUALITY

Coordinate with Owner regarding water system flow and pressure. Utilize approved methods to prevent backflow and cross connections. Pressure Gauges shall be installed on existing pipes that are used to feed water to the new main to allow for pressure monitoring. System pressure shall be maintained at a minimum of 20 psi, or as required by Water Utility.

All valves separating the new main from the existing system shall be kept closed at all times until the main is accepted. Valve operation for flushing, testing, disinfection etc. shall require approval of the Water Utility.

02721.05 PREVENTATIVE MEASURES

Prevent contaminating materials from entering the pipe during installation. Plugs shall be used where necessary during installation of the pipe to prevent the pipe from being contaminated with mud and silt. All gaskets and lubricants shall conform to AWWA standards. In no case shall petroleum based lubricants be used.

02721.06 FLUSHING AND TESTING

The water main shall be flushed and tested prior to disinfection as outlined in Section 02720 WATER MAIN TESTING.

02721.07 APPLICATION OF CHLORINE

The required method of disinfecting the water main is by uniform continuous injection of a hypochlorite solution into the main while flowing one source. The chlorine shall be fed into the main at a measured rate so that the entire main is chlorinated to a concentration of 50 mg/l. The chlorine shall be retained in the main for at least 24 hours. At the end of 24 hours the chlorine concentration in the main shall be at least 25 mg/l.

The Slug Method and the Tablet Method of disinfection shall not be allowed. Hypochlorite solutions shall utilize sodium hypochlorite (liquid), solutions shall not be mixed from tablets or powdered hypochlorite.

02721.08 FINAL FLUSHING OF MAINS

After the required retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the main is no higher than water in the system or is acceptable for domestic use. **Pressure Gauges shall be installed on existing pipes that are used to feed flushing water to the new main to allow for pressure monitoring. System pressure shall be maintained at a minimum of 20 psi, or as required by Water Utility**. The Contractor shall be responsible for the proper disposal/dechlorination of the highly chlorinated water, per Department of Human Services and DEP regulations.

02721.09 BACTERIOLOGICAL TESTING

After final flushing and before the water main is placed in service, initial samples shall be collected from the water main for bacteriological testing per State of Maine regulations and AWWA specifications. Twenty-four (24) hours after collecting the initial samples, confirmation samples shall be collected. The tests shall be done in accordance with Standard Methods and shall be done by a State Certified Laboratory. If both the initial and confirmation tests show that the samples meet State coliform and bacteria standards then the main shall be placed in service.

If the initial tests fail, the main shall be reflushed and resampled. If these tests fail, the main shall be rechlorinated and the process repeated at the Contractor's expense until satisfactory results are obtained.

The Utility District or Engineer will collect the bacteriological samples and provide the testing. A sample is required within 20 feet of each dead-end section and samples are required at 1200 ft. maximum spacing along the piping being tested.

02721.10 FINAL CONNECTIONS

Any pipe section or connection longer than 18 feet shall be capped or plugged and then tested and disinfected per Sections 02720 and 02721.

Final connections shall be as short as possible but shall not exceed 18 feet in length. Final connections shall be disinfected by spraying or swabbing per AWWA C651-05, 4.6.

SECTION 02730
WATER SERVICES

02730.01 GENERAL

Furnish and install water services as specified in the contract documents. Testing of water services (if required) shall comply with Section 02720.

02730.02 MATERIAL

All service brass shall conform to AWWA C-800. The pack joint end connection shall consist of a Buna-N beveled gasket for watertight fit and an independent, slip-clamp locking device which is grooved on the inside for additional restraint.

A. Copper Tubing -- Copper tubing shall be Type K as manufactured by Revere or Bridgeport Brass, or approved equal. Tubing shall conform to ASTM B-88 and AWWA C-800. Tubing shall be of the diameters shown on the drawings. Individual house services shall be 3/4" in diameter unless shown otherwise on Plans.

B. Corporations -- Corporations shall be ball valve type. Corporation inlets shall have AWWA taper and outlets shall have a compression pack joint. Corporations for individual house services shall be 3/4" unless shown otherwise on plans. Corporations shall be manufactured by Ford or McDonald, or approved equal. Corporation taps to PE mains of all sizes shall utilize an electrofusion saddle.

C. Curb Stops -- All curb stops shall be ball valves as manufactured by Ford or McDonald, or approved equal. Curb stops shall have solid one-piece tee head and stem. Curb stops shall have copper packed joints on inlets and outlets. Curb stops shall not have drains. Curb stops for individual house services shall be 3/4" unless shown otherwise on Plans.

D. Curb Boxes -- Curb boxes shall be cast iron extension type with arch pattern base. Curb box tops (covers) shall come complete with pentagon brass plug and shall be marked "Water." A ½" stainless steel service box rod shall be included. All curb stop box tops shall be threaded. No setscrew type box tops shall be utilized. Curb stop boxes shall be of sufficient length to not require extensions. Curb boxes for 1" and larger curb stops shall have heavy design foot piece.

E. Curb Stop Wrench -- A curb stop wrench (rod end with pentagon x 2-hole handle) shall be supplied to the Owner.

F. Service Saddles -- Service saddles shall have ductile iron (65-45-12) body and double strap type. Straps shall be 304 (18-8) SS with Teflon coated threads. Saddle body shall have 10 mils of fusion applied nylon coating. Saddles for PVC piping shall be pre-formed at the factory to the exact pipe size to avoid over-stressing the pipe during installation. Corporation taps to PVC or HDPE mains of all sizes or ductile iron mains 6" and smaller shall utilize a service saddle. All corporations larger than 1" shall utilize a service saddle.

02730.03 INSTALLATION

Installation shall follow the general AWWA standards and manufacturers latest recommendations. Curb stops and boxes for individual services shall be installed at the right-of-way limit. Curb boxes shall be installed plumb with the box lid installed flush with the finish grade. Curb stops and boxes shall be supported so that they do not put pressure on the service line. Copper tubing shall be bedded with 8" of clean sand bedding (from 4" below to 4" above the pipe).

Water service pipes and curb stops shall be installed with the same amount of cover as specified for the associated water main (6'-0" unless noted otherwise on the plans). Connections to existing service pipes which have less cover than required shall be done with copper tubing and couplings on the private side of the curb stop.

Flush the service line prior to connecting to existing services. Pressurize the service line and inspect for leaks prior to backfilling.

All corporations requiring a service saddle shall be installed prior to pressure/leakage test (Section 02720).

All water services shall be continuous (no 3-part couplings allowed) from the corporation to the curb stop.

02730.04 WARNING TAPE

Install Warning Tape in trench approximately 2 feet above new service line. Install per manufacturer's recommendation.

Warning tape shall be a minimum of 2" wide, be color coded for water in accordance with the APWA and be marked Caution Buried Water Line Below.

DIVISION 3
CONCRETE

SECTION 03203
UNDER-SLAB VAPOR BARRIER

03203.01 GENERAL

Furnish all labor, equipment and materials necessary to install under-slab vapor barrier and accessories as specified in the contract documents.

03203.02 MATERIALS

Under-slab vapor barrier shall be Stego Wrap 10-mil Class A vapor retarder or approved equal. Vapor barrier shall have permeance of less than 0.03 Perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).

03203.03 INSTALLATION

Level and compact base material. Install vapor barrier in accordance with ASTM E1643 and manufacturer's recommendations. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the Engineer or (b) where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.

Overlap joints 6 inches and seal with manufacturer's seam tape, applied to a clean and dry vapor barrier. Seal all penetrations (including pipes) per manufacturer's instructions.

Use reinforcing bar supports with base sections that eliminate or minimize the potential for puncture of the vapor barrier. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile strength.

SECTION 03205
CONCRETE REINFORCEMENT

03205.01 GENERAL

Furnish all plant, labor, equipment and materials necessary to install reinforcement in the concrete as specified in the contract documents.

03205.02 MATERIALS

Reinforcing bars shall be deformed billet steel bars. Bars shall have a minimum yield point of 60,000 psi and shall be substantially free of mill scale, oil, rust, dirt or other foreign matter. In the cases of mill scale and rust, it is sufficient merely to remove large flakes; wire brushing or sanding is not recommended. Reinforcing bars shall conform to ASTM specification A615, grades 60 and be installed as indicated on the drawings.

03205.03 DRAWINGS AND SCHEDULES

The Contractor shall submit to the Engineer detailed drawings showing bending and cutting schedules, splice locations, and placement locations for all reinforcing steel. No reinforcement shall be erected until the Engineer has given written approval of these drawings and schedules. Typically splices will only be allowed in horizontal continuous reinforcing. Horizontal steel is continuous unless noted otherwise and as such should wrap around corners and through intersections unless special details or splice bars are shown.

03205.04 FABRICATING AND PLACING REINFORCING

All fabrication and placing shall comply with the applicable CRSI-Code of Standard Practices.

A. Fabrication Tolerances

1. Sheared length: +/- 1 inch
2. Depth of truss bars: + 0, -1/2 inch
3. Stirrups, ties and spirals: +/- 1/2 inch
4. All other bends: +/- 1 inch

B. Placement Tolerances

1. Concrete cover to formed surfaces: +/- 1/4 inch
2. Minimum spacing between bars: +/- 1/4 inch
3. Top bars in slabs and beams:
   a) Members 8 inch deep or less: +/- 1/4 inch
   b) Members more than 8 inches but not over 2 feet deep: +/- 1/2 inch
   c) Members more than 2 feet deep: +/- 1 inch
   d) Crosswise of members: spaced evenly within 2 inches
   e) Lengthwise of members: +/- 2 inches

C. Bar Relocation

Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval.

D. Support

Support all reinforcing bars and wire them together to prevent displacement by construction loads or the placing of concrete beyond the tolerances specified herein. On ground and where necessary, supporting metal chairs shall be used. Use metal, or other approved bar chairs and spacers over formwork. Use galvanized or plastic accessories where concrete surface will be exposed to the weather in the finished structure or where rust would impair architectural finishes.

E. Splices in Fabric, Load Bearing

Lap splice welded wire fabric designated as load carrying reinforcement so that the overlap measured between outermost cross wires is the wire spacing plus 2 inches. Support welded wire fabric as required for reinforcing bars.

F. Splices in Fabric, Non Load Bearing

Lap splice welded wire fabric not specifically designated as load carrying reinforcement so that the overlap measured between outermost cross wires of each fabric sheet is not less than 2 inches; extend welded wire fabric across supporting beams and walls and to within 4 inches of concrete edges; extend welded wire fabric through contraction joints and construction joints except keyed joints in slabs on ground. Position welded wire fabric during placing of concrete to insure its proper position in the slab.

G. Bar Splices

Offset vertical bars at least one bar diameter at lapped splices. Obtain Engineer's approval of all splices not shown on the project drawings.

Table of Minimum Lap Splices				
Bar No.	4	5	6	8
Top Bars	24	30	34	58
Other Bars	24	24	24	42

H. Bending Bars

Steel shall be cold bent around revolving collar of recommended size.

Unless permitted, do not bend reinforcement partially embedded in hardened concrete. Field bending shall not be allowed.

SECTION 03210
CONCRETE FORMWORK

03210.01 GENERAL

Provide concrete formwork as specified in the contract documents. The Contractor shall not use earth cuts as forms for vertical surfaces, unless otherwise specified herein.

03210.02 MATERIALS

A. FORMS shall be of wood, metal or other approved material that will not adversely affect the surface of the concrete and that will produce or facilitate obtaining the specified surface finish of the concrete.

1. Wood forms shall be commercial standard Douglas Fir, moisture-resistant, concrete-form plywood not less than 5-ply and at least 1/2 inch thick.

2. Metal forms shall be of approved type that will produce surfaces equal to those specified for wood forms.

B. FORM OIL shall be non-staining and shall not cause softening of the concrete, impede the wetting of surfaces to be cured with water or curing compound, nor be otherwise deleterious. A submittal on form oil is required.

C. FORM TIES shall be of an approved design, fixed or adjustable in length and free of devices that will leave a hole larger than 7/8 inch in diameter in surface on concrete. When form ties are used where discoloration of the concrete would be objectionable, the metal remaining shall be at least 1 inch below the finished surface.

03210.03 DESIGN

A. Design formwork in accordance with "Recommended Practice for Concrete Formwork: (ACI 347)" and wind loads as specified by the local building code.

B. Provide temporary openings at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is deposited.

C. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be a commercially manufactured type. Nonfabricated wire is not acceptable. The portion remaining within the concrete shall leave no metal within 1 inch of the surface when the concrete is exposed to view. Spreader cones on ties shall not exceed 1 inch diameter.

03210.04 TOLERANCES

A. Construct so that concrete surfaces will conform to the tolerances of ACI 347.

B. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members. Provide moldings or chamfer strips in the corners of column, beam, and wall forms where the concrete will be exposed to view.

C. Camber formwork to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and construction loads.

D. Provide positive means of adjustment (wedges or jacks) of shores and struts to take up settlement during concrete placing operation. Brace shores and struts securely against lateral deflections.

03210.05 PREPARATION OF FORM SURFACES

A. Construct forms sufficiently tight to prevent leakage of grout or cement plaster. Swell board forms having joints opened by shrinkage of wood until closed by wetting before concrete is placed.

B. Seal plywood and other wood surfaces not subject to shrinkage against absorption of moisture from the concrete by either (1) a field applied, approved form oil or sealer, or (2) a factory applied nonabsorptive liner.

C. Coat forms prior to placing reinforcing steel. Do not allow coating material to stand in puddles in forms nor to come in contact with concrete against which fresh concrete will be placed.

D. Where as-cast finishes are required, do not coat form surfaces with materials which will impart a stain to the concrete. Where the finished surface is required to be painted or coated, coat form surfaces with materials compatible with type of paint or coating to be used.

E. Clean all form surfaces before re-use.

F. Set edge forms and intermediate screed strips accurately to produce the designed elevations and contours; they shall be sufficiently strong to support vibrating bridge screed or roller pipe screeds if finish specified requires use of such equipment. Align concrete surface to the contours of screed strips by use of strike-off templates or approved compacting type screeds.

G. When the formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

03210.06 REMOVAL OF FORMS

A. Delay removal of formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete until concrete has hardened sufficiently to resist damage from removal operations. Do not remove forms until concrete has achieved at least 75% of its specified 28-day strength. In no case shall forms be removed until at least 72 hours after placement.

B. Leave formwork for beam soffits and slabs, and other parts that support the weight of concrete, in place until concrete has reached its specified 28-day strength, unless otherwise specified or permitted.

C. When shored and other vertical supports are so arranged that the form facing material may be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age as specified or permitted.

03210.07 RESHORING

A. Perform reshoring so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, do not permit live loads on the new construction. Leave reshores in place until concrete has reached its specified 28-day strength, unless otherwise specified or permitted.

B. Reshore floors supporting under set concrete above or leave their original shores in place. The reshores shall have at least one-half the load capacity of the shores above and shall be distributed in approximately the same pattern as those above. Leave these reshores in place until the freshly placed concrete has reached 75 percent of its specified 28-day strength, unless otherwise specified or permitted.

0310.08 REMOVAL STRENGTH

A. When formwork removal or reshoring removal is based on the concrete reaching its specified 28-day strength (or a specified percentage thereof) the concrete shall be presumed to have reached this strength when either of the following conditions has been met:

1. When testing cylinders, field cured under the most unfavorable conditions prevailing for any portion of the concrete represented, have reached the required strength. Except for the field curing and age at test, the cylinders shall be molded and tested as specified in Division 3, Section 03220.

2. When the concrete has been cured as specified for the same length of time as the age at the test of laboratory cured cylinders which reached the required strength. The length of time the concrete has been cured in the field shall be determined by the cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of the air in contact with the concrete is above 50 degrees F. and the concrete has been damp or thoroughly sealed from evaporation and loss of moisture.

SECTION 03220
CAST-IN-PLACE CONCRETE

03220.01 GENERAL

All materials, testing and workmanship for cast-in-place concrete shall comply with ASTM C94, Standard Specification for Ready-Mix Concrete, and ACI 301 specifications for structural concrete for buildings.

The Contractor shall furnish all labor, material, equipment and incidentals required to prepare, construct and test all cast-in-place concrete required for the project.

The Contractor shall provide field testing of concrete during placing operations including: slump, cylinders, air content, etc. The cost of testing shall be incidental to the concrete.

03220.02 MATERIALS

A. CEMENT shall conform to ASTM Designation C-150 as revised, Type II.

B. AGGREGATES shall conform to the Standard Specifications for Concrete Aggregates, ASTM Designation C-33 as revised.

C. SAND shall be medium gradation with fineness modules of 2.60 to 2.90.

D. COARSE AGGREGATES shall not exceed 1-1/2 inches for mass concrete and 3/4 inch for reinforced slabs.

E. WATER shall be from an approved water supply and free of oil, acid, salt, alkali, organics or other foreign matter.

F. AIR ENTRAINING AGENT shall conform to ASTM Designation C260 and shall be used in all concrete.

G. WATER REDUCING ADMIXTURES conforming to ASTM Designation C494, Type A shall be used in all concrete. Tests shall be performed to ensure that excessive shrinkage or retarding of set does not result with use. Results shall be provided to the Engineer for approval.

03220.03 PROPORTIONING

Concrete shall be a homogenous mixture of Portland Cement, water, and fine and coarse aggregates as specified and within limits stated herein.

Concrete shall be proportioned by weights. The proportion of ingredients shall be selected to produce proper placeability, durability, strength, and other properties. The mixture shall be proportioned so it will work readily into rock voids, but will not slump down the slope face or cause the materials to segregate.

If it is found impossible to obtain concrete of the desired placeability and workability with the proportions specified, the Contractor shall make such changes in aggregate weights as may be authorized by the Engineer to adjust the workability to a satisfactory condition.

Admixtures shall be proportioned in accordance with manufacturer's recommendations or as determined by trial batches.

Reference for the proportioning and mix design shall be the Portland Cement Association manual "Design and control of Concrete Mixes," latest edition.

A Copy of the mix design shall be submitted to the Engineer for approval.

Proportioning requirements are specified as follows:

28 Day Compressive Strength = 4,000 psi
Maximum Size Coarse Aggregate = 3/4"
% Air Entrainment = 6.0 +/-1 for Footings, Walls, and Exterior Slabs;
- no air entrainment for interior slabs
Minimum/Maximum Slump = 1" to 3"*
Minimum Cement Content #/cy = 611
Maximum W/C Ratio = .45

* = slump range prior to addition of high range water reducing admixtures. When high range water reducers are used, they shall be added at the site and the manufacturer's latest recommendation shall be followed. High range water reducers ("superplasticizers") conforming to ASTM C494 shall be used during placement of all concrete. High range water reducers should be added at the site to bring the slump up to approximately 6 inches.

03220.04 CONSTRUCTION METHODS

A. General: Deposit concrete continuously, or in layers so that no seams or planes of weakness will be formed within the section. If a section cannot be placed continuously, locate construction joints at points as indicated or as approved. Deposit new concrete while previously placed concrete is still plastic. Discard concrete which has partially hardened or has been contaminated by foreign materials. Remove temporary spreaders in forms when concrete is at an elevation where they are unnecessary. Permanent metal or concrete spreaders may be left in forms if approved by the Engineer.

B. Placement: Place concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not place concrete in lifts over 24". Concrete shall not drop more than 2 feet from hopper "elephant trunk" to surface of previous concrete lift.

C. Consolidation: Consolidate all concrete by vibration, spading, rodding, or forking. Work concrete around reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets. Honeycombing, pitting, or places of weakness will not be allowed. Mechanical vibrators shall have a minimum frequency of 7,000 revolutions per minute and shall be operated by competent workmen. Do not over-vibrate or use vibrators to transport concrete within forms.

Vibrate concrete at many points, from 18 to 30 inches apart. Use care in vibrating not to cause segregation. Keep spare vibrator on job site during all concrete placing.

D. Weather: Unless adequate protection is provided and/or approval is obtained, concrete shall not be placed during rain, sleet or snow. Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.

E. Placing Temperature:

a.) Cold Weather: When the mean daily temperature falls below 40 deg F, the minimum temperature of concrete as placed shall be 50 deg F.

b.) Hot Weather: Concrete deposited in hot weather shall have a placing temperature which will not cause difficulty from loss of slump, flash set, or cold joints (usually less than 90 deg F).

03220.05 CURING

A. General: Protect all new concrete against injury from weather and construction. Provide moist curing above 50 deg F for at least 7 days. Walls and vertical surfaces shall be covered continuously with saturated burlap or two coats of approved waterseal or other approved means. Horizontal surfaces shall be kept wet with burlap or sprinklers. Protect finished surfaces from direct sunlight. In cold weather, provide 350 day degrees of heat.

Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures; maintain minimal moisture loss at relatively constant temperature for period of time necessary for hydration of the cement and proper curing of the concrete.

B. Initial Curing: Do initial curing immediately following finishing operation. Keep concrete continuously moist at least 24 hours. Use one of the following materials or methods:

a.) Ponding or continuous sprinkling.

b.) Absorptive mat or fabric kept continuously wet.

c.) Continuous steam (not exceeding 150 deg F) or vapor mist wet.

d.) Curing compounds conforming to "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete" (ASTM C309). Apply such compounds in accordance with recommendations of manufacturer; do not use on any surfaces against which additional concrete or other cementitious finished materials are to be bonded, nor on surfaces specified herein on which such curing is prohibited. Mask off all areas to be caulked prior to the application of curing, sealing and hardening compounds.

e.) See requirements under (J.) below for curing and sealing of slabs.

C. Final Curing: Immediately following the initial curing and before the concrete has dried, provide additional curing by one of the following materials or methods.

a.) Continuing the method used in initial curing.

b.) Waterproof paper conforming to "Specifications for Waterproof Paper for Curing Concrete" (ASTM C171).

c.) Other moisture-retaining coverings as approved.

D. Duration of Curing: Continue final curing until the cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of the air in contact with the concrete is above 50 deg F, totals 7 days. If high-early-strength concrete has been used, continue final curing for a total of 3 days. Prevent rapid drying at the end of the curing period.

E. Formed Surfaces: Keep steel forms which are heated by the sun, and all wood forms in contact with the concrete, wet during the final curing period. If forms are to be removed during the curing period, cure by one of the above curing materials or methods immediately. Continue such curing for the remainder of the curing period.

F. Cold Weather Curing: When the mean daily temperature of the atmosphere is less than 40 deg F, maintain temperature of the concrete between 50 deg F and 70 deg F for the required curing period. Make arrangements for heating, covering, insulating, or housing the concrete work in advance of placement, arrangements shall be adequate to maintain required temperature and moisture conditions without injury due to concentration of heat. Heat shall be thermostatically controlled and properly vented.

G. Hot Weather Curing: When necessary, make arrangements for installation of windbreaks, shading, fog spraying, ponding, or wet covering of a light color in advance of placement. Employ such protective measures as quickly as concrete placing and finishing operations will allow.

H. Excessive Temperature Changes: During curing period protect concrete from temperature changes in excess of 5 deg F in any 1 hour or 50 deg F in any 24 hour period.

I. Protection from Mechanical Injury: During the curing period protect concrete from damaging mechanical disturbances, particularly load stresses and excessive vibration. Protect all finished concrete surfaces from damage caused by construction equipment, materials, or methods and from rain or running water. Do not overload self-supporting concrete structures.

J. Curing and Sealing of Slabs: Follow the manufacturer's latest recommendations in regard to surface preparation, curing and sealant application and post application procedures.

1- Slabs intended for water containment applications (reservoirs, clearwells, etc.) Cure and harden slabs with EUCOSIL, or equal, as manufactured by Euclid Chemical Company, Cleveland, Ohio. Do not apply on any surfaces against which additional concrete or cementitious materials are to be bonded.

2 - All other concrete slabs shall be cured with A.H. Harris Koncure Clear Emulsion (resin based dissipating curing compound) or approved equal. The curing product shall be applied immediately after the final finishing of the concrete surface as recommended by the manufacturer. Once the slab has reached its 28-day strength, it shall be sealed with Vexcon Starseal PS Clear (silicate based densifying sealer) or approved equal.

03220.06 FINISHING

A. Slabs: Finished floor and slab surfaces shall be true plane surfaces, with a tolerance of 1/8 inch in 10 feet unless otherwise indicated on the drawings. Surfaces shall be pitched to drains. The dusting of finished surfaces with dry materials will not be permitted.

a.) Monolithic Street Trowel Finish: Except where otherwise specified, floor slabs shall be finished by tamping the concrete with special tools to force the coarse aggregate away from the surface, then screeding and floating with straight edges to bring the surface to the required finish level. While the concrete is still green but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood-floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. After surface moisture has disappeared, surfaces shall be steel-troweled to a smooth, even impervious finish, free from trowel marks. After having set sufficiently to ring the trowel, the surface shall be given a second steel-troweling to a burnished finish.

b.) Power-Machine Finish (option): In lieu of hand finishing, the Contractor may use an approved power finishing machine in accordance with the directions of the machine manufacturer. The preparation of concrete surfaces for finishing by machine shall, in general, be as hereinabove required for hand finishing.

B. Formed Surfaces: Knock off all protrusions, fill the holes and honeycombed areas with grout as specified in Section 03601. Grind surface of all exposed walls to remove all protrusions and to provide a smooth surface.

03220.07 CONCRETE TESTING

The Contractor shall employ an approved independent Concrete Testing Laboratory to sample and test the concrete and its materials. The Concrete Testing Laboratory must be approved by the Engineer. Concrete field quality control testing shall be performed only by technicians certified by (1) the Maine Concrete Technicians Certification Board, or (2) another body having a certification reciprocity agreement with the Maine Concrete Technicians Certification Board. The concrete field testing technician shall be employed by the approved lab. The concrete field testing technicians must be approved by the Engineer.

The following tests are required:

A. Slump: ASTM C143; One test for each set of compressive strength test specimens. Sample shall be taken at the start of the load. A slump test must be run prior to the incorporation of the CFP fibers per recommendations of ACI 544. A slump test must be run prior to and following the addition of a water reducer (superplasticizer) per recommendations of ACI 301.

B. Air Content: ASTM C231 "Pressure method for normal weight concrete." one test for each set of compressive strength specimens measured at point of discharge.

C. Concrete Temperature: Test hourly when air temperature is 40° F (4° C) and below, and when 80° F (27° C) and above; and each time a set of compression test specimens is made.

D. Compression Test Specimen: ASTM C31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

E. Compressive Strength Tests: ASTM C39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 2,400 sq. ft. of surface area placed; 1 specimen tested at 7 days and 2 specimens tested at 28 days, 1 specimen retained in reserve for later testing if required.

a.) When frequency of testing will provide less than 3 sets of strength tests for a given class of concrete, conduct testing from at least 3 randomly selected batches or from each batch if fewer than 3 are used.

b.) When total quantity of a given class of concrete is less than 10 cu. yds., strength test may be waived by Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.

c.) When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

F. Pumped concrete shall be tested at point of discharge per ACI 301.

All test results shall be reported in writing to the Engineer and Contractor on the day following the day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, compressive breaking strength and type of break for 3-day, 7-day and 28-day tests.

03220.08 EVALUATION OF STRUCTURE

A. Strength: Strength of concrete shall be considered satisfactory if the average of each set of three consecutive strength tests of the laboratory specimens representing each individual placement of concrete is equal to or greater than the specified strength and if no individual strength test result falls below the specified compression strength by more than 10%.

B. Additional Tests: If concrete shown by laboratory strength tests is defective, the Contractor may, at his own expense conduct such testing as he may deem necessary. Test results so obtained, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection. If cores are taken for such determination, they shall be in accordance with ASTM C42.

a.) Impact hammers, sonoscopes, or other nondestructive testing devices may be used, if approved, to determine relative strengths of various areas of the structure as an aid in evaluating concrete strength in place or in determining locations of areas to be cored. Test results so obtained unless properly

calibrated and correlated with other test data shall not be used as a basis for acceptance or rejection.

b.) When required, core tests shall be conducted in accordance with "Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" - ASTM C42. Cores shall be tested saturated-surface-dry if the concrete they represent will be wet at any time during use of the completed structure. Cores shall be tested air-dry if the concrete they represent will be dry at all times during use of the completed structure. The laboratory report shall state whether the cores were tested saturated-surface-dry or surface-dry.

c.) At least three cores shall be taken from each potentially deficient area. Locations will be determined by the Engineer. Damaged cores may be replaced.

d.) Strength of cores from each member or area shall be considered satisfactory if their average is equal to or greater than 90 percent of the specified strength.

e.) Core holes shall be plugged solid with 2:1 grout.

03220.09 ACCEPTANCE OF STRUCTURE

A. The strength of the structure in place will be considered sufficient if it complies with all requirements which control the strength of the structure as outlined below:

a.) Adequate concrete strength as evaluated by the requirements of this section.

b.) Reinforcing steel size, quantity, strength, position and arrangements in conformance with the project drawings.

c.) Concrete which conforms to the required dimensions and as shown on the project drawings.

d.) If specified elsewhere the structure shall pass a leakage test prior to acceptance.

SECTION 03400
PRECAST ITEMS

03400.01 GENERAL

Furnish, install and test all precast concrete items as specified in the contract documents. Submit copies of shop drawings for all precast concrete items to the Engineer for review. Manholes and catch basins are covered under different sections of these specifications.

03400.02 MATERIALS

All precast concrete items shall be constructed of concrete with an ultimate compressive strength of 4000 psi. Concrete shall have obtained 75% of its compressive strength prior to being shipped to the jobsite.

Precast concrete items shall be constructed to the dimensions shown on the drawings. Precast concrete items shall be designed by the manufacturer to safely support the anticipated loads. Precast items shall be manufactured by Genest of Sanford, Maine or approved equal. Precast blocks for pump station shall be Comfort Block by Genest of Sanford, Maine or approved equal.

All pipe penetrations shall utilize lock joint flexible pipe sleeves.

The exteriors of all buried precast items shall be waterproofed with 2 coats of bituminous waterproofing. Comfort Block shall be finished per manufactures directions with stucco.

03400.03 INSTALLATION

Install the precast items at the locations and grades shown on the plans.

All interior joints shall be caulked with Sikaflex 1A. All exterior joints shall be sealed with two coats of bituminous waterproofing.

Backfill precast items with well compacted sand and gravel.

DIVISION 5
METALS

Miscellaneous Metal Work 05501

SECTION 05501
MISCELLANEOUS METAL WORK

05501.01 GENERAL

Furnish, fabricate (where necessary) and install all miscellaneous metal work necessary for the completion of the contract, as shown on the drawings, as specified in the appropriate sections of this division and as required to complete the work. Items to be embedded in concrete or masonry shall be furnished under this section but installed under the concrete or masonry sections.

Complete shop drawings shall be furnished for all metal work. Shop drawings shall show sizes, finish, method of assembly, hardware, anchorage, etc. Layout and details shall also be submitted.

05501.02 MATERIAL

Steel shapes (bars, beams, angles, etc.) shall conform to the requirements of ASTM A36-75 "Specifications for Structural Steel." All galvanized items shall be coated by the hot-dip process according to ASTM A123-73, A153-73, A386-73 and A525-73.

A. Hatches -- Not used

B. Stair Nosings -- Not used

C. Expansion Bolts -- Stainless steel bolts shall be used when anchoring aluminum and in all submerged locations. Where anchors or expansion bolts are required in concrete, Hilti Kwik-Bolt or RedHead Wedge Anchors shall be used.

D. Thresholds -- Metal thresholds are as shown on the drawings. Thresholds shall be alloy 6063-T5 (mill finish) aluminum extrusions. Thresholds shall be cut to size, fitted to jambs and secured in place by countersunk flat-head screws in anchors built into the floor.

E. Guard Chains -- Not Used

F. Ship's Ladder -- Not Used

G. Aluminum Stairs -- Not Used

H. Anchor Bolts -- Anchor bolts shall be made of ASTM A307 galvanized steel except where stainless steel is noted. Anchor bolts shall be of the sizes indicated, hooked and threaded. Stainless steel bolts shall be used to anchor aluminum to masonry or concrete and shall include stainless steel washers and nuts.

05501.03 INSTALLATION

Materials and workmanship shall be subject to review and approval by the Engineer. Sectional work shall be shop assembled as far as practicable. All bolts that project beyond nuts in exposed work shall be cut off. All cutting, tapping, drilling and fitting required to install the work and make connections shall be included in this work. When welding is permitted or required, it shall conform to the current requirements of the American Welding Society for the type of work in question. The design details and workmanship of steel plates and structural steel shall conform to the current AISC specifications for design, fabrication and erection of steel for buildings as applicable.

Shop painting of metals shall be as follows:

Non-Immersion Service -- All ferrous metal work shall be cleaned in accordance with SSPC-SP6 specifications for commercial blast cleaning and given one coat of prime paint.

Immersion Service -- All ferrous metal items shall be cleaned in accordance with SSPC-SP10 specifications for near white blast cleaning and given two coats of prime paint.

Where aluminum surfaces come in contact with metals other than stainless steel or zinc, aluminum surfaces shall be kept from direct contact with such parts by utilizing mylar isolators, painting with zinc chromate paint, or installing non-absorptive tape between the dissimilar metals. When aluminum comes in contact with concrete or masonry, the aluminum shall be coated with bituminous paint.

DIVISION 6
WOOD & PLASTICS

SECTION 06110
CARPENTRY

06110.01 GENERAL

Perform all carpentry and furnish and install all materials as specified in the contract documents. Coordinate all carpentry work with other trades and provide carpentry assistance as required by other trades.

06110.02 RELATED WORK SPECIFIED ELSEWHERE

Roofing and insulation are specified in Division 7. Doors and windows are specified in Division 8. Finishes are specified in Division 9.

06110.03 MATERIAL PROTECTION

Only new undamaged materials are to be used. Store all materials under cover and in such a manner as to insure proper ventilation and drainage. Protect materials from damage and weather. Protect materials from extreme changes in temperature and humidity.

06110.04 MATERIALS

A. SILLS: Sill plates shall be pressure treated lumber of the dimensions shown on the plans. Install foam sill sealer between sill and foundation. Sill shall be bolted securely to the foundation with 1/2" diameter anchor bolts spaced 4' o.c. maximum. Use anchor bolts on each side of door openings.

B. FRAMING LUMBER: Framing lumber shall be kiln dried structural grade native spruce. All lumber shall be dressed four sides and shall bear the grade mark of the appropriate inspection bureau grading to conform with the rules of the Lumber Manufacturer's Association. Unit dimensions of lumber are "nominal" unless otherwise noted.

C. TIMBERS THICKER THAN 2": Timbers thicker than 2" shall be Douglas fir, No. 1 structural.

D. PLYWOOD: See Section 06115.

E. GYPSUM WALLBOARD: Not Used

F. EXTERIOR WOOD TRIM: Unless otherwise noted on plans, all exposed exterior wood trim shall be No. 1 pine. Exterior trim that is to be covered with vinyl or aluminum shall be No. 2 or better.

G. INTERIOR WOOD TRIM: Unless otherwise noted on plans, all interior wood trim shall be clear pine. Finger-jointed trim will be allowed for surfaces that are to be

painted and not stained. Unless otherwise noted on plans, casing shall be 3-1/2" colonial style, and bases shall be 4-1/2" colonial style.

H. WINDOW SILLS: Unless otherwise noted on plans, window sills shall be clear pine and dimensioned as per window manufacturer's details.

I. NAILS: All nails and screws shall be galvanized.

J. OTHER MATERIALS: All other materials not specifically described but required for a complete and proper installation as indicated on the Drawings, shall be new, suitable for intended use, and subject to the approval of the Engineer.

06110.05 INSTALLATION

A.) ROUGH CARPENTRY

1.) WORKMANSHIP

All rough carpentry shall produce joints true, tight, and well nailed, with all members assembled in accordance with the drawings and all pertinent codes and regulations. Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making connections. Cut out and discard all defects that render a piece unable to serve its intended function. Lumber shall be rejected for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting. Do not shim sills, joists, short studs, trimmers, headers, lintels, or other framing components.

Set all horizontal or sloped members with crown up. Do not notch, bore, or cut members for pipes, ducts, conduits, or other reasons except as shown on the drawings or as specifically approved in advance by the Engineer. Make all bearings full unless otherwise indicated on the drawings. Finish all bearing surfaces on which structural members are to rest so as to give sure and even support. Bearing ends of framing members that slope shall be cut or notched as required to give a uniform bearing surface.

Install all blocking required to support all items of finish and to cut off all concealed draft openings, both vertical and horizontal, between ceiling and floor areas. Fire-blocks shall be two inches (nominal) in thickness by the full width of the opening being blocked. Install fire-block in all stud walls at ceiling and floor levels including furred spaces, so that the maximum dimension of each concealed space is not more than eight feet. Install fire-blocks at all other locations where openings could afford passage for rodents or flames. Install wood cross bridging of not less than two inches

by three inches nominal, metal cross bridging of equal strength, or solid blocking between joists where the span exceeds eight feet. The distance between a line of bridging and a bearing shall not exceed eight feet. Install solid blocking between joists at all points of support and wherever sheathing or flooring is discontinuous. Blocking may be omitted where joists rest on ribbons and are nailed to studs, and where joists are supported on metal hangers.

Use no less than two joists spiked together to support partitions running parallel to the joists, provided, however that where necessary to permit passage of pipes such joists may be separated by solid blocking spaced at no more than four feet on center.

Make all studs single length, un-spliced, and platform framed. Frame all corners and intersections with three or more studs to provide all required bearing for wall finish.

On all framing members to receive a finished wall or ceiling, align the finish subsurface to vary not more than 1/8 inch from the plane of surfaces of adjacent framing and furring members.

2.) FASTENING

For bolts drill holes 1/16 inch larger in diameter than the bolts being used. Drill straight and true from one side only. Bolt threads shall not bear on wood. Use washers under heads and nuts that bear on wood; use washers under all nuts. For lag screws and wood screws, pre-bore holes same diameter as root of thread; enlarge holes to shank diameter for length of shank. Screw, do not drive, all lag screws and wood screws.

Use common wire and galvanized nails or spikes of the dimension shown on the Nailing Schedule.

For conditions not covered in the Nailing Schedule or IBC-2009, provide penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike provided, however, that 16d nails may be used to connect two pieces of two inch nominal thickness.

Do all nailing without splitting wood. Pre-bore as required. Split members shall be replaced at the Contractor's expense.

NAILING SCHEDULE: The following schedule is summarized, in part, from the International Building Code 2009, Table 2304.9.1. See IBC for additional information and options.

Blocking to joist bearing:	Three 8d toenailed each side
Blocking to joist or stud:	Three 8d toenailed each side
One inch brace to stud:	Two 8d face nailed
Bridging to joist:	Two 8d toenailed
Built-up beams and girders	20d @ 32" on centers, staggered
	Two 20d @ ends & splices
Joists and rafters: to support:	Three 8d toenailed each side
At laps (12") minimum:	Three 16d face nailed
Multiple joists:	16d @ 12" on centers, staggered
Joists to sill or girder:	Three 8d toenailed
1" furring to underside of joists:	#8 x 2" screw
Studs toenailed to plate:	Four 8d
Studs nailed together:	16d @ 24" on centers, staggered
Plates: Upper to lower:	16d @ 16" on centers, staggered
At splices:	Eight 16d face nailed
Plate lap at corners:	Two 16d face nailed

B.) FINISH CARPENTRY

1.) INSTALLATION OF WOOD DOORS

Not Used

2.) TRIM

Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims.

Install to a tolerance of 1/8" in 8'-0" for plumb and level and with 1/16" maximum offset in flush adjoining surfaces and 1/8" maximum offsets in revealed adjoining surfaces.

Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

Install standing and running and miscellaneous trim with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners, to produce tight fitting joints with full surface contact throughout length of joint. Use scarf joints for end-to-end joints.

Anchor finish carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nail for exposed nailings, countersunk and filled with flush with finished surface, and matching final finish where transparent is indicated.

Attach panels to supports with countersunk finish nailing where covered by moldings (if any), in accordance with manufacturer's instructions for concealed-fastener installation. Putty holes with matching color.

Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

Clean finish carpentry work on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.

Refer to Division 9 sections for final finishing of installed finish carpentry work.

Installer of finish carpentry work shall advise Contractor of final protection and conditions to maintain to ensure that work will be without damage or deterioration at time of acceptance.

SECTION 06115
PLYWOOD SHEATHING

06115.01 GENERAL

Furnish all labor and materials necessary to install plywood sheathing required for a complete project, as specified in the contract documents. All sheathing shall be new. Sheathing used as concrete forms shall not be reused as part of the building.

06115.02 MATERIALS

A.) Interior

1.) Plywood shall be a minimum of 4 ply, Douglas Fir sanded grade CDX or better and of the thickness shown on the plans. Plywood shall utilize exterior glue.

2.) Strapping shall be kiln dried pine or spruce and of the nominal dimensions shown on the plans.

B.) Exterior

1.) Plywood shall be 1/2" or 5/8" CDX fir (as noted on the plans). When placing portions of sheathing on existing structures, plywood shall be of a thickness which accommodates existing sheathing. TYPAR wind barrier shall be installed over entire exterior sheathed walls per manufacturer's recommendations.

2.) Roofing plywood shall be 5/8" CDX, Fir.

06115.03 INSTALLATION

Strapping shall be installed 16" o.c. (unless noted otherwise on the plans) and securely fastened to any concrete or masonry. Install blocking between strapping to support all plywood edges.

Clean and smooth all surfaces where sheathing is to be applied.

Nail sheathing securely with 8d nails (galvanized) 12" c/c for intermediate members and 6" c/c for end supports. Galvanized screws shall be used to secure all interior sheathing. Leave 1/16" space at all panel end joints and 1/8" space at all panel side joints.

Roof sheathing shall be installed with face grain perpendicular to framing members with panel and joints staggered 48".

Installation shall be according to the manufacturer's latest recommendations.

SECTION 06210
WOOD TRUSSES

06210.01 GENERAL

Furnish and install the prefabricated wood trusses as specified in the contract documents.

06210.02 QUALITY ASSURANCE

The wood trusses shall be designed and produced by a manufacturer with at least 5 years experience in the design and manufacture of wood trusses. Design, fabrication and erection of wood trusses shall be in accordance with Truss Plate Institute "Design Specifications for Metal Plate Connected Wood Trusses," and "Quality Standard for Metal Plate Connected Wood Trusses," latest edition. Each truss shall be stamped with the name and address of the licensed fabricator.

Trusses shall be designed by truss manufacturer to support all superimposed dead and live loads indicated, with design approved, stamped and signed by a structural engineer licensed to practice in the State of Maine.

06210.03 SUBMITTALS

Submit complete shop drawings, design data and design analysis. Submittals shall state the species and commercial grade of lumber used and lumber sizes. Submit plate inspection information per either plate placement or tooth count method, whichever is required per TPI standards.

06210.04 DELIVERY, STORAGE AND HANDLING

Handle and store trusses with care, and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

06210.05 MATERIALS

All lumber used in trusses shall be kiln dried and dressed four sides. Each piece of lumber shall be factory marked to show the type, grade, mill and grading agency.

Lumber shall be of the size, species and grade necessary to meet the load requirements. Lumber may be visually or machine stress-rated. All lumber for webs shall be structural grade number 2 or better and shall be a minimum size of 2"x4". All lumber for chords (top and bottom) shall be structural grade number 1 or better and shall have a minimum size of 2"x4". Chords on trusses with spans of 22 feet and longer shall be 2"x6" minimum.

All truss connector plates shall be of hot dip galvanized sheet steel complying with ASTM A-446, Grade A. Plates shall be zinc-coated by hot-dip process to comply with ASTM A-525, designation G60 (but not less than 0.036 inches).

06210.06 LOADING CONDITIONS

The trusses shall be designed to safely carry the following loads:

Top Chord Live Load	:	100 psf
Top Chord Dead Load	:	10 psf
Bottom Chord Live Load	:	10 psf
Bottom Chord Dead Load	:	10 psf
Truss Spacing	:	16 inches
Maximum Deflection	:	L /360

06210.07 SPECIAL CONDITIONS

Provide special end trusses with vertical framing members at 16 inch on center.

Provide hurricane clips on all trusses.

06210.08 INSTALLATION

Install trusses as recommended by manufacturer. Temporary and permanent bracing shall be as recommended by the manufacturer in addition to that shown on the drawings. Nail trusses as recommended by the manufacturer and secure with hurricane clips.

SECTION 06310
PRESSURE TREATED LUMBER

06310.01 GENERAL

Furnish and install pressure treated lumber as specified in the contract documents.

06310.02 MATERIALS

Pressure treated lumber shall be No. 1 Southern Yellow Pine or Douglas Fir. All lumber shall be dressed four sides and shall bear the grade mark of the appropriate inspection bureau grading to conform with American Wood Protection Association (AWPA) standards. Unit dimensions of lumber are "nominal" unless otherwise noted.

Prior to treatment all lumber shall be kiln-dried. Conditioning by heating is not permitted. Pressure treating shall be in accordance with AWPA Standards P5 and C2.

Sealing compound for treatment of field cuts shall be copper naphthenate (Cuprinol, or equal) meeting AWPA standard P8.

Dimensional pressure treated lumber (2" nom. thickness), decking, and other members with frequent human exposure shall be treated to a retention level of 0.40 lbs/ft^3 of alkaline copper quaternary (quat) (ACQ) or other approved non-arsenic preservative.

Where allowed by regulations, all other pressure treated lumber shall be treated to a retention level of 0.40 lbs/ft^3 of chromated copper arsenate (CCA), per AWPA standards.

06310.03 INSTALLATION

Installation shall be in accordance with Section 06110 CARPENTRY where applicable.

Decking shall be installed bark side up.

All field cuts shall be treated with two coats of copper naphthenate.

All fasteners for pressure treated lumber shall be stainless steel.

DIVISION 7
THERMAL AND MOISTURE PROTECTION

SECTION 07015
VAPOR BARRIERS

07015.01 GENERAL

The Contractor shall furnish all material and labor for and shall install all necessary vapor barriers as indicated on the drawings and as herein specified. The Contractor shall also supply all incidental work necessary for the installation of that item.

07015.02 MATERIAL

Polyethylene film and sheeting shall conform to ASTM D-2103 and D2578 and shall be supplied in six (6) mil thick sheets unless otherwise specified on the drawings. Butyl rubber barriers shall conform to ASTM E-96-66 for permeability and ASTM D-297-72A for specific gravity and shall be of the highest quality and formed from multiple plies of rubber fabricated into single ply rubber membrane. Splicing materials, sealants, prefabricated accessories and termination shall be of the highest quality and supplied by the manufacturer of the vapor barrier membrane.

07015.03 INSTALLATION

Before applying barriers the Contractor shall correct defects or conditions such as debris, bulges, cracks, etc., that will interfere with or prevent a satisfactory vapor installation.

Installation of vapor barriers that have become damaged shall be repaired or removed and replaced with new acceptable material to the satisfaction of the Engineer. Complete vapor barrier repairs and installation in one area where directed, and obtain approval of such work on remaining areas. The vapor barrier in the approved sample area shall be properly identified to establish the quality of workmanship acceptable for the installation of vapor barriers for the project.

Apply membrane and accessories in accordance with manufacturer's written instructions and as shown on the drawings and details.

SECTION 07280
INSULATION

07280.01 GENERAL

Furnish and install the general building insulation as specified in the contract documents.

07280.02 QUALITY ASSURANCE

Comply with fire-resistance and flammability ratings as shown and specified; and comply with governing regulations as interpreted by authorities. The materials shown are for the thermal resistance values R specified for each material. Provide adjusted thickness as directed for the equivalent use of material having a different thermal conductivity. Submit manufacturer's specifications and installation instructions for each type of insulation required. Include data substantiating that materials comply with specified requirements.

07280.03 MATERIALS

A.) Glass Fiber Reinforced Polyisocyanurate Foam (Thermax): Rigid, closed-cell, urethane insulation board, foil faced; FS HH-I-530, Type I, Grade 2, Class 1 or 2; aged K-value of 0.17; manufacturer's standard lengths and widths. Thickness as shown on the drawings.

B.) Glass Fiber, Blanket-Batt Insulation (Fiberglass or FG): Glass or other inorganic fibers, formed into flexible, resilient blankets or semi-rigid sheets; complying with FS HH-I521, Type as indicated; density as indicated but not less than 1.0 lb per cubic foot; approximated thermal conductivity (K- value at 75 degrees F) of 0.27; thickness as indicated or as required to yield the "R" values as indicated; manufacturer's standard lengths and widths, as needed to coordinate with the structural elements of spaces to be insulated.

1.) Type II: Units with non-reflective facing on at least one face, Kraft paper and asphalt or similar composition to provide vapor barrier rate 1.0 perms maximum on the warm side; provide only highly permeable facing on cold side. Provide 1" flanges along long edges of units, unless not required for attachment of units.

2.) Type III: Units with reflective vapor barrier facing of aluminum foil on one face (the warm side) rate 1.0 perm maximum; provide only highly permeable facing on cold side. Provide 1" flanges along edges of units, unless not required for attachment of units.

C.) Blown-In Insulation: Blown-in insulation shall be cellulose complying with ASTM C-739 and ASTM E-84. Thermal resistance shall be R 3.3 minimum per inch of depth. Thickness shown on the drawings is settled thickness; unless otherwise

specified by manufacturer, installed thickness shall be 10% higher to account for settling.

D.) Foundation Insulation: Foundation insulation shall be extruded Polystyrene insulation of the thicknesses specified on the drawings. Extruded Polystyrene insulation for foundations shall be plastic foam insulation board equal to Styrofoam brand as manufactured by the Dow Chemical Company and as meeting ASTM C-578 Type IV.

1.) Unless otherwise noted on the drawings, foundation insulation shall be Dow Styrofoam T&G or Owens Corning Foamular 250 T&G or equal. Insulation shall have a minimum compression strength of 25 psi (ASTM D-1621). Insulation shall be tongue and groove. This insulation may be referred to on the drawings as Styrofoam or Blue Dow.

2.) High Strength Foundation Insulation shall be Dow Styrofoam or Owens Corning Foamular 400. Insulation shall have a minimum compression strength of 40 psi (ASTM D-1621). Insulation shall be square edged.

E.) Stone Fiber Insulation (Roxul): Stone fiber insulation shall be non-combustible, lightweight, semi-rigid stone wool batt insulation of thickness specified on the drawings with a U-value of 0.24 at 75 degrees F. Density shall be 2 lbs. per cubic foot. Insulation shall comform to ASTM C665 Type 1, ASTM C167, ASTM C518, ASTM E136 and ASTM E84. Stone fiber insulation shall be Roxul Comfortbatt, as manufactured by Roxul, Inc. or equal. Dimensions shall be manufacturer's standard lengths and widths, as needed to coordinate with structural elements of spaces to be insulated.

07280.04 INSTALLATION

Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

Install all insulation as shown on the drawings and according to the manufacturer's latest recommendations. Comply with manufacturer's instructions for the particular conditions of installation in each case; including method of support or anchorage to the substrate, as appropriate for each application indicated. If printed instructions are not available or do not apply to the project conditions, consult the manufacturer's technical representative for specific recommendations before proceeding with the work.

Extend insulation full thickness as shown over entire surface to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Apply a single layer of insulation of the thickness indicated or the required thickness for the thermal value indicated, unless otherwise shown or required to make up the total thickness.

Blown-in insulation shall be installed after all other trades have completed work in the attic space. Verify that eave vents are not blocked.

SECTION 07620
FLASHING

07620.01 GENERAL

Furnish and install all flashing as specified in the contract documents.

07620.02 MATERIAL

Roof flashing for hips and valleys shall be 28-gauge aluminum and of a width to accommodate area of installation.

Flashing for windows, doors, wall louvers, wall fans, and other wall openings shall be Grace Vycor Butyl self-adhering flashing or approved equal.

07620.03 INSTALLATION

Flashing shall be installed wherever a roof joins another object such as chimneys, valleys, exterior side walls, vent pipes, etc., and over each window, door and fan or louver.

Install per manufacturer's latest recommendations.

SECTION 07910
JOINT SEALING AND CAULKING

07910.01 GENERAL

Furnish all materials, labor and equipment required to do all caulking and sealing for the proper completion of the project. Caulking shall be done at exterior and interior windows, doors, joints, and all exterior wall openings.

07910.02 MATERIALS

All sealants shall be of a single manufacturer. The color shall be approved by the Engineer. Acceptable products are Sikaflex 1-A. Caulking shall be a premium-grade, high-performance, moisture-cured, 1-component, polyurethane-based, non-sag elastomeric sealant. Caulking shall meet Federal specification TT-S-00230C, Type II, Class A. Caulking shall meet ASTM C-920, Type S, Grade NS, Class 25; Canadian Standard 19-GP-16A, Type II. Caulking shall be permanently flexible, watertight and non-staining.

07910.03 INSTALLATION

Install per manufacturer's latest recommendations. Utilize manufacturer's primer where required.

All caulking shall be done on clean dry joints to the minimum depth recommended by the manufacturer. All joints shall be vacuum cleaned before caulking. Masonry and concrete work shall be properly covered and dry before caulking. Finish material shall be properly protected by masking tape before caulking.

DIVISION 8
DOORS AND WINDOWS

SECTION 08020
DOORS AND FRAMES

08020.01 GENERAL

Furnish and install all doors, frames, and accessory items as indicated on the drawings and/or specified herein.

Submittals: Shop drawings for the fabrication and installation of doors and frames shall include details of each door and frame type, elevations of floor design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, details of joints and connections, anchorage and accessory items.

Delivery and Storage: Deliver doors and frames cartoned or crated to provide protection during transit and job storage. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided the finished items are equal in all respects to new work and acceptable to the Engineer; otherwise, remove and replace damaged items as directed.

Store doors and frames at the building site under cover. Place the units on at least 4" high wood sills or on the floors in a manner that will prevent rust and damage. If the cardboard wrapper on the door becomes wet, remove carton immediately. Provide a 1/4" space between stacked doors to promote air circulation.

The Contractor must examine the substrate and conditions under which the doors and frames are to be installed and notify the Engineer in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

08020.02 MATERIALS

Doors and frames shall be manufactured by Republic or approved equal. Doors shall be Republic DE Series Flush Doors, 1¾" thick, galvanized steel construction. Door thickness, gauge and insulation shall be as specified on the Door Schedule.

Frames shall be 14 gauge galvanized steel and designed for wood frame construction.

Furnish doors complete with all hardware and accessories including:

- Closers w/stay-open feature
- Stainless steel hinges (3 ea)
- Weather stripping and thresholds as shown in schedule
- Insulation
- Silencers
- Bolts, anchors, inserts, supports, fasteners, etc.
- Installation instructions
- Shop applied paint
- Standard hardware

- Lockset, keyed-alike locks, keys, strikeplates and accessories
- Floor-mounted stops
- Top and bottom caps
- All components shall comply with ADA requirements

08020.03 DOOR SCHEDULE

See Plans.

08020.04 INSTALLATION

Install units and accessories accurately and neatly into their respective locations in accordance with final shop drawings and manufacturer's data and as herein specified. Doors shall be installed true, plumb and square, such that they remain open in any position.

All doors and frames shall be painted per Division 9.

DIVISION 9
FINISHES

Painting 09910

SECTION 09910
PAINTING

09910.01 GENERAL

Furnish all labor, materials and equipment required to paint all items as specified in the contract documents. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of the work. The term "paint" as used herein means all coating system materials, which includes primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

09910.02 SUBMITTALS

A.) Submit copies of manufacturer's technical information, including paint label analysis and application instructions for each material proposed for use. Transmit a copy of each manufacturer's instructions to the paint applicator.

B.) List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.

C.) Submit samples for Owner's review of color and texture. Compliance with all other requirements is the exclusive responsibility of the Contractor.

09910.03 DELIVERY AND STORAGE:

A.) Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information:

a.) Name or title of material
b.) Manufacturer's stock number and date of manufacture
c.) Manufacturer's name
d.) Contents by volume, for major pigment and vehicle constituents
e.) Thinning instructions
f.) Application instructions
g.) Color name and number

B.) Store materials in a protected area at a temperature between 40 and 110 degrees F.

09910.04 MATERIALS

A.) Quality:

Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable paint manufacturers. Materials not displaying the manufacturer's identification as a standard, best grade product will not be acceptable.

B.) Colors and Finishes:

Colors will be selected by the Owner in accordance with 09910.02. No colors containing lead or other toxic substances shall be used.

C.) Acceptable Manufacturers: Paint shall be manufactured by Sherwin-Williams, Tnemec, Carboline, or approved equal.

09910.05 EXECUTION

A.) Inspection:

1.) Examine the areas and conditions under which painting work is to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator.

2.) Starting of painting work will be construed as the Contractor's acceptance of the surfaces within any particular area.

3.) Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint.

B.) Surface Preparation:

1.) General: Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition. All surfaces shall be clean, dry and free of contamination.

2.) Wood:

a.) Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off with appropriate tack cloth.

b.) Prime, stain, or seal wood required to be job painted or stained immediately upon delivery to job. Prime or stain edges, ends, faces, undersides, and backsides of such wood.

c.) When transparent finish is required, use spare varnish for backpriming.

d.) Backprime paneling or interior partitions only where masonry, plaster, or other wet wall construction occurs in backside.

e.) Seal tops, bottoms and cut-outs of wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

f.) Scrape clean small, dry seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of the priming coat.

g.) After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

h.) Sand surface after prime coat has dried and between coats of finish paint to produce a smooth uniform finish.

3.) Shop Primed Metal: Hand or power tool clean field connections, welds, burned and abraded areas to remove rust and contaminants and touch up with compatible primer before further rusting occurs.

4.) Ferrous Metals: Remove loose rust, mill scale and other foreign matter by hand or power tool cleaning and apply specified prime coat before further rusting occurs.

5.) Galvanized Steel: Remove protective mill coating by solvent cleaning.

6.) Non-Ferrous Metals: Clean surface with mineral spirits.

7.) Gypsum Drywall:

a.) Sand joint compound smooth and flush with the surface using fine grit sandpaper.

b.) Fill nicks, scratches and uneven spots with spackling compound and after dry, sand flush with the surface.

8.) Interior Concrete and Masonry Units: All surfaces must be clean and dry. Prepare surfaces with a brush-off blast or acid etch. Apply epoxy filler.

C.) Material Preparation and Application:

Mix and prepare painting materials in strict accordance with the manufacturer's directions. Apply paint by brush, roller, spray, or other acceptable practice in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required.

D.) Protection:

Protect work of other trades, whether to be painted or not, against damage by the painting and finishing work. Leave all such work undamaged. Correct any damages by cleaning, repairing or replacing and repainting, as acceptable to the Owner.

Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

E.) Cleanup:

During the progress of the work, remove from the site all discarded paint materials, rubbish, cans, and rags at the end of each work day. Upon completion of painting work clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

F.) Painting Schedule:

Paint surfaces per paint/finish schedule on drawings.

1.) Verify with Engineer which specific surfaces are to be painted prior to painting. Surfaces not to be painted include:

a.) Items with factory applied final finish
b.) Concealed ducts, pipes, conduits and surfaces
c.) Exterior concrete surfaces
d.) Aluminum finishes, stainless finishes
e.) Rigid galvanized electric conduits

2.) Painting Schedule

Surface to be Painted	Sherwin-Williams Industrial Coating (or approved equal)
a.) Wood (interior)	1st coat – Sher Tile High Solids Epoxy 4.0 mils. 2nd/3rd coats – Sher Tile High Solids Epoxy 4.0 mils.
b.) Steel (dry areas) doors, windows, etc. (Ferrous Metals)	1st coat – Kem Bond HS Metal Primer (2-5 mils) (B5ONZ3, B5OWZ4) 2nd/3rd coats – Industrial Enamel HS (2-4 mils each) (B54WZ400)
c.) Steel (wet areas) tanks, pipe stands, etc.	1st coat – Recoatable Epoxy Primer (4-6 mils) 2nd/3rd coats – Sher Tile High Solids Epoxy (4-8 mils each) (B67W200 Series/B60V200)
d.) Ductile Iron Pipe	1st coat – Xymax Monolock PP (1.5-2.0 mils dry film thickness) 2nd coat – Xymax Maxcoat A (2.0-2.5 mils dry film thickness))
e.) PVC Pipe	Do not paint.

DIVISION 11
EQUIPMENT

SECTION 11001
EQUIPMENT - GENERAL

11001.01 GENERAL

Furnish, install and test all equipment specified in the contract documents.

11001.02 QUALITY ASSURANCE

Provide only new equipment of proven reliability and performance. Acceptable manufacturers are listed for each piece of equipment specified. Certificates, patents, licenses, and other required legalities are specified where applicable for each piece of equipment.

11001.03 SUBMITTALS TO THE ENGINEER

Attention is called to the Shop Drawings and Submittals sections of the General Conditions and of Division 1. Manufacturers' literature and illustrations shall be submitted on all equipment to be installed. Installation instructions, operating data, operating manuals, and maintenance data shall also be submitted.

11001.04 GUARANTEE

Submit the equipment manufacturers' warranty to the Engineer for approval. All materials and workmanship shall also be warranted as specified in the General Conditions.

11001.05 MATERIALS

All standard recommended spare parts, as indicated in the manufacturers' instruction manuals shall be provided for each piece of equipment.

11001.06 DELIVERY, STORAGE AND HANDLING

Deliver equipment according to manufacturers' detailed instructions and/or as specified within the appropriate applicable sections of the specifications.

11001.07 INSPECTION

All equipment will be inspected by the Engineer, the Contractor, and the manufacturers' representative to determine the condition. See the appropriate section for the details of inspection for the various pieces of equipment.

11001.08 INSTALLATION AND ADJUSTMENTS

Install all equipment in accordance with the manufacturers' requirements. Install equipment under the direct supervision of a manufacturer's representative when specified. All equipment shall be checked and adjusted for proper operation and alignment.

11001.09 POTABLE WATER CONTACT

All components and materials that will be in contact with the finish water when the project is complete shall be certified to be in compliance with ANSI / NSF Standard 61. This includes but is not limited to piping, valves, fittings, pumps, tanks, meters, and other appurtenances, etc.

SECTION 11400
PRESSURE TRANSDUCERS

11400.01 GENERAL

Furnish and install the pressure transducers and accessories as specified in the contract documents. Submit a copy of the manufacturer's warranty to the Engineer. The transducers shall carry a minimum 1-year warranty.

11400.02 EQUIPMENT

A.) Well Transducer: Pressure transducer shall be:

- Constructed of stainless steel
- Loop powered
- 4-20mA @ 24VDC
- Range as specified
- Accuracy ±0.25% of full scale or better
- Operating temperature 0-150°F
- Maximum Diameter of Submersible Transducer = 3/4 inches
- Supply with vent tube and super dry vent filter
- Transducers shall have surge protection and Life-Time Surge Warranty
- Well transducer shall be KPSI 320 or approved equal
- Provide Model 3019 digital readout with 4-20ma retransmission to EtherTrak 2

Location	Number	Range	Other
Well	1	0-60 feet	Submersible with 100' of cable

11300.03 INSTALLATION

Install as shown on the plans and according to the manufacturer's latest recommendations. Provide with isolators and surge protection as shown and recommended by manufacturer.

Install twisted shielded pair (#16 AWG min.) in conduit from transducers to digital displays and from digital displays to existing EtherTrak 2.

SECTION 11710
CHEMICAL FEED SYSTEMS

11710.01 GENERAL

The chemical feed systems include the pumps and accessories specified for the feeding of caustic soda and Seaquest polyphosphate blend. Furnish and install the chemical feed systems as specified herein.

11710.02 MATERIALS

Caustic Soda Pump - Chemical feed pump shall be Gamma XL manufactured by ProMinent Fluid Controls, Inc. Pump shall be suitable for caustic soda, 25% solution. Pump shall deliver up to 8 gph at 120 psi. Suction line and a foot valve shall be supplied with each pump. Discharge tubing from pumps to injection nozzle shall also be supplied and installed.

Seaquest Pump - Chemical feed pump shall be Gamma XL manufactured by ProMinent Fluid Controls, Inc. Pump shall be suitable for Seaquest, 3% solution. Pump shall deliver 5 gph at 120 psi. Suction line and a foot valve shall be supplied with each pump. Discharge tubing from pumps to injection nozzle shall be supplied and installed.

Accessories -

1.) Polyethylene Day Tank - 50 gallon capacity tank with cover assembly, Model No. 26350 as manufactured by LMI or equal. Two solution tanks with cover shall be supplied and installed.

2.) Caustic Soda Bulk Storage Tank – 500 gallon capacity vertical tank with cover and bulkhead fittings as manufactured by Norwesco or equal. One bulk storage tank shall be provided.

3.) Caustic Soda Level Sensor – Ultrasonic level sensor with 4-20ma and relay output equal to The Probe as manufactured by Siemens.

4.) Caustic Soda Transfer Pump – Transfer pump for caustic soda rated for 12 GPM at 12 feet TDH, TE-5C-MD as manufactured by March Mfg. Co. or equal. One transfer pump shall be provided.

5.) Corporation Stop and Nozzle Assembly - Model No. 10998 with injection check valve and cable assembly as manufactured by LMI or equal. Three corporation stop and nozzle assemblies with injection check valves shall be supplied and installed (one for future chlorine).

6.) Self degassing closing head, if required.

7.) Suction Tube Shield - Model No. 10458 as manufactured by LMI or equal. Two suction tube shield shall be supplied.

8.) Splash Guard - Model No. 10583. Two splash guards as manufactured by LMI or equal shall be supplied and installed.

9.) Flow Indicators – Model FM 200 as manufactured by LMI or equal. Two flow indicators shall be supplied and installed.

11710.03 INSTALLATION

Install as shown on the plans and according to the manufacturer's latest recommendations. A representative of the manufacturer shall be present during installation and start-up.

SECTION 11816
ELECTROMAGNETIC FLOW METERS

11816.01 GENERAL

Furnish and install the electromagnetic flow meter and accessories as shown on the plans and as specified herein. Meters used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects.

11816.02 MATERIALS

The electromagnetic flow meters shall utilize electromagnetic induction to measure fluid flow through the meter. The meter shall include a detector through which the fluid flows and which produces a low-level electrical signal proportionate to the flow rate. The meter shall also include a converter that supplies excitation current to the detector and which amplifies the signals from the detector and processes them into a 4-20 mA DC current signal proportional to fluid flow. Meter shall have passive (non-powered) 4-20 mA output, or a loop-powered isolator shall be provided.

Electromagnetic flow meters shall be EPDM lined and shall be Siemens MAG 5100W with direct mounted Sitrans FM MAG 6000 transmitter in polyamide enclosure or approved equal. Provide one relay output for chemical feed pump control.

Provide meter designed for remote detector and converter installation. Magmeter detector shall be IP68 rated for complete submergence.

Meter end connections shall be as shown on the plans, either wafer or flanged. Provide grounding rings, as required.

Provide flow meter with excitation and signal cables as recommended by manufacturer.

11816.03 INSTALLATION

Install the flow meter detector and converter as shown on the drawings and according to the manufacturer's latest recommendations. All conduits and connections shall utilize waterproof flexible conduit for connection from rigid conduit to converter for both 120 VAC and signal. Provide services of manufacturer's representative to start up, program, test meter and confirm proper operation.

SECTION 11826
ON-LINE MONITORING EQUIPMENT

11826.01 GENERAL

Furnish and install the on-line monitoring equipment as shown on the plans and as specified herein. The pH monitoring system shall consist of an electronic monitor housed in a NEMA 4X enclosure suitable for wall, pipe, or panel mounting, a differential-style pH sensor, and accessories listed below. The pH Monitoring System shall be ATI Series Q45P/Q25P as described below.

11826.02 MATERIALS

pH Monitor –Unit shall provide for continuous measurement (and 4-20 mA outputs) for pH and ORP. Provide unit with all recommended spare parts.

The pH sensor shall be a 1" NPT, dual-electrode design. The reference electrode shall be fully sealed in a glass to prevent contamination of the reference element. The reference chamber of the sensor shall be fully serviceable by removal of the saltbridge and replacement of the reference chamber solution.

The sensor shall be constructed of molded PEEK (poly-ether-ether-keytone) components. These components include the saltbridge, body, all rear seal components, and all internal components. The body shall be hex shaped to facilitate quick connection to standard 1" NPT fittings. The sensor shall include a titanium ground electrode to improve signal stability and enable electrode breakage diagnostic functions to be performed. The sensor shall include a Pt1000 RTD for high accuracy temperature measurements. The sensor shall include an integral preamplifier to provide a low impedance signal output capable of being driven 3000 feet with standard sensor cabling. The sensor preamplifier shall contain features to monitor for electrode breakage and sensor seal failure. The integral electronics shall be encapsulated into the sensor.

The sensor shall include a highly chemical resistant, cross-linked polyethylene jacketed cable. The sensor cable shall contain two foil shields for optimum electrical performance.

The sensor saltbridge shall be a high capacity, dual-junction, high-capacity device. The saltbridge shall be completely replaceable

The pH Monitor electronic assembly shall be a loop-powered 2-wire instrument providing an isolated 4-20 mA output proportional to pH into a maximum load of 500 ohms.

The pH monitor electronic assembly shall provide a variety of functions as follows.

1. Provide user selectable display of pH, process temperature, or PID % output on the main display. Main display variable shall be indicated with a minimum character height of 0.75" to allow easy readability up to 20 feet away.

2. Provide the ability to use the 4-20 mA output for PID control. Proportional, Integral, and Derivative functions shall be user adjustable, and also provide for output hold when needed.

3. The transmitter shall allow the 4-20 mA output to be set to any two points within the measuring span of 0-14 pH, as long as the points are at least 2 pH units away from each other. The points may also be reversed. The transmitter shall allow the user to place a delay on the reaction time of the output and display. Typical Specification TS/Q45P (03/14)

4. Provide output hold and output simulate functions to allow for testing or remote receiving devices or to allow maintenance without disturbing control systems.

5. The transmitter shall contain calibration functions for 1-point (sample or buffer) and 2-point calibration for pH. The user shall be able to easily override the automatic buffer recognition values and manually enter values if desired. Calibration stability monitors shall be provided to hold calibration status until stable buffer conditions have occurred.

6. Diagnostic functions shall be incorporated into the transmitter. The 4-20 mA output shall be capable of being assigned to safely rise to 20 mA, fall to 4 mA, or be left alone, during diagnostic failures. Diagnostic error messages shall be displayed in clear language; no confusing error codes shall be displayed. The complete pH Monitor shall be an Analytical Technology Inc. Model Q45P/Q25P, or approved equivalent

11826.03 INSTALLATION

Install units as shown on the plans and according to the manufacturer's latest recommendations. Provide services of manufacturer's representative during start-up.

Provide shielded twisted pair in conduit from pH meter to EtherTrak2 and from magnetic flow meter to EtherTrak2.

SECTION 11853
SECURITY AND FIRE ALARM SYSTEM

11853.01 GENERAL

Furnish, install and test all components of the new security and fire alarm system as specified in the contract documents.

11853.02 MATERIALS

A.) Control Panel -- The security/fire alarm control communicator panel shall be installed in the pump station as shown on the drawings. The control communicator panel shall be Morse microprocessor Model MDC-8 or approved equal. Any mounting hardware required to install this panel shall be included. The system shall have back-up battery power (min. 6 hours) and charger.

B.) Personal Control -- Alphanumeric personal control shall be Morse Model MPC-32 DL or approved equal. This panel shall be installed as shown on the drawings.

C.) Accessories

1.) Infrared/microwave sensors shall be DSI, Inc. Model 774-TI or approved equal. One sensor shall be installed in the operation room and one in the maintenance area as shown on the drawings.

2.) Door contacts shall be Sentrol wide-gap sensors. One sensor shall be installed on the garage overhead door and one on the exterior door.

3.) Smoke/heat detectors shall be installed in the operations room and the maintenance area. These detectors shall be combination smoke and heat detectors and shall be located as shown on the drawings.

11853.01 INSTALLATION

Install the security and fire alarm system in the locations shown on the drawings. Comply with all local and State code requirements. The entire system shall be tested by the installer and the operation of the system shall be reviewed with the Owner.

DIVISION 15
MECHANICAL

SECTION 15001
POTABLE WATER CONTACT

15001.01 GENERAL

All components and materials that will be in contact with the finish water when the project is complete shall be certified to be in compliance with ANSI / NSF Standard 61. This includes but is not limited to piping, valves, fittings, pumps, tanks, meters, and other appurtenances, etc.

SECTION 15110
DUCTILE IRON PIPE & APPURTENANCES

15110.01 GENERAL

Furnish, install and test all ductile iron pipe, fittings and appurtenances installed in buildings, vaults and tanks as specified in the contract documents. Materials used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects.

15110.02 MATERIALS

A.) Pipe:

Pipe shall be ductile iron, double cement lined, shop primed and of the appropriate lengths necessary. Pipe shall be in full conformance with AWWA C151 and AWWA C111 and AWWA C104. All pipe shall be flanged unless indicated otherwise on the drawings. Flanged pipe shall be Class 53.

B.) Fittings:

Flanged pipe fittings shall be ductile iron Class 250 and shop primed. Fittings shall be in accordance with AWWA C110 for radii of curvature and AWWA C104 for cement lining. Fittings shall have 125 lb. faced and drilled flanges in accordance with ANSI B16.1. Bolt holes on flanges shall be foundry drilled to allow alignment of fittings as shown on plans.

C.) Gaskets & Bolts:

All gaskets for flanged pipe shall be of the ribbed type. All bolts and nuts for flanged pipe and fittings shall be stainless steel. Utilize approved thread lubricant (never seize) to prevent galling of stainless threads.

D.) Wall Pipes:

Wall pipes of the sizes and dimension shown on the drawings shall be provided. Wall pipes shall have welded waterstops and shall be tar-coated when one end of the pipe will be buried.

E.) Omni-Sleeves:

When shown on the drawings, Omni-Sleeve ductile iron waterstop anchor rings shall be installed in concrete walls. Omni-Sleeves shall be furnished with ductile iron sleeve pipes of the appropriate length. Mechanical joint restraint used with Omni-Sleeves shall be One-Lok. Omni-Sleeve and One-Lok are by Sigma/Nappco.

F.) Flange Adapters:

All flanged pipe shown on the drawings shall utilize foundry-installed flanges, except where shown as RFCA (restrained flange coupling adapters). RFCA shall be used where shown. RFCA shall be ductile iron with ductile iron bolts. RFCA shall be Romac RFCA, or approved equal.

G.) Gate Valves:

When shown on the drawings, gate valves shall be furnished and installed. Gate valves for non-buried service shall be resilient seat type flanged, OS & Y (unless specified on the plans as NRS). The body and bonnet shall be ductile or cast iron and shall conform in thickness to those listed for gray iron in the applicable AWWA gate valve standards. The valve stem root diameter shall meet or exceed AWWA C-500 and the valve shall have a bronze thrust collar bushing. Valves shall have heat fusion bonded epoxy coating inside and out. Handwheels shall be provided. Valves shall open left. Acceptable manufacturers are:

Clow R/W
Metroseal 250 RS
Approved Equal

H.) Butterfly Valves:

When shown on the drawings, butterfly valves shall be furnished and installed. Butterfly valves shall conform to AWWA C504 for Class 150B. Valve bodies shall be cast iron short body design with 125 # flanged ends. Discs shall be offset and shall be ductile iron. Seating edge shall be 316 SS. Valve shaft shall be 304 SS and seat shall be Buna N. Valves shall be painted inside and outside and factory tested per AWWA C504.

Provide with 10 position locking manual lever actuators. When specified, valves shall have rotary manual actuators with handwheels.

Butterfly valves shall be Dezurik BAW or approved equal.

I.) Pipe Supports:

Pipe supports shall be as shown on the contract drawings.

J.) Saddles:

Chemical injection taps and other small connections shall utilize saddles. Saddles shall have ductile iron (65-45-12) body and double u-bolt type. Straps shall be 304 (18-8) SS with Teflon-coated threads. Saddles for use on PVC pipe shall be double strap pre-formed at the factory to the exact pipe size to avoid overstressing the pipe during installation.

K.) Plug Valves:

Plug valves shall be eccentric and 3-way plug valves by DeZurik or equal. Valves shall have 125 lb. flanges, cast iron construction, single lever handle and resilient plugs.

L.) Other Appurtenances:

The following items are specified elsewhere in Division 15, if applicable:

Check Valves
Hydraulic Operated Valves
Air Release Valves
Meters
Static Mixers

15110.03 INSTALLATION

Install all pipe and appurtenances as shown on the drawings per AWWA specifications and according to the manufacturer's latest recommendations.

15110.04 PAINTING FLANGED PIPE

Flanged pipe and fittings installed in interior locations shall be painted as follows:

-- 1st Coat -- XymaX Mono-Lock P.P. (Penetration Primer) 1.5-2.0 mils dry film thickness.
-- 2nd Coat -- XymaX Max-Coat A 2.0-2.5 mils dry film thickness.

Install paint according to manufacturer's recommendations. Do not paint valves or fittings that have a factory applied final finish.

SECTION 15122
HYDRAULIC VALVES

15122.01 GENERAL

Furnish and install the pressure relief valve as specified in the contract documents.

15122.02 EQUIPMENT

All valves shall be manufactured by the same manufacturer. Acceptable manufactures are Cla-Val Co., Newport Beach, CA and OCV. All valves shall be of ductile iron construction.

A.) 3" PRESSURE RELIEF VALVE - The 3" PRV shall be Cla-Val Model 50-01 Angle Type or approved equal.

The valve shall have screwed assemblies and all iron castings shall be coated on all sides with at least two coats of a rust inhibiting synthetic resin and asphaltum enamel. The valve trim shall be 303 stainless steel and the adjustment range shall be 20-200 psi. The valve shall be supplied with isolation valves and an opening speed control. Valve shall be supplied with a delrin sleeve stem.

15122.03 INSTALLATION

Install the valves as shown on the plans and according to the manufacturer's latest recommendations.

SECTION 15124
CHECK VALVES

15124.01 GENERAL

Furnish and install all check valves as specified in the contract documents. Valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects.

15124.02 MATERIALS

Check valves in ductile iron piping shall be flanged Wafer Style Silent Check Valves and shall be constructed with ductile iron bodies, brass seat and plug, stainless steel spring. The valve plug must be center-guided at both ends with a thru-integral shaft and spring-loaded for guaranteed silent shut-off operation.

The spring must be helical or conical. The seat and plug shall be hand replaceable in the field for ease of maintenance. The flow area through the body shall be equal to or greater than the cross-sectional area of the equivalent pipe size.

All materials of construction shall be certified in writing to conform to A.S.T.M. specifications as follows:

Body	Ductile Iron	Type 60-45-10 ASTM A536
Plug & Seat	Brass	ASTM B584 C83600
Spring	Stainless Steel	ASTM A313 T316
Exterior Paint	Phenolic Primer Red Oxide	FDA Approved for Potable Water

Valve shall be Valmatic Wafer Silent Check Valves or equal, as manufactured by DeZurik, Inc..

15124.03 INSTALLATION

Install the check valves as shown on the plans and according to the manufacturer's latest recommendations.

SECTION 15220
PLUMBING FIXTURES

15220.01 GENERAL

A. Furnish all labor, equipment and materials necessary to install the interior plumbing, plumbing fixtures and fittings as specified in the contract documents. Materials used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects.

B. All work shown on the drawings is intended to be approximately correct to the scale of the drawings, but figured dimensions and detailed drawings are in all cases to assume precedence over them. The drawings are diagrammatic and are not intended to show every detail of construction or the exact location of fixtures. Where construction makes it advisable or necessary to change the location of fixtures, the Subcontractor shall perform such work without cost to the Owner on written request of the Engineer. Any doubt as to the intended location of equipment shall be resolved by the Engineer before proceeding with the installation.

C. All plumbing work shall be performed by a duly licensed plumber or under his direct supervision.

D. Comply with all pertinent standards, codes and regulations (including the State Plumbing Code).

15220.02 MATERIALS

A. Domestic water valves shall be ball valves unless otherwise specified. Ball valves shall have brass body and ball. Interior hose bib shall be standard boiler drain units.

B. All water pipe for domestic plumbing shall be Type L copper of the sizes shown on the drawings. Minimum size shall be 3/4" except feeds to individual fixtures may be 1/2". All fittings shall be sweat with lead-free solder.

C. Domestic water pipe insulation shall be Polyethylene Therma-Cel Insultube (1/2" insulation wall thickness) or approved equal (Grainger). Seal insulation with contact adhesive.

15220.03 INSTALLATION

Install all fixtures in accordance with the manufacturer's recommendations. Interior piping shall be installed within interior walls where possible. When necessary to serve plumbing fixtures pipe shall be surface mounted to the pump station walls with appropriate hangers at 36" c/c maximum. Pipe shall be installed with runs parallel or perpendicular to walls, ceilings and structural members. Pipe shall be installed to avoid conflicts with equipment and electrical conduits.

SECTION 15315
HEATING SYSTEM

15315.01 GENERAL

Furnish and install the heating system as specified in the contract documents.

15315.02 MATERIALS

A. Electric Unit Heater -- The chemical room shall be heated with an electric unit heater. The heater model and required accessories are specified on the contract drawings.

B. Direct Vent Propane Wall Furnace -- The operation room and maintenance area shall each be heated by a direct vent propane wall furnace. Furnaces shall be Model DV-25-1SG, or approved equal, as Manufactured by Empire Comfort Systems, Belleville, IL (1-800-851-3153). Furnace shall be rated 25,000 BTU/Hour input. Supply furnace with DRB-1 blower kits and DV-822 vinyl siding vent kits. Supply with all necessary wall collars, mounting hardware, vent pipes, supply pipes, adapters, etc.

C. Fuel Tank -- Fuel tank shall be furnished by local fuel supplier. Provide all needed copper supply piping, adapters, accessories, etc. Coordinate tank location with fuel supplier and install copper supply piping to the heaters.

15315.03 INSTALLATION

Install heating system as shown on the plans, according to the following detail and as recommended by the manufacturer. Comply with all state and local code requirements. All gas piping shall be tested.

SECTION 15341
DEHUMIDIFIER

15341.01 GENERAL

Furnish and install the dehumidifier as specified in the contract documents.

15341.02 MATERIALS

The dehumidifier shall be Oasis D-165 HG with a 35 pint/day removal capacity at 60% relative humidity at 80°F or approved equal. Included with the unit shall be a drain hose to extend from the unit to the equipment drain provided for the unit. The unit shall have a 5-year parts and labor warranty on the sealed system and a 1-year warranty on all other parts.

15341.03 INSTALLATION

The dehumidifier shall be installed per the manufacturer's latest recommendations. All manuals and warranty information shall be supplied to the owner.

SECTION 15381
LOUVERS, DAMPERS & EXHAUST FANS

15381.01 GENERAL

Furnish and install the louvers, dampers and exhaust fans as specified in the contract documents.

15381.02 MATERIALS

A.) Exhaust Fan and Appurtenances

One roof exhaust fan shall be furnished and installed. The fan shall be Domex Model DX10S as manufactured by Penn Ventilator Co., Inc., Philadelphia, PA, or approved equal. The fan is a direct drive centrifugal roof exhaust fan with a 1/25-HP motor and a capacity of 316 cfm at 0.125 inches. Provide fans with Lek-Trol variable speed controllers.

The exhaust fan shall come equipped with a motor-operated backdraft damper with disconnect switch. The exhaust fan shall be mounted on sloped roof curb Model UCG by Penn Ventilator Co., Inc., or approved equal.

B.) Motor-Operated Dampers

Motor-operated dampers shall be furnished and installed in the sizes shown in the contract documents. The dampers shall be Model PCD-10S (parallel blade dampers) as manufactured by Penn Ventilator Co., Inc., or approved equal.

Damper frames are to be constructed of formed 13-gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel. Compressible spring stainless steel side seals, and synthentic or bronze bearings shall be provided. Damper blades are to be constructed with 16-gauge galvanized steel. Damper blade width shall not exceed nominal eight inches. Blades shall rotate on 3/8" square zinc plated pins. Pivots shall extend through the jam and be connected to concealed blade linkage also located in the jamb.

Provide vinyl gasket along the full width of each blade to seal mating blade surfaces. Also provide stainless steel jamb seal cushion attached to inside of jamb face to seal blades at pivot ends.

Motors shall be electric, power open, spring return type and have a rating of not less than twice the torque needed for actual operation of the damper. Motors shall provide sufficient torque to open louvers when the gen-set fan is operating at approximately 6,000 cfm. Provide adjustable stops for the open and closed positions and adjustable return spring. Damper motors shall be mounted on a base and frame compatible with the damper. The damper motors and mounting base shall not be

mounted directly on cold or insulated ducts and casings, but shall be mounted outside the insulated covering in a manner which will prevent sweating and interference with the insulation.

C.) Fixed Louvers

Fixed louvers shall be furnished and installed as shown in the contract documents. Louvers shall be extruded aluminum louvers as manufactured by Penn Ventilator Co., Inc., Model ASA, in 0.081" gauge thickness.

Head, sills and jambs shall be one-piece extruded structural members. Blades shall have continuous reinforcing bosses on underside. All fastenings shall be either stainless steel or aluminum.

Provide 1/4" aluminum expanded bird exclusion screen secured to louver with removable extruded aluminum frames on inside of louver. Bird screen shall have a minimum free area of 80% of gross area. All louvers shall have mill finish.

Louver, Damper, and Exhaust Fan Schedule

Location	Fan	Fixed Louver	MOD
Ceiling	Penn DX10S	N/A	
Inlet	N/A	16" x 16"	120V, 1Ph

15381.03 INSTALLATION

Installation of exhaust fans, louvers and motor-operated dampers shall be according to the plans and the manufacturer's latest recommendations. The units shall be properly caulked and sealed to protect against the weather.

SECTION 15510
FIRE EXTINGUISHERS

15510.01 GENERAL

Furnish and install the fire extinguishers and brackets as specified in the contract documents.

15510.02 MATERIAL

Fire extinguishers shall be multi-purpose dry chemical type Tri-Class "ABC" with non-corrosive nylon valve. Fire extinguishers shall have 10 lb. charge Kidde Model # XL10TCZ (Grainger Stock # 5T905), or approved equal.

Fire extinguisher shall be wall mounted with a Kidde #RB-18 heavy-duty bracket (Grainger Stock # 5T909) or approved equal.

All extinguishers shall be U.L. approved.

15510.03 INSTALLATION

The fire extinguishers and brackets shall be mounted on the walls at the approximate locations shown on the drawings and as recommended by the manufacturer and approved by the Engineer. Mounting heights shall not exceed 5 feet.

SECTION 15515
PORTABLE EYEWASH STATION

15515.01 GENERAL

Furnish and install the portable eyewash stations and accessories as specified in the contract documents.

15515.02 MATERIAL

Portable eyewash stations shall be wall mount, self contained emergency eyewash stations. Portable eyewash stations shall provide a constant flow for 15-minutes. Portable eyewash stations shall meet or exceed OSHA and ANSI Z358.1 requirements. Provide with wall mounting bracket, bacteriostatic additive, placards and complete operating instructions.

15515.03 INSTALLATION

The portable eyewash stations shall shall be mounted on the walls at the approximate locations shown on the drawings and as recommended by the manufacturer and approved by the Engineer.

DIVISION 16
ELECTRICAL

SECTION 16040
ELECTRICAL WORK

PART 1 - GENERAL

16040.1.01 GENERAL:

Furnish all labor, materials, equipment, supplies, devices, electrical apparatus, motor control centers, fixtures, and lamps and the performance of all operations necessary for the installation and/or modification of electrical facilities in and about the structure and around the grounds, as indicated on the contract documents.

Examine all other sections of the Specifications for requirements which affect the work of this Section, whether or not such requirements are particularly mentioned herein. Coordinate the work of this Section with the related work of other trades, and cooperate with such trades to assure the steady progress of all work of this Contract.

Where the National Electrical Code appears in this specification, it shall be interpreted to mean the latest edition.

16040.1.02 SCOPE:

This work shall include all costs involved in modifying power distribution at the facility and any costs involved with any other special utilities on the project, including provision of new utility service. Without limiting the work required under this specification section, the following is included:

A.) Provision of a new 1-phase electric service for Pump Station #3 from existing utility pole.

B.) 250 amp, 3-phase main circuit breaker in enclosure.

C.) 250-amp non-automatic transfer switch.

D.) 150 HP variable frequency drive.

E.) Transient voltage surge suppression with 30 amp disconnect

F.) 15 KVA 3phase to single phase transformer

G.) 120 volt distribution panel

H.) Wiring of all instrumentation, level sensors, etc. provided by other sections of these contract specifications.

I.) All conduit, wire, electrical equipment and devices, lighting, receptacles per project requirements, fully installed, connected and tested.

16040.1.03 WORK OF OTHER SECTIONS:

Refer to other Sections in this specification as appropriate.

16040.1.04 SUBMITTALS:

A.) Shop Drawings. Within thirty days after award of the Contract, submit shop drawings in accordance with the requirements of the contract and in the manner described therein. Shop drawings shall indicate specifications section and paragraph requiring equipment indicated.

Shop drawings are required on all major pieces of equipment in the following list, but not necessarily limited thereto: breakers; motor starters; contactors; relays of all types involved; push button stations; motor control center; capacitors; pull junction, and terminal boxes; disconnect switches; lighting fixtures; etc.

B.) Samples. Within thirty days after award of the Contract, submit samples of all materials requested by the Engineer. Samples shall be prepared and submitted in accordance with the requirements of the contract, all postage and transportation costs being paid by the Contractor submitting same.

C.) Record Drawings. In accordance with requirements of the contract, the Subcontractor shall furnish and keep on the job at all times one complete set of blackline prints of the electrical work, on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all building and electrical changes, revisions and additions to the work. Wherever work is installed otherwise than as shown on the contract drawings, such changes shall be noted.

The Subcontractor shall indicate on these prints the daily progress by coloring in the various apparatus and associated appurtenances as they are installed.

No approval of requisition for payment for work installed will be given unless supported by record prints as required above.

At the conclusion of work, prepare record drawings in accordance with the requirements of the contract.

D.) Operating Instructions and Maintenance Manual. The Subcontractor shall instruct, to the Owner's satisfaction, such persons as the Owner designates in the proper operation and maintenance of systems and their parts.

Furnish in accordance with contract installation, operating and maintenance manuals and forward same to the Engineer for transmittal to the Owner.

The operating instructions shall be specific for each system and shall include copies of posted specific instructions.

For maintenance purposes, provide shop drawings, parts lists, specifications and manufacturer's maintenance bulletins for each piece of equipment. Provide name, address and telephone number of the manufacturer's representative and service company, for each piece of equipment so that service or spare parts can be readily obtained.

E.) Manufacturers' Data. Within thirty days of award of Contract, the Subcontractor shall submit for Engineer's approval a complete list of manufacturers' names of all materials and equipment proposed for the project.

After approval of the above list, the Subcontractor shall submit for Engineer's approval complete detailed manufacturers' data consisting of bulletins, shop drawings, and parts lists of the materials and equipment to be furnished, as required.

Shop drawings and manufacturers' data submitted must bear the Electrical Subcontractor's stamp stating that the shop drawings and data have been checked and meet the plans and specifications before being submitted for Engineer's approval, or they will not be considered and will be returned for resubmission. If the shop drawings and data show proposed variations from the requirements of the plans and specifications because of standard practice or other reason, specific mention shall be made of such variations in the letter of transmittal.

The Electrical Subcontractor shall assume the entire cost and responsibility for any changes in the work which may be occasioned by approval of materials other than those specified.

Errors, omissions, and coordination of shop drawings shall be the sole responsibility of the Subcontractor whether or not the shop drawings are approved.

In the event that any specified manufacturer's number has been superseded by a new number since the writing of this specification, the new manufacturer's number shall be immediately submitted to the Engineer for approval. It shall be the responsibility of the Subcontractor to notify the Engineer of any superseded manufacturers' numbers mentioned in these specifications.

16040.1.05 QUALITY ASSURANCE:

A.) Applicable Standards, Permits and Codes:

The installation shall comply with all laws applying to electrical installations in effect in **Limerick, Maine**, and with regulations of any other governmental body or agency having jurisdiction, including OSHA; with regulations of the National Electrical Code where such regulations do not conflict with those laws, with the regulations of the company involved, with the telephone utility, and with ASHRAE Standard 70, as amended.

File all required notices and plans. Obtain and pay for all permits, inspections, licenses, and certificates required for work under this Section.

If any portion of the electrical plans or specifications conflict with any laws or ordinances with regard to type of materials, equipment, or fixtures to be used, the Electrical Subcontractor shall bring it to the Engineer's attention at least seven days before submitting the bid. Otherwise the cost of all work necessary to make the installation comply with said laws or ordinances shall be paid by the Electrical Subcontractor and shall become a part of this Contract.

16040.1.06 EXAMINATION OF SITE AND CONTRACT DOCUMENTS:

Before submitting prices or beginning work, thoroughly examine the site and the contract documents. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and contract documents prior to executing the Contract would have revealed.

16040.1.07 DRAWINGS:

The Subcontractor shall refer to the electrical drawings and the building floor plans and details for a full comprehension of the extent and detail of the work to be performed. These drawings are intended to be supplementary to the specifications, and any work indicated, mentioned, or implied in either is to be considered as specified by both.

All work shown on the drawings is intended to be approximately correct to the scale of the drawings, but figured dimensions and detailed drawings are diagrammatic and are not intended to show every detail of construction or the exact location of equipment. Where building construction makes it advisable or necessary to change the location of equipment, the Subcontractor shall perform such work without cost to the Owner on written request of the Engineer. Any doubt as to the intended location of equipment shall be resolved by the Engineer before proceeding with the installation.

The intent is to obtain an electrical installation of all systems, complete in every detail within and about the building, and with all facilities properly interconnected with power and telephone. The Electrical Subcontractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trade practice and to the satisfaction of the Engineer. Upon completion, the electrical systems and all equipment throughout the structures shall operate properly and adequately and function as intended.

In any discrepancy between requirements of any Section, between notes on the drawings, between drawings, between details in the specifications, or between drawings and specifications, that which is in the best interest of the Owner shall apply.

Testing by Contractor: Provide equipment and personnel for operating test of electrical system.

Changes by Contractor: The contract drawings indicate the extent and schematic arrangement of the conduit and wiring systems. If changes from the drawings are deemed necessary by the Contractor, submit details of such changes within 30 days of award of Contract. Make no changes without written authorization of Engineer. Where conduit routings are not indicated, coordinate with Engineer, General Contractor, and other Subcontractors to insure no conflicts result from routings selected.

16040.1.08 ELECTRICAL REFERENCE SYMBOLS:

Standard symbols have been employed where such will meet the need. These are augmented and modified to illustrate as necessary. The chart on the contract drawings is intended to illustrate all symbols and explain the function and installation method of the device represented. When not clear, or where one has been inadvertently omitted, it shall be the responsibility of the Electrical Subcontractor to obtain a ruling on the intent before proceeding with any work.

16040.1.09 TEMPORARY POWER:

The Contractor or Electrical Subcontractor shall furnish and install temporary feeders of proper capacity power required for the building while under construction. In general, Owner's existing facility service may not be utilized for construction power. Sufficient outlets shall be installed at convenient locations so that extension cords of not over 50 feet will reach all areas requiring power.

The General Contractor and all Subcontractors shall furnish their own extension cords and such lamps as may be required for their work, and shall pay for the cost of temporary wiring of construction offices or shanties used by them and any temporary wiring of a special nature for light and power required other than that mentioned above.

16040.1.10 GUARANTEE:

A.) Contractor's guarantee for items furnished covers and includes:

- Faulty or inadequate design;
- Improper installation;
- Defective workmanship and materials.

B.) Warranties of Manufacture

- Not less than one year;
- As specified;
- As normally supplied if greater than one year.

16040.1.11 ALTERATIONS:

A.) The Subcontractor shall execute all alterations, additions, removals, relocations, or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the drawings and specifications.

B.) Remove all existing equipment to be discontinued as directed by Owner.

C.) Existing equipment to be discontinued and removed shall remain the property of the Owner and shall be carefully packed and delivered for on-site storage by the Owner.

D.) Any existing work disturbed or damaged by the alterations or new work shall be repaired or replaced to the Engineer's and Owner's satisfaction.

E.) Renovations in existing areas may not be limited to those noted in contract documents. Review of the existing building to determine the full scope of removals and/or relocations is required by the Contractor prior to bidding.

F.) Any existing wiring discontinued under this project shall be completely removed.

16040.1.12 NON-CODE CONFORMING WIRING IN SYSTEMS NOT BEING UPDATED:

A.) Any non-code conforming wiring conditions in the existing facility service and distribution and/or other wiring are not to be corrected under this contract unless noted on contract documents. If required to be corrected by code authorities, they will be handled outside the scope of this Contract.

PART 2 - PRODUCTS

16040.2.01 GENERAL REQUIREMENTS:

All materials, devices, and equipment, unless specifically excepted, shall be new.

16040.2.02 IDENTIFICATIONS:

All materials shall bear UL labels where such have been established for the particular device.

All devices shall show make, type, serial number (where applicable), voltage, amperage, wattage, motor ratings, and all other pertinent data.

All wire shall have make, type of insulation, size, and voltage rating clearly marked upon it.

16040.2.03 SLEEVES/JUNCTION BOXES/ANCHORS:

The Subcontractor shall advise the Contractor of locations for all sleeves, openings, anchors, supports, conduits, and boxes, and shall provide same so that they may be built into the job wherever feasible.

16040.2.04 ACCESS PANELS (if any):

Furnish, for installation by the General Contractor, all metal access panels required for access to services provided under this Section.

Coordinate locations and sizes of all such panels with the Contractor, subject to the Engineer's approval.

16040.2.05 CONDUITS:

A.) Exterior:

Direct buried conduit and conduit in concrete or below concrete floor slabs in earth shall be Schedule 40 PVC or rigid galvanized steel. Where steel is used, it shall be double coated with bitumastic dried at least 24 hours between coats before installation. Where PVC is used, all elbows and/or offsets shall be rigid galvanized steel. Rigid galvanized steel shall be used above grade also. Signal cable conduits shall be rigid galvanized steel only (per "C" below).

B.) Interior, Dry Locations:

Interior conduits shall be rigid galvanized steel, or intermediate metallic conduit in dry locations, installed exposed on walls or ceilings.

Fittings, boxes, and related items for interior work shall be manufactured by Steel City Electric Company, Appleton, Raco, or approved equal.

Minimum size conduit for light and power wiring, where required, shall be 3/4".

C.) Interior and Exterior, Corrosive Areas, Other Areas:

Rigid galvanized steel conduit with factory applied 40 mil PVC exterior coating and urethane interior coating.

D.) General:

The use of nonmetallic conduit or raceway within a building is not permitted.

Rigid galvanized conduit shall be manufactured by Youngstown Sheet and Tube Company, Republic Steel, or equivalent.

Liquid-tight flexible metallic conduit shall be used to tie in all motors or similar equipment. Provide minimum 2-foot diameter loop at all locations.

PVC conduit shall be Type II by Carlon Products or approved equal.

Aluminum conduit shall not be used on this project. PVC coated rigid galvanized steel conduit shall be Rob Roy Plasti-Bond Red or approved equal.

All terminations of conduits shall have smooth, rounded bushings. All conduit 1" and larger shall have insulation which may be integral with the bushing connector, or an insulated bushing may be added.

All rigid conduit joints shall be threaded. Do not use any type of clamp on fittings. All plastic joints shall be cemented or heat welded.

16040.2.06 WIRE AND CABLE:

All cable and wire shall comply with the latest requirements and specifications of the NFPA and/or the Insulated Power Cable Engineers Association (IPCEA) and shall be as manufactured by General Cable, General Electric, Anaconda, Phelps Dodge, or approved equal, unless otherwise specified or indicated.

All conductors used in the wiring system shall be soft-drawn copper wire having a conductivity of not less than 98% of that of pure copper, unless otherwise indicated or specified. All conductors shall be stranded. Solid conductors are not acceptable. Aluminum conductors are not permitted.

All wire and cable shall be stamped approximately every two feet to indicate voltage, type, temperature rating, UL listing, manufacturers' name, size, etc.

All underground conductors shall be installed in conduits. All underground conductors shall enter manholes, building walls, or termination points through a protective galvanized steel conduit sleeve of appropriate size.

All cable and wire shall be : 600 volt; installed in approved raceways or conduit; not less than No. 12 AWG (except that No. 14 AWG may be used for control wiring).

Insulation for cable and wire shall be as follows:

Wet or Moist Locations	XHHW
Feeders to Panels, other	XHHW

All internal wiring to fixtures shall be minimum, No. 14 AWG, silicon rubber insulated (150° C) with minimum 300 volt insulation.

All branch circuit wiring from panelboards to any outlet on the circuit over 50' but under 100' shall be No. 10 AWG for the first half of the circuit, over 100' but under 175', use No. 8 AWG for the first half.

The following color code shall be used for all conductors. The colors must be fast, fadeless, and capable of withstanding cleaning.

120/208 Volt (3-Phase)

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Bond	Green

Multiconductor control cables shall be approved equal to General Electric SI-58779, Flame Resistant (if any).

Multiconductor shielded cables shall be approved equal to General Electric SI-58760, #16 AWG, with individual grouping shielded.

All circuit wires shall be tagged in cabinets, etc., with 1/16" thick tags securely fastened to the conductors with a heavy type of linen wrap at time wires are pulled in and tested. Circuit numbers shall be indicated on the tags. Tags shall not be removed for any reason.

At least 8" loops or ends shall be left at each outlet for the installation of devices or fixtures in the future. All wires in outlet boxes not for the connection to fixtures at that outlet shall be rolled up, connected together, and taped.

Wires and cables shall be carefully handled during installation.

When a lubricant is necessary for pulling wires, it must be listed by UL and be of such consistency that it will leave no obstruction or tackiness that will prevent pulling out old wires or pulling in new wires or additional wires. No soap flakes or vegetable soaps will be permitted.

Conductors shall be continuous from panelboard to outlet and from outlet to outlet. No splices shall be made except within junction or outlet boxes.

Splices and tapes in wires No. 8 AWG and larger shall be made with crimp-on type connectors designed for the purpose. All connections between wires at fixtures and boxes shall be made with UL approved 600 volt pressure connectors equal to ideal "Wire-Nut" or "Wing-Nut" (for general lighting and receptacle circuits, only -- See 2.12).

Type NM, NMC, AC, MC, or similar cables shall not be permitted on this project. All wiring shall be installed in conduit.

All conductors and connections shall be free of grounds, shorts, and opens.

16040.2.07 OUTLET BOXES:

All boxes shall be held to wood surfaces by wood screws. On metal surface, boxes shall be held by metal-to-metal screws or by machine bolts.

All boxes shall be mounted exposed in the buildings and shall be cast metal type with integral threaded hubs, or where indicated as NEMA 4X. In corrosive areas boxes shall be Rob Roy Plasti-Bond Red (style similar to Crouse Hinds FS or FD).

16040.2.08 PULL BOXES AND JUNCTION BOXES (non-corrosive areas):

Pull boxes, cabinet boxes and junction boxes shall be constructed of code gauge galvanized sheet metal of not less than the minimum size recommended by the National Electrical Code. Boxes shall be furnished with screw-fastening covers. Where several feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number and panel designation. Where pull boxes must be used in finished areas, the Engineer shall be consulted for the location, style of cover, and finish of box. The location shall always be as inconspicuous as possible. Where shown on the drawings, sizes of pull boxes, terminal boxes and junction boxes shall be followed or next larger standard trade size shall be used. Add pull boxes when such are deemed advantageous. Where required due to length of exterior or underground conduit runs, underground cast concrete shall be provided, per details on contract drawings.

NOTE: Those installed in corrosive areas shall be stainless steel or non-metallic with stainless hardware.

16040.2.09 PULLING CABLES:

All raceways are to be equipped with conductors. Swab all conduit before cable is drawn into them. Any crushed raceways shall be replaced before drawing in cable. Where cable pulling compounds are required, materials specifically intended for that purpose may be utilized.

16040.2.10 DISCONNECTS:

Where shown on the drawings, or when NEC required whether or not shown, install disconnect switches appropriate for the application. When serving motors, they shall be motor rated. Those for equipment (if any) outdoors shall be in rain-tight enclosures, or as otherwise indicated on contract drawings.

Switches shall be heavy duty, quick make and break type. They may be non-fused by a solid copper bar, silver-plated, heavy duty on motors over 2-HP. For small motors (1/8-HP and less), a toggle switch, motor rated, may be used; otherwise, they shall be similar to Square D Type HU. Where NEMA 4X switches are noted they shall have "krydon" enclosures. Manual starters with overload protection built in are approved when NEC acceptable.

16040.2.11 OVERCURRENT PROTECTION SERVICES:

Overcurrent protection for motors is to be in the starters. There is to be protection in each phase wire. Overcurrent protection of conductors is by thermal and magnetic molded case circuit breakers in the panelboards. Where combination starters are used, the breaker is to be a motor circuit protector with only magnetic trips. These must be supplied from a branch circuit protected by a thermal and magnetic trip breaker.

16040.2.12 WIRE CONNECTORS AND DEVICES:

All wire joints shall be made with a pressure squeezed connector such as T & G Sta-kon and Ideal, or bolted clamp such as made by Dossert. Twist-on type wire nuts are also permitted for general lighting and receptacle circuits, only. Make up to terminals shall be mechanical squeeze connector. Wherever only a screw connector is available, install a conductor terminal like T & G Sta-kon spade or donut and designed for the application and compression set to the conductor.

Cover all joints made with non-insulated clamp devices with Scotch brand plastic electrical tape. Type #88 may be used at any joint and shall be used whenever the temperature of joint or the room is below 50°F. In the summer, or when temperature is above 60°F, new type #33 plus may be used. Triple wrap joints, each wrap having a 50% overlay.

16040.2.13 SWITCHES AND PLATES:

Switches shall be specification grade, 20 amperes at 120/277 volts, with ivory handle, such as Bryant 4901-I, for SPST applications. For three-way use No. 4903-I, and for four-way use 4904-I. All switches shall have clamp type terminals screw set.

Mount all switches vertically, wall-flush, and at a height of 4'-0", adjusted to minimize cut of tile or masonry unit, unless otherwise specified.

All switches must have machine screw held wire and be back wired. Automatic grips will not be permitted. All switches must be classed as heavy duty.

All flush plates are to be smooth-line nylon, one piece construction for all grouped switches, or Mulberry equivalent. On surface boxes they shall match the box style for the device installed.

Plates in corrosive areas shall be non-metallic, NEMA 4X rated.

Switches and plates shall be a product of Bryant or Hubbell.

16040.2.14 CONVENIENCE AND OTHER OUTLETS AND PLATES:

Convenience outlets shall be duplex, specification grade, ivory face, side wired binding screw type, two-pole, three-wire, rated 20 amperes at 120 volts, Bryant 5362-I or equal. Use Bryant ivory nylon plates or equal. Mount all outlets a minimum of 24" AFF. Where single outlet unit is indicated, use Bryant #5361-I.

Where "GFI" receptacles are indicated on drawings, it is the intent that ground fault protection be provided by individual Class A, 20 ampere, 120 volt, GFI receptacles for each device shown, equal to Bryant GFR53FT-I.

Outdoors and elsewhere as shown, use weatherproof covers, Hubbell 5206 or equal, with double covers, spring held gasketed. Mount the outlet horizontally.

Corrosion resistant receptacles (for chemical feed pumps) shall be approved equal to Bryant 5361-CR, NEMA 5-20R, with non-metallic enclosure and weather protective polycarbonate cover #7418-B by Bryant.

Automatic grip set outlets are not permitted.

On exposed FS and FD boxes, use cast feraloy covers matching the box or stainless steel as above, if styled for the box. Outdoor and in damp locations, use twin spring loaded weatherproof covers, Bryant 4500 FS or equal.

Outlets and plates shall be a produce of Hubbell or Bryant.

16040.2.15 MOTORS:

These specifications relating to motors and motor control apply to all motors and controls furnished by this Section or any other Section.

Each section supplying motor drive apparatus will be responsible for supplying an electric motor of sufficient size for the duty performed. These shall not be oversized beyond a

normal safety factor, except that standard design ratings for next above motor size required will be used. Unless otherwise specified, all motors shall have open frames, Class A insulation and continuous duty classification based on a 40°F ambient temperature of reference.

Motors ½-HP and larger shall be, and those smaller may be, 208 volts, three-phase, 60 Hertz. Motors 1/3-HP and smaller shall be 120 volts, single-phase, 60 Hertz.

Motor Control: Each motor, or group of motors, requiring a single control shall be provided with a suitable controller and devices which shall perform the functions as specified for the respective motors in other sections of these specifications. All controllers shall conform to the adopted standards and recommended practices of the Industrial Control Standards of the National Electrical Manufacturers Association and the Standards for Industrial Control Equipment of Underwriters' Laboratories, Inc.

Thermal Overload Protection: Each motor shall be provided with an overload protective device, integral with either the motor or controller. Unless otherwise specified, the protective device shall be of the manually reset type. Manual controllers for motors shall be specifically designed for the purpose, and shall have a HP rating adequate for the motor. Automatic control devices such as thermostats or floats are satisfactory, provided they are designed for that purpose and have an adequate HP rating.

16040.2.16 ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM

The Subcontractor shall furnish all labor, materials, etc. necessary for a complete approved electrical service as required by the structure, including inspection and approval by the utility and local inspection departments.

The Subcontractor shall notify the utility company in writing, with a copy to the Engineer, no later than ten days after signing construction contracts, as to when the building power service will be required.

16040.2.17 OVERHEAD:

Overhead service shall comply with all the requirements of the National Electrical Code, National Electrical Safety Code, local utility company, and local enforcing authority.

Secondary service shall be cable in rigid galvanized conduit riser at building, as directed by utility, and rigid galvanized conduit to service entrance equipment.

16040.2.18 PRIMARY POWER SERVICE:

The Owner shall pay in full for any and all primary power line costs as charged by the local utility. These shall not be included in the bid.

16040.2.19 METERING:

Electrical Subcontractor shall furnish and install all equipment and meter trim for metering, in accordance with utility company requirements, except that the utility meter will be provided by the local utility. Any required meter transformer enclosure is to be provided by the Electrical Subcontractor, to local utility standards.

Where the local utility does not provide the meter sockets, the Electrical Subcontractor shall provide them to the local utility's specifications.

Any utility charges for poles, service cable, meters, etc., in connection with the provision of the temporary and/or permanent building power shall be paid in full by the Electrical Subcontractor under this Section; this does not include the cost of temporary power use as covered elsewhere or the cost of primary line extension covered in Item 2.19 of this Section.

16040.2.20 PANELBOARDS:

Panelboards shall be provided with main lugs or main breakers and branch circuit breakers, according to the schedules on the drawings.

The general requirements for the panels are shown on the drawings including mounting and gutters. Mount the panels 6'-6" up to top of roughing cabinets. Gutters shall not be less than 5". Breaker frame size is shown on the drawings. Handle ties will not be permitted anywhere. Multi-pole breakers shall have common trip and one handle.

All breakers shall be trip-free, suitable for switching, and thermal magnetic. All breakers shall be bolted to bus type secured in place by holding bolt. "Space" means provisions for adding breakers. Breakers or busses shall contain terminations or tappings designed for these attachments. All points of contact between bus and sub-bus shall be of copper, full silvered between all contact surfaces. All breakers shall have an interrupting capacity of 22,000 amperes at 240 volts AC (symmetrical RMS amperes).

Provide a typewritten tabulation indicating fixture outlets, devices, machines, or apparatus served by each breaker and their room location. This shall follow coding on the drawings with breakers numbered from top to bottom. Mount tabulation inside the door in a frame for the purpose, with a transparent plastic cover.

Where existing panels are indicated to be replaced, provide new panel with breakers that match those in the existing panel regarding amperage and poles.

All panelboards shall be manufactured by Square D, or approved equal.

This specification is to cover panelboards in Motor Control Centers, also.

16040.2.21 BALANCING OF LOADS:

The Contractor shall balance all loads between phases in all panels, etc., around the neutral. Neutral conductors shall be the same size as phase conductors unless specifically noted otherwise. No common neutrals will be permitted.

All circuits shall be distributed among the phases so as to restrict any phase load imbalance to less than 10% at any panelboard.

After completion of the installation, record under full load conditions the current flow in each phase feeder. Submit four copies to the Engineer giving name and location of each panel, etc.

Circuit members assigned to home runs and devices on the drawings are for purposes of indicating individual circuits and are intended to correspond with the circuit numbers in the panels. The panelboard directory shall designate each circuit and its associated load. If the numbers deviate from the drawings, the as-built drawings shall reflect this.

16040.2.22 LIGHTING FIXTURES:

The lighting fixtures listed on the drawings are to indicate quality, appearance, lamping and photometric characteristics acceptable. Alternative fixtures may be proposed for the project where they provide the equivalent characteristics, quality and appearance, and subject to Engineer approval.

16040.2.23 LAMPS, BALLASTS AND ACCESSORIES:

Except as otherwise specified, all fluorescent ballasts are to be for rapid start lamps and power factor corrected to approximately 95% lagging. All ballasts shall carry E.T.L. approval, and where available in the type needed, shall carry an "A" sound rating. All ballasts shall be super premium, low energy type, Advance Mark III or approved equal.

Fluorescent lamp ballasts shall be so mounted as to avoid amplifying hum, and any ballast which, within one year, develops a hum considered excessive by the Architect or the Engineer, shall be replaced free of charge with another of a noise level considered satisfactory by the Engineer.

All lamps shall be color and type specified. Incandescent lamps shall be for 125 volt service. They shall be the product of General Electric, Sylvania or Westinghouse, and be so labeled. Fluorescent lamps shall be low energy type.

16040.2.24 TELEPHONE:

Not used

16040.2.25 EMERGENCY LIGHTS:

Provide emergency lights per contract drawings.

16040.2.26 WIRING OF MECHANICAL AND OTHER EQUIPMENT:

The Electrical Subcontractor shall wire all power to, providing and installing local disconnects for, all mechanical equipment and equipment by other trades or this section per contract drawings. This shall include but not be limited to:

- Exhaust fans, heaters, dampers, etc.
- Pumps, pump control valves, etc.

NOTE: Review plans and specifications for all sections providing equipment to be wired to determine special wiring or control requirements to be provided for such under this specification section.

NOTE: Exhaust Fans, including motor operated dampers, are provided by the Mechanical Subcontractor.

16040.2.27 TRANSFORMERS:

NEMA ST20, general-purpose, dry-type, self-cooled, ventilated. Provide transformers in a NEMA 1 enclosure. transformer shall have 220°C insulation system with a temperature rise not exceeding 150°C under full rated load in a maximum ambient of 40°C. Transformer shall be capable of carrying continuously 115% of the nameplate kVA without exceeding the insulation rating. This shall include any built into motor control centers.

16040.2.28 FUSES :

A.) Provide a complete set of fuses for each fusible switch. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation; submit coordination data for approval. Fuses shall have a voltage rating not less than circuit voltage.

B.) Cartridge Fuses, Current-limiting Type (Class R): UL 198E, Class RK-1 time-delay type. Associated fuse holders shall be Class R only.

C.) Cartridge Fuses, Current-limiting Type (Classes J and L): UL 198C, Class J for 0 to 600 amps and Class L for 601 to 6000 amps.

16040.2.29 INSTRUMENTATION:

The Subcontractor under this section shall provide all conduit for and install all signal cables for instrumentation provided under all Sections of these specifications, including provision of all required 120 volt power wiring and interconnections of signal cables, alarms, etc.

16040.2.30 BUILDING LOW TEMPERATURE THERMOSTATS:

Provide low temperature alarm thermostats for alarm purposes, as shown on the drawings. Wire to plant control panel.

16040.2.31 FIRE/SECURITY ALARM SYSTEM:

Fire and security system shall be subcontracted to Brown Electric (Joe Brown 207-290-0132)

Furnish and install smoke/fire detectors, motion sensor and door switch as shown on the drawings and connect to automatic cellular dialer.

16040.2.32 BUILDING SECURITY SYSTEMS:

See 16040.2.32

16040.2.33 NAMEPLATES:

Provide black laminated nameplates with white letters to identify all panel boards, starters, disconnects, equipment panels, push buttons, etc. Plates shall be secured to outdoor equipment with epoxy glue and to indoor equipment with epoxy glue or self tapping stainless steel fasteners. Minimum letter height shall be 3/8".

16040.2.34 MOTOR CONTROL CENTER:

Not Used

16040.2.35 MAIN SERVICE BREAKER:

Provide main service breaker, NEMA 12 enclosed, with interrupting capacity as required by fault current available from serving utility, but in no case less than 42,000 amperes RMS symmetrical at 480 volts. Breaker must have instantaneous trip and be of make and model to provide UL listing protection of non automatic transfer switch as specified in Section 16620.

16040.2.36 PLANT CONTROL PANEL:

Install and connect panel as provided under a separate section of these specifications.

16040.2.37 DELIVERY, STORAGE AND PROTECTION:

The Subcontractor shall be responsible for the work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to the site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

Each Subcontractor shall protect work and material of other trades from damage that might be caused by that Subcontractor's work or workers and shall make good a damage thus caused.

PART 3 - INSTALLATION

16040.3.01 GENERAL:

The entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner.

The Subcontractor shall obtain detailed information from the manufacturer of apparatus as to the proper method of installing and connecting same. The Subcontractor shall also obtain all information from the Contractor and other Subcontractors that may be necessary to facilitate the work and the completion of the whole project.

Before installing any of the work, the Subcontractor shall see that it does not interfere with the clearances required for finished columns, pilasters, partitions, walls, and ceilings, as shown on the contract drawings and details.

Work installed by the Subcontractor which interferes with or modifies the building design as shown on the contract drawings shall be changed as directed by the Engineer, and all costs incidental to such changes shall be paid by the Subcontractor.

In any and all cases of discrepancy in figures, plans or specifications the matter shall be immediately submitted to the Engineer for decision.

16040.3.02 SITE VISITS:

The Subcontractor will be required to visit the site as the work progresses and to carefully investigate the structural and finished conditions affecting all details of the work, and shall arrange such work required to meet such conditions.

16040.3.03 CUTTING AND PATCHING:

It is the duty of the Subcontractor to furnish and install all sleeves required in the performance of this Contract and to furnish to the Contractor the size and location of all openings required on the performance of this Contract; and it shall be the duty of the Contractor to provide the required openings during building construction.

If this Subcontractor fails to provide for all sleeves and openings as required in the performance of this Contract, the Subcontractor shall instruct the Contractor, who shall do such cutting, drilling, patching and grouting and so forth necessary for the proper installation of this Subcontractor's work. The Contractor is to charge this Subcontractor for this work and it shall be done at no additional expense to the Owner.

Should the Contractor, after having been fully advised by the Subcontractor, fail to arrange for this work, the Subcontractor shall promptly notify the Engineer in writing of such failure. In the event of any disagreement between the Electrical Subcontractor and the Contractor over the foregoing, and in the absence of any written requests or agreements between the two, the decision of the Engineer shall be final.

16040.3.04 ALUMINUM CONDUITS:

Aluminum conduits shall not be installed.

16040.3.05 INTERIOR CONDUIT SYSTEMS:

Electrical Subcontractor shall coordinate with Engineer as to locations, sizes and number of conduit sleeves to be installed through cast concrete.

Exposed runs of conduit shall have supports not more than 6'-0" apart and shall be installed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of cast metal fittings or symmetrical bends. Conduit bends and offsets shall be avoided where possible, but where necessary, shall be made with an approved hickey or conduit bending machine. Conduit which has been crushed or deformed in any way shall not be installed. Expansion fittings shall be used to provide for expansion joints. Wooden plugs inserted in masonry or concrete shall not be used to secure conduits or boxes. Conduits shall be supported on approved types of stainless steel wall brackets, ceiling trapeze, straphangers or pipe straps, secured by means of toggle bolts in hollow masonry units, expansion bolts in concrete or brick, machine screws on metal surfaces, and wood screws on wood construction. Provide stainless steel hardware for stainless steel support systems. Conduit shall be installed in such a manner as to insure against trouble from the collection of condensation, and all runs of conduit shall be so arranged as to be devoid of traps wherever possible. The Contractor shall exercise the necessary precautions to prevent the lodgment of dirt, trash, or plaster in conduits, fittings, or boxes during the course of installation. A run of conduit which has become clogged shall be entirely freed of the accumulation or shall be replaced.

In corrosive areas, all clamps, fasteners, etc. shall be stainless steel or PVC coated clamps with stainless steel fasteners.

Conduits shall be securely fastened to all sheet metal outlets, junction boxes, pull boxes, and panelboards with galvanized locknuts and bushings, care being taken to establish a firm mechanical and electrical contact between the box and the conduit.

Flexible conduit shall be installed only where necessary to overcome vibration at motor connection, and shall be as short as possible between the motor terminal box and the junction box on the branch circuit rigid conduit. All flexible conduit shall be of the liquid-tight type similar to "Sealtite", with proper fittings. Provide minimum 2-foot diameter loop.

All rigid metallic conduit shall utilize threaded fittings.

Pull boxes, junction boxes and cabinet boxes shall be constructed of code gauge galvanized sheet steel of not less than the minimum size recommended by the National Electrical Code. Boxes shall be furnished with screw fastened covers. Where pull boxes are used in finished areas, the Engineer shall be consulted as to the location, type of cover, and finish of box and cover. Locations shall be as inconspicuous as possible.

16040.3.06 CONDUCTORS:

A complete system of conductors shall be installed in the raceway system, except where otherwise noted. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Compression type connectors properly taped shall be utilized for all splices.

16040.3.07 OUTLETS:

Outlets shall be installed in locations as indicated on the contract drawings. The Subcontractor shall study the general building plans in relation to the spaces surrounding each outlet in order that the work may fit the other work required by these specifications. Where necessary, the Subcontractor shall relocate outlets so that installed fixtures are symmetrically located according to room layout and will not interfere with other work or equipment.

16040.3.08 DEVICE PLATES:

Device plates shall be installed on each outlet to suit the device installed therein. Plates shall normally be installed vertically, with an alignment tolerance of 1/16".

16040.3.09 GROUNDING:

The conduit system and the neutral conductor of the wiring system shall be grounded. The grounded connection between the electric system neutral and the conduit system shall be made at the main electrical service panel. A bare copper conductor sized per NEC shall be installed in non-metallic conduit from the breaker enclosure to the entrance of the water service. Connection to the water pipe shall be made by a suitable ground clamp or a lug connection to a plugged tee. If flanged pipes are encountered, the connection shall be made with the lug bolted to the street side of the flange connection.

If non-metallic water lines are provided on the project, the ground electrode conductor shall be connected by a process approved equal to "Cadweld" process to copperweld ground rods, 3/4" diameter by 10 feet long. Provide certified test of recognized testing agency that ground resistance does not exceed 25 ohms.

Ground wires shall be grouped and bonded to panel boxes, not to system neutrals. The ground terminal or receptacles shall be bonded to outlet boxes with No. 12 AWG bare or green insulated wire, or other suitable means per the National Electrical Code.

All electric heating equipment shall be grounded.

Conduit and/or raceway shall not be utilized as the bonding conductor.

16040.3.10 EXPLOSION PROOF REQUIREMENTS:

If encountered, equipment shall be Class I, Division I, Group D rated.

16040.3.11 PULLING CABLES:

Cables shall be installed utilizing pulling equipment designed for the types of wireways or conduits installed. Where lubricating material is required, it shall be a material manufactured for and designated by UL label as suitable for the types of insulation involved on the conductors. Care shall be taken during cable pulling not to cause kinks or sharp bends in the conductors. If insulation on conductors is cut or nicked during pulling, the conductors involved shall be removed and replaced at no added cost to the Owner. During pulling, the maximum strain applied to the conductors shall not exceed 50% of the ultimate strength of the conductors.

16040.3.12 CORROSIVE AREAS:

The areas within chemical storage or feed system equipment areas are to be considered corrosive. All conduits and equipment entering, passing through, or otherwise installed in these areas shall be NEMA 4X and/or PVC coated rigid galvanized steel with matching fittings.

16040.3.13 EXAMINATION AND APPROVAL OF WORK:

No work shall be covered before examination and approval by the Engineer and by all inspectors and authorities having jurisdiction. Replace any imperfect or condemned work with work conforming to requirements and satisfactory to the Engineer, without extra cost to the Owner. If work is covered before due inspection and approval, the Subcontractor shall pay all costs of uncovering and reinstating work.

16040.3.14 CLEAN UP AND REPAIR:

At the completion of the work, the work area shall be left clean. Any damage caused to work of other trades by electrical installation shall be repaired at the expense of the Electrical Subcontractor.

16040.3.15 GUARANTEE:

Attention is directed to provisions of the General Conditions regarding guarantees and warranties for work under this Contract.

Manufacturer shall provide standard guarantees for work under this Section. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and Subcontractor may have by law or by other provisions of the contract documents.

All materials, items or equipment and workmanship furnished under this Section shall carry the standard warranty against all defects in material and workmanship for a period of not less than one year from the date of final acceptance of the work. Any fault due to defective or improper material, equipment, workmanship or design which may develop within that period shall be made good, forthwith by and at the expense of the Subcontractor, including all other damage done to areas, materials and other systems resulting from this failure.

This Subcontractor shall guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as are set forth herein or as indicated.

Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Subcontractor.

This Subcontractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

SECTION 16101
CONTROL PANELS

16101.01 GENERAL

Furnish and install the control panels and associated equipment as specified in the contract documents.

16101.02 QUALIFICATIONS

Control panel supplier shall submit a list of 5 similar previous projects that have been completed within the last 2 years. The submittal shall include a list of references with phone numbers.

16101.03 RELATED SPECIFICATIONS

Comply with all other specifications in Division 16 - Electrical. Comply with electrical drawings and details.

Refer to Section 16212 for information on VFDs to be supplied with, and built into, control panels.

Refer to Divisions 11 and 15 for information on pumps and other equipment to be controlled by panels.

16101.04 SUBMITTALS

The control schematics shown on the contract drawings are intended to show the control/operational logic of the station controls, alarms, and monitors. Design of wiring and connection in the control panel shall be by the control panel manufacturer.

Shop drawings and submittals are required for the control panel and all its major components. Shop drawings shall include panel schematics, equipment and component submittals, manufacturer's proposed door and panel dead front layout (if applicable) (to scale with dimensions) and panel interior layout (to scale with dimensions) and nameplate schedule.

16101.05 PANEL SCHEDULE

The control panels required for this project are as follows:

Location/Description	Type	Enclosure
LAC Pump Station #3	Interior	NEMA 12 (Steel)

16101.06 MATERIALS

To the greatest extent possible use equipment from as few manufacturers as possible. All similar equipment shall be by the same manufacturer (i.e. identical switches, relays, pilot lights, etc.)

A.) Enclosures -- Control panels shall be NEMA 12 (Steel) enclosed. Panels shall have all control switches, overload resets (if applicable) and indicating equipment face mounted on the panel door.

All panels shall have hinged covers. NEMA 12 panel shall be secured with two key locking handles with cam plates. All panels shall have a padlock staple.

Panel manufacturer shall size panels for the equipment required. Panel shall include sufficient space to allow for dissipation of heat from enclosed components. Panels shall have room for future expansion and controls. A minimum of 25% of panel interior back panel shall be available for future expansion.

B.) Pilot Lights - All pilot lights shall be LED type. Pilot lights shall be wired so that they can be tested with an independent test signal from a single push-button. The wiring for this testing circuit is not shown on the contract drawings. Pilot lights shall be Cole Hersee Pl-612 series or equal. Pilot light color shall be as follows:

Description	Color
Run	Green
Alarm or Trouble	Red
Warning	Amber

C.) Wiring - The minimum size of factory installed control circuit wiring inside the panel shall be #16 AWG. Panel wiring shall be tinned copper MTW with 105°C rated insulation. The minimum size of control circuit wiring connecting to the panel shall be #14 AWG or larger, if necessary to match circuit protection. Control Panel wiring shall utilize the following colors:

Description	Color
DC+	Blue
DC-	Yellow
AC	Red
AC Neutral	White
Earth Ground	Green

D.) Terminal Strips - Panel shall be supplied with terminal strips for field connection of equipment and for all monitoring and future connections. Terminal strips shall be clearly labeled. Labels shall include the equipment or other name shown on the contract drawings as well as the manufacturer's terminal or connection number, if applicable.

Locate terminals for power connections in one area, and terminals for dry contacts/control circuits in another area. All AC line voltage terminals and connections inside the control panels shall include covers, guards or recessed screw terminals to provide "finger safe" conditions.

E.) Relays -- General purpose relays shall be heavy-duty plug-in socket-mount type. Contacts shall be rated for a minimum of 15A-120VAC. Relays shall have an LED indicating light and push-to-test button. Relays shall be full featured, DIN rail mounting and have recessed screw terminals for "finger-safe" conditions.

Time delay relays shall be identical to general-purpose relays for mounting and contact rating. Time delay shall be knob adjustable from 0.6 to 60 seconds unless specified otherwise on the contract drawings.

F.) Running Time Meters -- Not Used

16101.07 PANELS

The details and schematics for the control panels (including connections to EtherTrak 2 and accessories) are shown on the project drawings.

16101.08 ETHERTRAK 2 AND CELL MODEM

The details and schematics for the control panel at the pump stations are shown on the project drawings. Contractor shall provide ethernet switch, power supply, cell modem and antennae, all necessary relays, wiring and conduit. The Owners SCADA contractor (Mobius Automation, Mike Rioux 207-576-6189) will provide the EtherTrak 2 programming to the new devices and make any programming upgrades necessary on the districts remote SCADA computer.

16101.09 INSTALLATION

Install the panel and all associated equipment in accordance with the contract documents and as recommended by the manufacturers. Ground panel and components per NEC requirements. Provide the services of a manufacturer's representative to check the installation of the panel, to supervise its start-up and to confirm its proper operation.

If panels are wall-mounted they shall be installed using SS struts. If panels are freestanding (floor mounted) they shall be set on a housekeeping pad, per Contract Drawings.

16101.10 AS-BUILTS

The panel manufacturer shall provide as-built drawings and an updated schematic for the panels following installation and start-up.

16101.11 SPARE PARTS

Provide the following spare parts:

4 – General Purpose Relays (AC)
10 –fuses

E.) Power Supply – Panel shall be supplied with exterior 120 volt outlet for uninterruptable power supply placed on top of control cabinet. Power supply shall be APC BR1500G or approved equal.

16101.12 PUMP STATION INTEGRATION

Coordinate work with Owners SCADA integrator.

SECTION 16212
VARIABLE FREQUENCY DRIVE

16212.01 GENERAL

Furnish, install and start up the variable frequency drive, accessories and controls as specified in the contract documents.

16212.02 MATERIALS

A.) Variable Frequency Drive (VFD) - VFDs shall be Toshiba AS3 Series or equal.

The specifications and features of the AS3 Drive shall be the minimum acceptable standard.

The drives should be a PWM (Pulse Width Modulated) transistorized inverter with fully digital control. The manufacturer shall not have less than five years of experience in the manufacture of drives. The manufacturer shall be ISO-9001 certified.

The drives shall be UL listed and CSA approved, be capable of constant and variable torque applications, and utilize IGBT (insulated gate bipolar transistors) in its power section. The drive shall have a common design for all horsepower models.

The drives shall be suitable for operating at an ambient temperature of -10°C to 50°C and at an altitude of up to 3,300 feet. Drives shall be suitable for operation at 93% relative humidity and at 0.6 G vibration.

Drives shall be wall mounted in a NEMA 12 enclosure as shown on the plans.

B.) Drive Schedule -

Desc.	#	Motor HP	Input	Rated Output
Well # 3 Pump	1 ea.	75 HP	460V, 1Ø	460V, 3Ø 211A continuous, 250A for 60m

The VFDs and all accessories (terminals, breakers, filters, reactors, remote keypads, ventilation/fans, etc.) shall be built into a wall mounted NEMA 12 enclosure as shown on the plans

C.) Drive Control System -

The drive main input power shall be 460V, 1-Phase, 60Hz. The drive shall require no external control power and shall have a tolerance for voltage +10% to –15% and

frequency 45 to 66 Hz. The drive shall have an output frequency of 0 Hz to 320 Hz and a frequency resolution of 0.01Hz digital and 0.01Hz analog. The drive shall have a frequency accuracy of ±0.5% of maximum frequency at 25°C ±10°C.

The drive shall have the following volts/hertz characteristics:

- Constant V/Hz or second order non-linear variable V/Hz;
- Maximum voltage frequency adjustable from 0Hz to 320 Hz;
- Voltage boost adjustable from 0 to 30%; and
- Starting frequency adjustable from 0 to 10Hz.

The drive overload current shall be 100% continuous and 150% for 60 minutes.

The drive shall accept the following frequency command signals:

- Potentiometer;
- 0-10VDC;
- 4-20mA.

The drive shall contain three critical frequency jump points with individual bandwidth and shall be capable of setting both upper and lower limit frequencies. The PWM carrier frequency shall be adjustable from 500Hz to 3,000Hz (Drives 125 HP and below shall be capable of up to 10,000Hz carrier frequency). The drive shall be capable of PID set point control.

16212.03 OPERATIONAL FUNCTIONS

The drive shall contain two separate acceleration/deceleration times (0.1 to 3,000 seconds) with choice of linear S, or C curves.

The drive shall have the following electric braking:

- Dynamic braking circuit standard; and
- DC injection braking - starting frequency (0-10Hz), breaking voltage (0-20%), and braking time (0-5 seconds).

The drive shall operate the motor in the forward and/or reverse direction. The drive shall be capable of jogging the motor up to 20Hz, then stopping the motor by deceleration, DC injection, or coasting. The drive shall contain seven preset speeds which can be activated from the keypad, terminal inputs, and host computer. The drive shall restart into a rotating motor by sensing the coasting motor's speed and matching that frequency. The drive shall have adjustable soft stall (10%-150%) which reduces frequency and voltage of the inverter to sustain a run in an overload situation. The drive shall be capable of performing a time base pattern run using the seven preset speeds. The drive shall have adjustable electronic overload protection (10%-100%) and shall have a custom programmable volt/hertz pattern.

16212.04 PROTECTIVE FEATURES

The drive shall have an external fault input and shall be capable of re-setting faults remotely and locally.

The drive shall identify and display the following faults:

- OC1 -- Overcurrent during acceleration;
- OC2 -- Overcurrent during deceleration;
- OC3 -- Overcurrent during run;
- OCA -- Overcurrent during start-up;
- OCL -- Overcurrent due to load-side short circuit;
- Ocr -- Overcurrent in regenerative discharge resistor;
- OP -- Overvoltage;
- OP2 -- Overvoltage during deceleration;
- OL -- Overload;
- Olr -- Overload in regenerative discharge resistor;
- OH -- Overheat;
- EF -- Ground fault;
- E -- Emergency stop;
- Err.1 -- Frequency setting abnormality;
- EEP/EEP2/EEP3 - EEPROM abnormalities;
- Err.t -- Computer link abnormalities;
- POFF -- Control power supply undervoltage;
- nOFF -- Main power supply undervoltage.

16212.05 MONITOR FUNCTIONS

The drive digital display shall be capable of being scaled to display values other than frequency, like motor RPM. The drive shall have programmable parameters which can be changed while the drive is operating.

16212.06 FILTERS & LINE REACTORS

Furnish and install a built in 3% line reactor for each drive. Furnish and install a Long Lead Filter for each drive, if required. Furnish and install a EMI/RFI filter for each drive, if required.

16212.07 WARRANTY

A full one-year warranty shall be on the complete system, not just the inverter.

The manufacturer must certify in writing that the drive(s) will not produce any harmonic or line notching disturbances on the AC line that will adversely affect operation of any other VFD's, instruments, or equipment within or near the facility.

The supplier of the AC drive described herein, shall have a factory trained service representative to startup and configure the drives. The factory trained representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein. Start-up service for each drive shall be included in the Contractor's bid plus an added 4-hour review training session approximately 6 months after start-up.

16212.08 TRAINING

The Contractor shall include in his bid having AC drive manufacturer provide on-site training for plant personnel. This program shall provide operating and instruction manuals, training in equipment operation, and troubleshooting of the AC drive, and shall be for one 4-hour period as mutually arranged between the Contractor and Owner.

16212.09 DOCUMENTATION

Two instruction manuals for programming and hardware shall be provided with the drive at time of shipment.

16212.10 SPARE PARTS

A.) Recommended spare parts list and prices shall be provided with the O & M Manual.

B.) One set (total) of recommended spare parts shall be provided by the Contractor to the Owner as part of the Contractor's bid price. This shall include one complete set of fuses as a minimum.

16212.11 INSTALLATION

VFD's shall be installed as shown on the drawings and according to the manufacturer's latest recommendations. Start-up assistance shall include a manufacturer's representative as each separate drive is placed into service, including all representatives required for all portions of the system. This may require more than a single trip by the representatives involved.

Program each drive on-site for proper operation.

Programming to include:

- Ramp up, ramp down, current & voltage monitor, shutdown after time delay at no load.
- Current limit drive output to motor full load amps
- As recommended by manufacturer
- As required by Engineer at start-up

SECTION 16621
STANDBY GENERATOR SYSTEM

16621.01 GENERAL

Furnish and install a standby propane-fired generator system with automatic transfer switch, as specified in the contract documents.

16621.02 QUALITY ASSURANCE

A.) Manufacturer: Provide system from one (1) manufacturer.

B.) Warranty: Provide five (5) year comprehensive extended warranty from date of installation on entire standby power system by the system manufacturer (includes parts, labor, travel, etc.).

C.) NEC Compliance: Comply with applicable standby generator requirements of NEC.

D.) NFPA Compliance: Comply with applicable requirements of NFPA requirements of NFPA 37, "Installation and Use of Stationary Combustion Engines and Gas Turbine". Also, fully conform to NFPA 110, "Emergency and Standby Power Systems".

E.) UL Compliance: Provide standby generator system components which are UL listed and labeled.

F.) ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1, "Motors and Generators", and MG 2, "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators".

G.) IEEE Compliance: Comply with applicable portions of IEEE Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to standby power.

16621.03 SUBMITTALS

Submit manufacturer's product data, operation and maintenance instruction, and manufacturer's product warranty. Submit dimensioned DRAWINGS and wiring diagrams of generator units and accessories including start-stop stations, and instruments, showing accurately scaled generator set layout and its spatial relationship to associated equipment, and connections to remote equipment. Provide manufacturer's computer size verification for each unit per loads as indicated in 2.01.B, below. Maximum voltage dip shall not exceed 20%.

16621.04 GENERAL SYSTEM REQUIREMENTS

A.) Power: 480/277 volts, three-phase, 4-wire, 60 Hz.

B.) Capacity: Size for all indicated equipment, sequentially as follows:

Step #1	--	Miscellaneous Load	10 KW;
		Well #3 Pump	1 @ 75 HP, VFD;

Provide any required larger size unit/system at no added cost to Owner to comply with above. Sizing noted under 16621.05 is not to be utilized without verification; it indicates the minimum rating that will be accepted.

C.) System Components: Provide entire system furnished by generator manufacturer.
(1) Propane engine driven generator.
(2) Winter protective enclosure
(3) Engine start/stop controls.
(4) Automatic transfer switch.
(5) Mounted accessories as specified.
(6) Properly sized black plastic nameplates with engraved white letters to identify all relays, components, etc.

D.) Performance Certification: Provide certification of the following by an independent testing lab:
(1) Full power rating.
(2) Stability.
(3) Voltage and frequency regulation.
(4) All other certifications per NFPA 110.

E.) Starting Capability: Unit shall be capable of starting after extended periods at -35 degrees F.

16621.05 STANDBY GENERATOR

A.) Provide the following Onan generator:

Location	Onan Generator	C/B Size	ATS Size
Well #3	100 KW, 1800 rpm, C100 N6 minimum or as required per 16621.04.B.	200A, 3P (minimum)	250A, 3P

B.) Controls: Generator mounted control panel for unit with panel lights, safety devices, and engine starting controls which include, but are not limited to:

- Battery charge rate ammeter
- Oil pressure gauge
- Water temperature gauge
- Run-stop-remote switch
- AC voltmeter and ammeter
- Voltage adjusting rheostat
- High water temperature cutout
- Emergency latch-relay with manual reset and indicator light
- Cranking limiter
- Manual reset circuit breaker
- Automatic overspeed shutdown
- Control contacts to control inlet air supply and exhaust
- Alarm contacts for wiring to Owner's alarm/monitoring system
- Engine coolant fill for -35°F shall be provided by the Contractor

16621.06 AUTOMATIC TRANSFER SWITCH

A.) General: UL listed (standard 924) for all classes of load.

B.) Operation:

1.) Sequence as follows: Sense complete loss of power on any phase and signal generator to start.

When emergency power attains a minimum of 90% of rated speed and voltage, transfer load to emergency power.

Transfer load to normal power when normal power is restored; signal generator to stop. NOTE: It is intended that transfers shall incorporate a "dead band" time in the neutral position in all operations.

2.) Obtain operating current for load transfer from source to which load is to be transferred.

3.) Emergency power malfunction: Automatically disconnect load to allow generator to restart with no connect load. Reconnect emergency power when 90% of rate's speed and voltage is attained.

C.) Features:

1.) Disconnect device: Device to electrically disconnect control section from transfer switch to permit safe access for maintenance or service during normal operation.

2.) Test switch: Simulate power outage for operational test of engine, alternator and load transfer control.

3.) Float type battery charger: Fused with adjustable charge rate, millimeter.

4.) Cranking limiter: (24/12 volt, 2-wire start) fail to start protection for generator starting system.

5.) Operation and selector switch: (24/12 volt, 2-wire start) fail to permit operation of generator at the control site. Provide check, stop, automatic and handcrank functions.

6.) Undervoltage protection: Monitor normal power source and start emergency power on partial loss of power on any phase where feedback voltages exist. Provide devices: solid-state voltage sensitive, calibrated dial adjustment, temperature compensated for a maximum deviation of ±2 volts from -25°F to +175°F.

7.) Time delay to start emergency power: Provide to prevent emergency power from starting during normal voltage fluctuations, adjustable from 1.5 to 15 seconds.

8.) Time delay to pick up load: Provide to allow emergency power to operate for a period of time before accepting load, adjustable 5 to 50 seconds.

9.) Time delay to retransfer load: Provide to delay transfer of load to normal power to override initial voltage fluctuations of returning normal power and to provide a minimum period of operating time for emergency power.

Bypass time delay if emergency power fails during delay period; retransfer load immediately to normal power.

Adjustment: 2 to 60 minutes.

10.) Time delay to stop emergency power: Provide to allow engine to run unloaded before being shut down after load has been retransferred to normal power, adjustable 2 to 60 minutes.

11.) Indicating lights: Provide an enclosure door, label to indicate transfer switch postion.

Green -- normal source
Red -- emergency source

12.) Automatic engine exerciser: Provide built-in unit to exercise generator weekly for adjustable time periods. Loads to be transferred under exercise mode.

13.) Provide added auxiliary contacts for purposes required:
   a.) Alarm
   b.) Damper motor control (3)
   c.) Heater interlocking
   d.) etc.

NOTE: Transfers to emergency and from emergency to normal shall have a deadband period to ensure residual voltages have decayed before new power source is applied.

D.) Rating and Performance:

1.) Continuous duty in a non-ventilated NEMA 1 enclosure.

2.) Load: All classes of load including inductive and non-inductive at 600 volts; tungsten lamp load at 250 volts.

3.) Close on inrush current of 20 times continuous rating without welding or excessive burning of the contacts.

4.) Load switching capability: 15 times continuous rating.

5.) Cycles of operation: 600 cycles at rated current at a rate of 6 cycles per minute. One cycle: One complete opening and closing of both sets of contacts in inrush current 10 times continuous rating.

E.) Withstand Ratings:

Switch withstand rating based on manufacturer's published U/L listing of acceptable protective devices (which limit any fault currents to within switches published withstand rating) must be provided. Contractor and vendor must provide written certification that new or existing circuit protective devices ahead of the transfer switches provide proper protection. If they do not do so, the required appropriate devices will be provided and installed under this specification section.

F.) Construction:

1.) General: No wearing surfaces or moving parts requiring routing lubrication or maintenance.

2.) Enclosure: NEMA 1 for indoor installation; key operated door locks, swing-out service panel, prepunched for future addition of control components.

3.) Interlocking: Mechanical and electrical interlocking to prevent simultaneous energizing of load by normal and emergency power.

4.) Contacts: Double break design for fast arc suppression, solid silver cadmium, completely enclosed in heat resistant contact chambers.

16621.07 FUEL SYSTEM

The General Contractor shall provide tanks and connections to engine flexible fuel connection.

16621.08 GENERATOR ENCLOSURE

Provide winter protective enclosure, install on concrete pad in accordance with the contract drawings and manufacturer's recommendation.

16621.09 INSTALLATION

A.) Install as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practice. Comply with NFPA and NEMA standards.

B.) Coordinate with other WORK, including fuel system, piping and accessories.

C.) Connect fuel piping to standby generator equipment as indicated, and comply with manufacturer's written instructions where not otherwise indicated. Flexible connections are required.

D.) Provide initial fuel tank fill after all tests are completed.

E.) Attach base using galvanized steel anchor bolt with vibration protection, as recommended by generator manufacturer.

16621.10 GROUNDING

Provide equipment grounding of engine-generator system in accordance with applicable sections of National Electric Code.

16621.11 TESTING

After building circuitry has been energized with normal power source, test engine-generator to demonstrate standby capability and compliance with requirements. Correct malfunctioning units, then retest to demonstrate compliance. Test shall conform to NFPA 110 requirements and shall utilize a load bank if operating loads are not adequate.