

WEST COOLEY ALLUVIAL WELLS REHABILITATION PROJECT CIP #20-062

100 PERCENT DESIGNS TECHNICAL SPECIFICATIONS



PREPARED FOR:

CITY OF THORNTON
9500 CIVIL CENTER DRIVE
THORNTON, COLORADO 80229

D&A JOB No. DA158039.03

JUNE 8, 2020

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TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK

Furnish all equipment, labor, and materials for the construction of reinforced concrete flow meter vaults, installation of flow meters and new pipe, pipeline realignment, installation of new 316 stainless steel pump-motor-check valve assemblies, transducers and wires in Wells 1, 3, 4 and 5, and the abandonment of Well 2, as a bid alternative, as detailed in the Construction Documents. The work includes, but is not limited to, the following work items:

- Pothole and accurately locate all existing water pipelines, electrical conduits and communication conduits at each proposed vault location and pipeline realignment location prior to construction.
- Coordinate with City of Thornton on Lock-Out, Tag-Out Protocol for the Motor Control Center.
- Access road maintenance.
- Preconstruction dewatering to lower the groundwater table to 2 feet below each vault excavation limits.
- Mobilization and demobilization from the site of all equipment, personnel, and materials required to complete the work.
- Submit for a City CIP Construction Permit (free of charge)
- Obtain City of Thornton building permit for all electrical work.
- Obtain a pedestrian traffic control plan from Adams County and a City Traffic Control Permit.
- Obtain a Storm Water Management Plan from the CDPHE.
- Comply with the project Floodplain Development Permit.
- Construction surveying and locating of existing utilities by potholing, including the existing pipelines from the wells and the pump station discharge line, and the buried primary power cables leading to the pump station and the transducer cables and electrical for the wells.
- Installation and maintenance of erosion and sediment control BMPs throughout the project.
- Installation of restrained ductile iron pipe and associated ductile iron fittings for the vault piping.
- Installation of PVC pipe and associated fittings, tracer wire and boxes for pipeline realignment.
- Installation of four 316 stainless steel pumps, motors, and check valves, and PVC Certalok drop pipe into existing Wells 1, 3, 4 and 5.
- Installation of pressure transducers and associated cable lengths for Wells 1, 3, 4 and 5 and the wet well.
- Construction of a pre-cast or cast-in-place reinforced concrete flow meter vault with a sump and 2 manhole openings for Well 5 and the outlet pipe flow meters.
- Construction of 3 pre-cast or cast-in-place reinforced concrete flow meter vaults with sumps and 1 manhole opening each for Wells 1, 3 and 4 flow meters.
- Installation of 5 totalizing flow meters (TFMs), transition couplings, flange coupling adaptors, grounding discs and associated fittings and supports.
- Flow meter installation certification by an SEO Certified Well Tester for all flow meters.
- Performance of a 6-day constant rate system test using all wells set to 250 gpm each.
- Installation of all electrical and communication lines and conduit associated with the new meter vaults.
- Relocation of existing electrical and communication lines Wells 1, 3 4 and 5.
- Programming of the existing PLC to incorporate the new communication lines.
- Field hydrostatic testing of all new pipes.
- Disposal of excess soils off-site and spreading and compacting crusher fines.
- Erosion control and seeding on all disturbed areas.
- Provide pedestrian Traffic Control.
- Provide programming of PLC to send instant and total flows from 12-inch discharge flow meter to the State.
- A data logger to record totalized and instantaneous flow meter data and send instant flows and total flows from the river discharge flow meter to the State by cellular signal. Include all field testing and programing to provide a complete system.
- As-built drawings for all new installations.
- Startup, testing and training on all new equipment.
- Submittal of pump installation reports (form GWS-32) for Wells 1, 3, 4 and 5 to the SEO.
- Submittal of totalizing flow meter installation forms (forms 3.1.2 and 3.1) for each flow meter to the SEO.
- Submittal of a well abandonment report (form GWS-09) for bid alternate Well 2 abandonment to the SEO.
- After initial acceptance, provide minimum one year of maintenance on erosion control items.
- Provide Quality Control testing services using independent testing laboratory.
- Well 2 is to be abandoned in-place per the Colorado State Engineer's Office (SEO) requirements for well

- abandonment.
- Provide, inspection, cleaning, refurbishing, rehabilitation or replacement of pitless well hanger pipe, spool and drop pipe connection trends.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

The entire cost of the work and the material necessary to complete all items shown on the Contract Documents or specified herein, shall be included and merged into the pay items in the Proposal Schedule. All payments shall be subject to the conditions of these specifications. Any work not specifically listed is to be included in these items.

All pay items shall include materials, transportation expenses to the job site, cost of installation, maintenance during construction, guarantees and warranties (if applicable), profit, sales tax, license, permits, and other taxes required for the completion of the project in-place for each item in the Proposal Schedule. Payment for items on a "lineal foot basis" shall be measured upon the horizontal plane after installation, and through all fittings for pipelines. Payment for items will be made after installation.

No additional compensation will be allowed for any item beyond the limits as shown on the Contract Documents without prior written approval of the Owner.

WEST COOLEY ALLUVIAL WELLS REHABILITATION PROJECT, CIP #20-062

Bid Item #1 – General Conditions, Mobilization and Bonding

1. Includes the mobilization of personnel, equipment, and temporary construction facilities to the project site and their subsequent removal. Provide temporary utilities, detailed construction schedule, surveying, project specific overhead, and road maintenance and plowing required to complete the West Cooley Alluvial Wells Rehabilitation Project.
2. Payment will be made per City of Thornton General and/or Special Conditions. Payment on a lump sum based on project progress.

Bid Item #2 – Clearing and Grubbing

1. Measurement and payment for clearing and grubbing shall be paid on a lump sum basis.

Furnish all equipment, labor and materials necessary for clearing and grubbing on the site prior to any excavation work, stripping and stockpiling topsoil, removal of shrubs, removal of debris off site, and any incidental items associated with clearing of grubbing as specified herein, shown on the Contract Documents.

Bid Item #3 – Well Pumps, Pump Motors, Check Valves, Discharge Pipe, and Pressure Transducers

1. Measurement and payment for the pumps, pump motors, check valves, discharge pipes, and pressure transducers shall be based on a lump sum basis.

Furnish all equipment, labor, and materials required to install the submersible well pumps, pump motors, check valves, level sensor probes, 1.5" PVC conduit and pressure transducers, probes and relays, and discharge pipe as shown on the Construction Drawings, including all fittings, welding, excavation, dewatering, and backfilling. Level sensor equipment shall connect to the pump drive and turn the pump on and off based on the water levels in the well. Pump control starter shall be installed with a pump saver plus motor protection sensor.

Bid Item #4 – Concrete Meter Vaults (4 Structures)

1. Measurement and payment for the pre-cast or cast-in-place concrete vaults shall be paid per cubic yard basis.

Furnish all equipment, labor, and material required for the complete construction of the concrete measuring vaults. This item includes, but is not limited to, excavation and foundation preparation; steel reinforcement and related appurtenances, wall sleeves and mechanical seals, forming and placing concrete, curing of concrete, hot dip galvanized grating, concrete sump, trenching and backfill of piping and structure, compaction to 95% Standard Proctor density, all accessories, fittings through walls and associated seals around pipes, finish grading, protection of existing structures, installation of 24" diameter manhole openings, disposal of excess soil offsite; and any incidental items associated with the complete installation as specified herein, shown on the Contract Documents.

Bid Item #5 – Vault Piping and Equipment

1. Measurement and payment for the vault piping and equipment shall be paid on a lump sum basis.

Furnish all equipment, labor, and material to install the vault piping, valves, flow meters, thrust blocks, corp stops, dresser couplings with restraining rods, pipe supports, sump pump, sump piping, sump discharge irrigation box with gravel, and associated fittings for the measurement vault. This item also includes purchasing and installing a data logger to record flows from the flow meters. This work shall include, but is not limited to, measuring, installing, and supporting as shown on the Contract Documents.

Bid Item #6 – Relocate 8-inch diameter PVC Pipe to avoid Meter Vault #5

1. Measurement and payment for the relocating the 8-inch diameter PVC pipe around Meter Vault #5 shown on the drawings shall be paid at per lineal foot installed.

Furnish all equipment, labor, and materials for the construction and installation of PVC restrained and unrestrained pipe with ductile iron bends. This item includes all the piping to be relocated around outlet and Well 5 vault and tie-into the existing PVC pipeline. The work shall include, but is not limited to, excavation and shoring of trenches as required by OSHA, surface water control, restrained and unrestrained pipe and fitting installation, bedding and backfilling, providing and installation of tracer wire, tracer wire location boxes, transition gaskets and fittings to connect to existing PVC pipe, and any incidental items associated with the complete installation as specified herein, shown on the drawings, or designated by the Contract Documents.

Bid Item #7 – Electrical Work

1. Measurement and payment for electrical shall be paid on a lump sum basis.

Furnish all equipment, labor, and materials to install all electrical items shown on the drawings, including, but not limited to, obtaining City of Thornton building permit, connecting to existing power source, all wiring and conduit (buried, exposed and directional drilled), mounting equipment within the existing pump station, coring holes as needed within the existing pump station walls, connecting of pump motors, sump pumps and flow meters, 120 volt LED red alarm light that turns on if the level control sensors or motor saver sensors shut off any pump in any well; the light should be mounted to the pump electrical disconnect box on the outside of the pump station, installation of electrical pedestals at each meter vault so that the electrical pedestal is above the 100 year flood elevation, and all other items for a complete installation as shown on the Contract Documents.

Bid Item #8 – Communications and Programming

1. Measurement and payment for communications and programming shall be paid on a lump sum basis.

Furnish all equipment, labor, and materials to install all communication systems shown on the drawings, including, but not limited to, obtaining City of Thornton building permit, connecting to existing programmable logic controller (PLC), all wiring and conduit (buried, exposed and directional drilled), mounting equipment

within the existing pump station, coring holes as needed within the existing pump station walls, connecting of transducers and flow meters, LCD readouts, and all other items for a complete installation as shown on the Construction Drawings. Provide all programming necessary to allow the PLC to control well pumping and recording of flow and water level data by the existing operator interface terminal (OIT). The existing data loggers in the OIT must be compatible with the pressure transducers and flow meters. Provide all programming and field testing required to record all flow and level data at 10-minute intervals. Furnish, installation and programming the data logger and cell phone antenna to transmit instant flows and totalized flows to the water commissioner web page, data to be conveyed to the Water Commissioner shall be instant and totalized flows discharged to the river as measured by the magnetic flow meter, no other data shall be transmitted to the State.

Bid Item #9 – Dewatering

1. Measurement and payment for dewatering shall be paid per acre-foot pumped. Payment will be made based on pumped volumes to reservoir or river measured with calibrated flow meters. Contractor to provide calibrated flow meters for dewatering.

Furnish all equipment, labor, and materials for the installation, operation and maintenance of a complete dewatering systems to perform the work indicated on the drawings and specifications. The work includes, but is not limited to, obtaining and complying with required permits, all subcontractors, engineering, design, pumping, power supply, earthwork, construction of well points, calibrated flow meter, piping, collecting totalizer flow numbers daily and reporting to Owner, submittals, and any incidental items associated with providing dewatering for all construction activities as specified herein, shown on the drawings, or designated by the Owner/Engineer.

Bid Item #10 – Hydrostatic Testing

1. Measurement and payment for Hydrostatic Testing shall be a paid at the contract lump sum price.

Furnish all equipment, labor, and materials to complete hydrostatic testing of the modified and new pipelines and associated fittings. Work includes, but is not limited to, obtaining water, installation of pressure testing system to test the pipeline with associated fittings capable of “bleeding” excess air, tapping and repairing the pipe as acceptable by the City, pressure gages, valves, water measuring, blind flanges, temporary pipe restraints, etc. Potable water is available at the City hydrant at 100th Avenue and McKay Road. Contractor to obtain a City hydrant backflow preventor with a refundable security deposit.

Bid Item #11 – Crusher Fines

1. Measurement and payment for crusher fines shall be paid at the contract lump sum price.

Furnish all materials, equipment and labor for the complete installation of crusher fines. The work includes, but is not limited to, foundation preparation, placing geotextile fabric, crusher fines, compaction, watering the fill, and any incidental items associated with the complete installation as specified herein, shown on the drawings, or designated by the Contract Documents.

Bid Item #12 – Erosion Control, Traffic Control and Fence Repair

1. Measurement and payment for erosion control, traffic control and fence repair shall be paid at the contract lump sum price.

Furnish all equipment, labor, and materials for the erosion control plan and traffic control plan. Work includes, but is not limited to, installing and removal of silt fences, sediment logs and sediment bales; upkeep of erosion control per Urban Drainage and Flood Control District requirements and approved submittal; seeding of construction staging area and access paths; obtaining an approved traffic control plan from Adams County; coordination with Adams County and the City of Thornton; installing and removal of erosion control and sedimentation fences, construction fences and traffic control signage; providing flagmen as necessary; removal

and repair of the fencing near meter vault M-5; and all incidental items associated with the complete installation as specified herein, shown on the drawings, or designated by the Contract Documents.

Bid Item #13 – Startup, Testing, and Training

1. Measurement and payment for startup, testing and training shall be paid on a lump sum basis.

Furnish all equipment, labor and materials for a complete start up, testing and training of City personnel of all the equipment associated with this project. This item includes providing operational and maintenance manuals and warranties for all equipment and operational training.

Bid Item #14 – Alluvial Wells System Performance Testing

1. Measurement and payment for performance testing shall be paid on a lump sum basis.

Furnish all equipment, labor and materials necessary for performance testing of the entire well field and water delivery system as part of project work.

Bid Item #15 - Potholing Existing Utility Locations and Miscellaneous Items

1. Measurement and payment for potholing and miscellaneous items shall be paid on a lump sum basis.

Furnish all equipment, labor and materials necessary for potholing and surveying the existing water pipelines and electrical and communications conduit prior to construction. The contractor shall document the top of the water pipeline elevation near the location of the meter vaults and submit them to the Owner/Engineer. This item also covers miscellaneous items including, but not limited to, installing vault utilities under the existing concrete trail, removal of excess soils offsite and removing the Well 2 isolation valve and capping the line.

Bid Item #16 – Inspection, Cleaning and Video logging of Wells 1, 3, and 4.

1. Measurement and payment for the inspection, cleaning and video logging of Wells 1, 3, and 4 units shall be paid on a lump sum basis.

At project start and prior to installation of well pumps and equipment the contractor shall furnish all equipment, labor and materials necessary for inspection, cleaning and video logging of Wells 1, 3, and 4. Work includes, but is not limited to, video logging the full depths of Wells 1, 3, and 4 before and after cleaning, cleaning of the well screens for each well, disinfecting each well, providing videotape footage and inspection photos to Owner, and any incidental items associated with the complete inspection, cleaning and video logging of Wells 1, 3, and 4 as specified herein, shown on the drawings, or designated by the Contract Documents.

Bid Item #17 - Project Quality Control

1. Measurement and payment for project quality control shall be paid on a lump sum basis.

Furnish all Quality Control Tests by an independent and certified testing company including all equipment, labor and materials necessary for performing independent quality control testing. Retain the services of a certified welder inspection Company to review all welding submittals and welders' certifications. Certified welder inspector shall perform all field welding inspections and acceptance of welds. This item also includes but is not limited to all concrete testing, all soil testing (density and moisture, Standard Proctors, Atterberg Limits, gradations) and hydrostatic testing as required to verify compliance with project specifications.

Bid Item #18 - Maintenance of Erosion Control Items after Acceptance – 1-year Maintenance

1. Measurement and payment for maintenance of erosion control items after initial project acceptance – 1-year maintenance shall be paid on a monthly basis for 12 months maximum.

Furnish all equipment, labor and materials necessary for performing maintenance on erosion control items for one full year or less following initial project acceptance or until the City signs off with approval. This item includes maintaining all erosion control items in good operating condition on a monthly basis for one year. The City will conduct monthly inspections with the Contractor. Contractor shall address and perform all the required erosion control repairs as indicated on the report.

Bid Item #19 – Project Survey, Controls and As-Built Survey

1. Measurement and payment for project survey, controls and as-built survey shall be paid on a lump sum basis.

Furnish all equipment, labor, materials, and a Professional Licensed Surveyor necessary for completion of the project survey, controls and as-built survey. This item includes, but is not limited to, verifying the survey benchmarks onsite, construction staking, setting survey controls during construction, surveying pipeline alignment and elevations and concrete structures during construction, a final on-site survey after construction is complete, preparation of as-constructed plans with final grades and contours of all structures built as part of this project, and any incidental items associated with the complete construction as specified herein, shown on the drawings or designate by the Contract Documents.

Bid Item #20 – Inspection and Rehabilitation of Well Pitless Hanger Pipes, Spools and Drop Pipe Connections for Wells 1, 3, and 4

1. Measurement and payment for inspection of existing well pitless hanger pipes, spools and drop pipe connections for Wells 1, 3, and 4 shall be paid on a lump sum basis.

Furnish all equipment, labor and materials necessary for inspection of well pitless hanger pipes, spools and drop pipe connection for Wells 1, 3, and 4. This item includes, but is not limited to, coordination with Owner/Engineer on inspection of existing pitless equipment stored by the City and disconnecting the assembled pieces except for Well 1 which has them welded together, cleaning of rust and muck from the disassembled pieces and threads, documentation and photographs of any disassembled pieces after cleaning, replacement of all O-rings for the spools, refurbishing pieces that are not damaged, replacement of pieces that are damaged, and any incidental items associated with the complete inspection of well pitless hanger pipes, spools and drop pipe connections for Wells 1, 3 and 4 as specified herein, shown on the drawings or designated by the Owner/Engineer.

Bid Item #21 - Abandon Well 2 (BID ALTERNATIVE)

1. Measurement and payment for abandoning Well 2 shall be paid on a lump sum basis.

Furnish all equipment, labor and materials necessary for abandoning Well 2. This item includes excavation and removal of pitless casing, placement of clean sand inside well, placement of cement grout inside well, backfill with clean native clays, submittal of a well abandonment report to the SEO and all other items for a complete well abandonment as shown on the Contract Documents.

Bid Item #22 - Other items not listed above

1. Measurement and payment for all other items not listed above shall be paid on a lump sum basis.

This item is included to allow for any other items not specifically listed on any other bid item but required to complete the work or the bidder deems necessary to include in the bid. The contractor shall provide a list of all items that are included within this bid item.

END OF SECTION

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01050 - FIELD ENGINEERING

PART 1 - GENERAL

1.01 SURVEYING

- A. The Owner/Engineer has established horizontal and vertical control points. It shall be the responsibility of the Contractor to provide construction staking for horizontal and vertical alignment, as well as for appurtenant features of the work. Contractor shall confirm coordinates of project benchmarks and report any discrepancy to Owner/Engineer immediately.

1.02 SUPERVISION

- A. The Contractor shall have supervisory personnel, knowledgeable of the project requirements and proper installation and construction procedures, available in the field at all times that work is progressing.
- B. The Contractor shall use the services of a registered professional land surveyor to perform the survey.

1.03 FIELD TRAILER - Not Required

END OF SECTION

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01310 - CONSTRUCTION SCHEDULES AND WEEKLY MEETINGS

PART 1 - GENERAL

1.01 GENERAL

- A. Prepare detailed schedule of all construction operations and procurements to be reviewed by parties attending the pre-construction conference.
- B. No work is to begin at the site until Owner/Engineer's acceptance of the preliminary Construction Progress Schedule and report of delivery of equipment and materials.
- C. Within 30 days after Notice to Proceed, the Contractor shall submit a base line master schedule to Owner for review and approval.
- D. Contractor shall attend weekly meetings and provide weekly meeting minutes.

1.02 FORMAT AND SUBMISSION

- A. Prepare construction and procurement schedules in a critical path method graph format suitable for displaying scheduled and actual progress, and in agreement with the General Conditions, Section 68. Use Microsoft Project software.
- B. With each pay application, Submit one copy of each schedule to Owner for review.
- C. Owner/Engineer will return 1 copy to Contractor with suggested corrections or revisions.

1.03 CONTENT

- A. Construction Progress Schedule
 - 1. Show the complete work sequence of construction by activity and location.
 - 2. Submit with each pay application.
 - 3. As a minimum, show: Duration in days, Early Start, Early Finish, Late Start, Late Finish, Total Float and percent complete for each activity. Schedule shall include and show critical path for the project. No activity should exceed 15 days in duration. The following activities shall be included:
 - a. Mobilization and site preparation
 - b. Pump and motor procurement and installation in Wells 1, 3, 4 and 5
 - c. Abandonment of Well 2
 - d. Potholing of existing utilities
 - e. Dewatering plan for concrete meter vaults excavation
 - f. Excavation for concrete meter vault
 - g. Concrete meter vault installation
 - h. Electrical and instrumentation
 - i. Pipe and equipment installation
 - j. PLC programming and testing
 - k. Startup, Testing and Training
 - l. Submittal of Pump Installation Report, Flow Meter Installation Report and Well Abandonment Report (Bid Alternate) to Colorado SEO
 - m. Demobilization
 - 4. Show projected percentage of completion of each item as of the 23rd day of the month.

- B. Report of delivery of equipment and materials.
 - 1. Show delivery status of critical and major items of equipment and materials.
 - 2. Include a schedule which includes the critical path for Shop Drawings, tests, and other submittal requirements for equipment and materials.

1.04 PROGRESS REVISIONS

- A. Submit revised schedules and reports when changes are foreseen, when requested by Owner/ Engineer, and with each application for progress payment.
- B. Show changes occurring since previous submission.
 - 1. Actual progress of each item to date.
 - 2. Revised projections of progress and project completion.

1.05 3-WEEK LOOK AHEAD CONSTRUCTION PROGRESS SCHEDULE

- A. Provide updated and current 3 week look ahead schedule for distribution at each weekly construction meeting.

1.06 MISCELLANEOUS

- A. Owner/Engineer's review is only for the purpose of checking conformity to the Contract Documents. Said review is not to be construed as relieving the Contractor from any responsibility to determine the means, methods, techniques, sequences, and procedures of construction as provided in the General Conditions.

1.07 WEEKLY MEETINGS

- A. Contractor and Owner shall meet on a weekly basis to discuss the project.
- B. Contractor shall take notes and provide weekly meeting minutes prior to the next meeting.
- C. The meeting notes shall include actual and updated Submittal Log, RFI Log, 3-Week Look-Ahead, Proposed Change Order Log and Change Order Log.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01345 - SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

- A. Submittal shall not be used to request approvals for substitutions. See Project General Conditions.
- B. Submittal shall follow guidelines provided in City of Thornton General and Special Conditions.
- C. Provide electronic submittals in pdf format. The electronic format must strictly follow the guidelines for submittals as provided in the City of Thornton General and Special Conditions.
- D. Contractor shall furnish, process, deliver, reproduce and perform other necessary functions incidental to scheduling and handling of shop drawings, project data and samples, operation and maintenance manuals, equipment record sheets, manufacturers' certificate of proper installation, Function and Performance Test Data Sheets, and record drawings, as indicated on Drawings or as specified, and in accordance with provisions of the Contract Documents.
- E. See appropriate Specification and Contract Documents sections for specific items for which data and/or samples are required. See General Conditions for additional information.
- F. No equipment or material for which listings, drawings, or descriptive material is required shall be installed until the Owner has on hand copies of such approved lists and the appropriately stamped final shop drawings.
- G. The review of drawings by the Owner will be limited to general design requirements only, and shall in no way relieve the Contractor from responsibility for errors or omissions contained therein.
- H. Submittals will be acted upon by the Owner as promptly as possible. Delays caused by the need for resubmittals shall not constitute reason for an extension of Contract Time. See General Conditions for additional information.
- I. The Owner will perform only two (2) reviews on a specific submittal. If additional review by the Owner is required, all costs associated with the additional review shall be borne by the General Contractor.
- J. Approval of submittals is not an authorization to perform contract changes. See General Conditions.

1.02 ADDRESS

- A. Electronic submittals shall be sent to the following addresses:

Mr. Eduardo Moreno
City of Thornton
12450 Washington Street
Thornton, CO 80241-2405
Eduardo.moreno@thorntonco.gov

1.03 SUBMITTALS - SHOP DRAWINGS

- A. The Contractor agrees that shop drawing submittals processed by the Owner/Engineer do not become Contract Documents and are not Change Orders; that the purpose of the Shop Drawing review is to establish a reporting procedure and is intended for the Contractor's convenience in organizing his work and to permit the Owner/Engineer to monitor the Contractor's progress and understanding of the design.
- B. Contractor shall be responsible to make submittals, and to transmit items with a letter of transmittal. i.e., Submittal 001A-03300 – Concrete mix 4000 PSI
- C. Number submittals consecutively beginning with 001 - Specification Number or Drawing it is intended for.
 - 1. An item that is resubmitted will retain the original number but with an added suffix letter starting at: B, C, D for subsequent revisions (i.e., 001-B-Concrete mix 4000 PSI).
 - 2. Do not change the scope of a submittal on any resubmittals.
 - 3. Insure only one specification section is covered by one letter of transmittal.
 - 4. Provide sufficient catalog information together with technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Specifications.
- D. Shop Drawings submitted to the Owner by other than the Contractor will be returned to the Contractor without action of any kind. Shop Drawings will not be received from or returned to subcontractors.
- E. Submit items sufficiently in advance of date required to allow reasonable time for review, and to allow for resubmission if necessary. Items not submitted in accordance with the provisions of Contract Documents will be returned, without action, for resubmission. Delays caused by above shall be Contractor's responsibility.
- F. On Shop Drawing transmittal sheet, identify manufacturer, item, drawing or data number and Specification section number. On Shop Drawings, identify use, type, project designation, tag number or drawing detail reference, and other pertinent information.
- G. The Contractor shall submit 1 electronic copy of each submittal. Shop drawings shall be drawn on 24" x 36" sheets or other formats as acceptable to the Owner. One electronic copy will be returned to the Contractor.
- H. Contractor shall stamp his approval on submittals prior to submission to Owner as indication of his checking and verification of dimensions and coordination with interrelated items. Contractor shall attach copy of the applicable specification and providing check mark in compliance to applicable section. Shop Drawings submitted without having the Contractor's stamp of approval will also be returned without action.
- I. Submit standard items such as equipment brochures, cuts of fixtures, product data sheets or standard catalog sheets or pages. Indicate exact item or model and all proposed options. Include material specifications, construction details, motor data, legible scale details, sizes, dimensions, weights, performance characteristics and pump curves, capacities, test data, anchoring details, location of connections to other work, installation instructions, storage and handling instructions, color charts and paint system, layout drawings, parts catalogs, rough-in diagrams, wiring diagrams, controls, supporting calculations for equipment and associated supports specified to be designed by equipment manufacturers or suppliers, special handling instructions, and other pertinent data.
- J. If proposed equipment or materials deviate from the Specifications or Drawings in any way, the deviations shall be clearly noted and justification for said deviations shall be explained in detail in

a separate letter immediately following transmittal sheet. If explanation is not given, Shop Drawings will be returned without action. Acceptance of deviations will not be provided on a submittal and a change order will need to be issued by the City.

- K. Should the Contractor propose any item on his Shop Drawings, or incorporate an item into the work, and that item should subsequently prove to be defective or otherwise unsatisfactory, (regardless of the Owner's preliminary review), the Contractor shall, at his own expense, replace the item with another item that will perform satisfactorily.

1.04 SUBMITTALS - OPERATION AND MAINTENANCE MANUALS AND EQUIPMENT RECORD SHEETS

- A. Operation and Maintenance Manual information and Equipment Record Sheets specific to one piece of equipment or material shall be submitted to the Owner for acceptance.
- B. Provide O&M electronic copy and submit final version, 10 days prior to initial acceptance, submittals of the Operation and Maintenance Manual information and Equipment Record Sheet.
- C. O&M submittals will be handled the same as Shop Drawings. See paragraph 1.03.
- D. The transmittal form for the Operation and Maintenance Manual and Equipment Record Sheets shall have original Shop Drawing submittal number of the accepted item plus a suffix "O-M".
- E. Equipment Record Sheets. Provide a completed equipment record sheet for each separate piece of equipment. Maintenance requirements must be filled out in detail; simply noting to refer to the Operation and Maintenance Manual is NOT acceptable.
- F. Submittal of Operation and Maintenance Manuals and Equipment Records Sheets shall be applicable to but not necessarily limited to:
 - 1. Pumps and pump motors
 - 2. Check valves and drop piping in the wells
 - 3. Transducers
 - 4. Flow meters
 - 5. Pipe fittings
 - 6. Sump pumps
- G. Operation and Maintenance Manual submittals. For each individual piece of equipment, submit operation and maintenance manuals that include, but are not necessarily limited to, the following detailed information, as applicable:
 - 1. Equipment function, normal operating characteristics, limiting conditions.
 - 2. Assembly, disassembly, installation, alignment, adjustment and checking instructions.
 - 3. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
 - 4. Lubrication and maintenance instructions.
 - 5. Guide to "troubleshooting".
 - 6. Parts list predicted life of parts subject to wear, and replacement parts ordering instructions with current price information, as applicable.
 - 7. List of special tools.
 - 8. Test data and performance curves, where applicable.
 - 9. Safety considerations.
- H. Where an Operation and Maintenance Manual submittal has been prepared by the manufacturer to cover more than one model of a particular piece of equipment all references to models other than the one specifically installed shall be deleted or crossed out.

- I. Submit final Operation and Maintenance Manuals in electronic (pdf) format.
- J. Reduce drawings or diagrams in electronic (pdf) format. However, where reduction is not practical to ensure readability, fold larger drawings separately and place in vinyl envelopes which are bound into the binder. Identify vinyl envelopes with drawing numbers.
- K. Include in Operation and Maintenance Manual copies of installation instructions, original parts lists, or other documents packed with equipment when delivered.
- L. Where the drawings and specifications identify a piece of equipment by an instrument tag number or equipment number, that same number shall also be used to identify the equipment in the Operation and Maintenance Manual.
- M. Operation and Maintenance Manuals and Equipment Record Sheets shall be discussed during the owner training sessions.

1.05 SUBMITTALS - SAMPLES

- A. Where required, submit 2 samples each to the project site for review by Engineer and Owner. Identify samples as to: manufacturer, item, use, type, project designation, tag number, specification section or drawing detail reference, color, range, texture, finish and other pertinent data.
- B. Forward with transmittal letters. Include brochures and installation instructions. Contractor to stamp his approval on sample transmittals as indication of his checking and verification of dimensions and coordination with interrelated items. Resubmit samples of rejected items.
- C. Acceptable samples submitted or constructed, constitute criteria for judging completed work. Finish work or items not equal to samples will be rejected.
- D. Samples may be retained for comparison purposes and the Contractor shall remove samples when directed. The contractor shall include in bid all costs of furnishing and removing samples.

1.06 SUBMITTALS - RECORD DRAWINGS (RED LINES)

- A. At project initial acceptance, The Contractor shall submit to the Owner a redlined set of drawings to indicate all changes performed during construction. Based on that information, the Owner/Engineer will prepare a set of Record Drawings for the project that will include the changes made in materials, equipment, location and dimensions of the work.

1.07 SUBMITTALS - MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION & TRAINING

- A. The Contractor shall submit manufacturer's certification of proper installation of all equipment prior to startup or performance testing. Areas in which manufacturer's certificates of installation are required include, but are not limited to, the following:
 - 1. Pumps and pump motors
 - 2. Flow meters
 - 3. Transducers
- B. Such certificate shall state that the equipment or system has been installed in accordance with the manufacturer's recommendation and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable safety equipment has been properly installed, and that the proper electrical and mechanical connections have been made. The Owner may provide, at their discretion, a specific certification form.

1.08 SUBMITTALS - CERTIFICATES OF COMPLIANCE WITH SPECIFIED STANDARDS AND CODES

- A. A Certificate of Compliance shall be furnished for materials specified to a recognized standard or code prior to the use of any such materials in the work. The Owner may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance. The certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications. A Certificate of Compliance shall be furnished with each lot of material delivered to the work and the lot so certified shall be clearly identified in the certificate.
- B. All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the work which conforms to the requirements of the Contract Documents and any such material not conforming to such requirements will be subject to rejection whether in place or not.
- C. The Owner reserves the right to refuse permission for use of material on the basis of a Certificate of Compliance.
- D. The form of the Certificate of Compliance and its disposition shall be as directed by the Owner.

1.09 SUBMITTALS - ACCEPTANCE OR REJECTION

- A. Submittals will be reviewed for overall design intent and returned to Contractor with action to be indicated by the Owner. It shall be the Contractor's responsibility to assure that previously accepted documents are destroyed when they are superseded by a resubmittal as such.
- B. It shall be the Contractor's responsibility to insure that required items are corrected and resubmitted in a timely manner.
- C. If the items or system proposed are acceptable, however the major part of the individual drawings or documents are incomplete or require revision, the submittal will be returned with requirements for completion.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01400 – PROJECT QUALITY CONTROL

PART 1 - GENERAL

Quality Control is the responsibility of the Contractor.

1.01 QUALITY CONTROL TESTING

- A. The Contractor, using the services of a certified and independent testing agency, shall provide all quality control testing for the project. Materials or equipment represented by samples shall not be used until tests, if required, have been made and the materials or equipment found to be acceptable. Any product which becomes unfit for use after approval thereof shall not be incorporated into the work. **Independent testing agency shall provide access to The City of Thornton via web page to see and download all testing reports. Unless not feasible, all test results shall be available after 24 hours of test performance. Forwarding test reports (paper, email or by other means) to Contractor to deliver to the City will not be acceptable.** The following tests will be performed as a minimum:
1. Fill and Backfill Tests

Control tests of soil fill, bedding, backfill, and base course shall be made at such times and in such numbers as specified in Division 2 - Site Work. Test locations shall be approved by the Owner. Contractor shall inform the Owner of quality control testing to allow Owner to witness.
 2. Concrete Tests

Control tests of concrete work shall be made at such times and in such numbers as specified in Division 3 - Concrete.
- B. All materials or equipment proposed to be used may be tested at any time during their preparation or use. The required samples shall be furnished without charge and sufficient notice given prior to the placing of orders to permit the testing. Products may be sampled either prior to shipment or after being received at the site of the work.
- C. The following additional quality assurance tests shall be made by a testing laboratory and/or the Owner/Engineer and paid for by the Owner as determined by the Owner/Engineer:
1. Fill and Backfill Tests

Control tests of soil fill, bedding, backfill, slurry wall, and base course shall be made at the discretion of the Owner/Engineer to compliment or verify the Contractor's quality control testing. Contractor's quality control testing, if witnessed and approved by the Owner/Engineer, may be accepted as quality assurance testing.
 2. Concrete Tests

Control tests of concrete work shall be made at the discretion of the Owner/Engineer to compliment or verify the Contractor's quality control testing. Contractor's quality control testing, if witnessed and approved by the Owner/Engineer, may be accepted as quality assurance testing.

All concrete testing shall have cylinders cast in the field for 7-day, (2) 28-day and 56-day compressive testing.

1.02 OTHER TESTING (QUALITY CONTROL)

- A. The Contractor shall engage the services of a certified welding inspector, to review and approve welders' certifications, welder qualifications, welding submittals and inspect and approve all field welds. The Welding Inspector shall provide a copy of the approvals or rejections to Thornton's Project Manager.
- B. If required by the Owner/Engineer, the following testing shall be performed at the expense of the Contractor installing the material being tested:
1. Factory tests - of any kind
 2. Shop welding and welding certifications
 3. Offsite granular material tests
 4. Any offsite tests
 5. Hydrostatic testing of pipeline
 6. Concrete mix preparation and testing
- C. Material Substitution
1. Any tests of basic material or fabrication equipment offered as a substitute for specified item on which a test may be required in order to prove its compliance with the Specifications. Substitutions shall be submitted and approved per city general and special conditions.
- D. Test Failure
1. Any test that fails shall be subject to the following conditions:
 - a. Quantity and nature of tests will be determined by the Owner/Engineer. All tests shall be taken in the presence of the Owner/Engineer or his representative.
 - b. Proof of noncompliance will make the Contractor liable for any corrective action which the Owner/Engineer determines is prudent including complete removal and replacement of defective material.

1.03 TEST REPORTS

- A. Reports of all tests made by testing laboratories shall be distributed by the testing laboratory and Certified welder as electronic (pdf) test reports within 24 hours of receiving the test results as follows:
- 1 electronic copy - Contractor
 - 1 electronic copy – Owner (Provide access to lab web page to see reports)
 - 1 electronic copy - Engineer
- B. Test results shall be provided within 24 hours of the test.
- C. Preliminary results shall be submitted to Contractor and Owner/Engineer via phone, fax, or e-mail as soon as testing is complete. If Contractor chooses to place additional material while testing is in progress, Contractor shall remove the new material at Contractor's expense if test fails.

1.04 CONTRACTOR'S QUALITY CONTROL SYSTEM

- A. General

1. The Contractor shall establish a quality control system to perform sufficient inspection and tests of all items of work, including that of Subcontractors, to insure conformance to the Contract Documents for materials, workmanship, construction, finish, functional performance and identification. This control shall be established for all construction except where the Contract Documents provide for specific compliance tests by testing laboratories or engineers employed by the Owner. The Contractor's quality control system shall specifically include all testing required by the various sections of the Specifications.
2. The Contractor's quality control system is the means by which he assures himself and the City of Thornton that his construction complies with the requirements of the Contract Documents. Controls shall be adequate to cover all construction operations and shall be keyed to the proposed construction schedule.

B. Pipe Alignment and Grade

1. Pipe alignment and grade is to be maintained through the use of suitable surveying instruments or laser equipment operated continuously during construction. Horizontal tolerances of $\pm 0.3'$ and vertical tolerances of $\pm 0.1'$ maximum deviation from plan and construction staking are to be maintained, except that visible "snaking" of the horizontal alignment and changes in direction of slope will not be permitted.

C. Records

1. The Contractor shall maintain correct records on an appropriate form for all inspections and tests performed, instructions received from the Owner/Engineer and actions taken as a result of those instructions. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.), proposed or directed remedial action, and corrective action taken. The Contractor shall document inspections and tests as required by each section of the Specifications. Records will be reviewed with each pay application.

D. Quality Assurance - Independent Testing

1. The City of Thornton reserves the option to use an independent testing agency to perform any test or inspections required to verify the Contractor's Quality Control or to test any defective work.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01500 - CONSTRUCTION TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 PERMITS

- A. Contractor is to obtain all necessary permits required to work in the City of Thornton, including but not limited to:
 - 1. NPDES Permit (if disturbance is >1.0 acre)
 - 2. Dewatering Permit (if water is discharged to river)
 - 3. Storm Water Management Plan
 - 4. Contractor's General Permit with the City of Thornton
 - 5. Building and Electrical Permits by City of Thornton Building Department
 - 6. Approved Traffic Control Plan by Adams County and the City of Thornton Engineering and Infrastructure Department
 - 7. Any Well permit required by the State for inspection, testing, implementation of the project

1.02 RELATED WORK

- A. Section 02370 – Sedimentation and Erosion Control
- B. Section 02980 – Traffic Control

1.03 NOISE CONTROL

- A. The Contractor shall comply with the City of Thornton noise ordinance.
- B. The Contractor shall equip construction machinery and vehicles with practical sound and muffling devices and operate in a manner to minimize noise consistent with efficient performance of the work.
- C. No work or noise shall be allowed between 6:00 p.m. and 7:00 a.m. Monday through Friday unless authorized in writing by the City of Thornton.

1.04 DUST CONTROL

The Contractor shall:

- A. Take reasonable measures to prevent unnecessary dust.
- B. Moisten dirt roads used for transportation and haul with water. No chemical dust suppressants shall be used unless written approval from the Owner is received.
- C. Cover dusty material in transit when necessary to prevent blowing.

1.05 POLLUTION CONTROL

The Contractor shall:

- A. Prevent the pollution of drains and water courses by sanitary wastes, concrete, sediment, debris and other substances resulting from construction activities.
- B. Retain all spent oils, hydraulic fluids and other petroleum fluids in containers for disposal off the

site. On site storage of fuel, diesel, gasoline or any product that can contaminate the reservoir water is not permitted.

- C. Not perform equipment maintenance or fueling within 50 feet of any water course or wetlands.
- D. Take appropriate measures to prevent sediment, debris or other deleterious substances from entering storm and sanitary systems, reservoir, river and wetlands.

1.06 EROSION CONTROL

The Contractor shall:

- A. Prevent erosion of soil on the site and adjacent properties that might result from construction activities; prevention measures shall include controlling runoff, trapping sediment and minimizing area and duration of erodible soils.
- B. Provide temporary materials such as CDOT Class A silt fencing, construction fencing, sediment control logs and hay bales to prevent the erosion of banks or excavations where runoff may be increased or concentrated due to construction activities.
- C. Preserve natural vegetation to greatest extent practical throughout project and when locating storage areas and performing all work.
- D. Install reinforced silt fence shown on the Plans. Fence is to be installed prior to start of any construction activity. Contractor shall maintain silt fence throughout project.

1.07 DRAINAGE

- A. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on site during performance of work.
- B. Drainage provisions will be adequate to prevent damage to the work and adjacent properties.
- C. Contractor shall obtain any necessary discharge permits.

1.07 TRAFFIC CONTROL

- A. Provide a traffic control plan for work impacting the regional trail, including signage and construction fencing, in accordance with an approved traffic control plan by Adams County and the City of Thornton.

1.08 HAUL ROUTES

- A. The Contractor shall coordinate haul routes with the Owner. The equipment and associated loads utilizing these routes shall be in accordance with applicable City, County, and State regulations.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01503 - PRESERVATION, RESTORATION, AND CLEAN-UP

PART 1 - GENERAL

1.01 SITE RESTORATION AND CLEAN-UP

- A. At all times during the work, keep the premises clean and orderly, and upon completion of the work, repair all damage caused by equipment and leave the project free of rubbish or excess materials of any kind.
- B. Stockpile excavated materials in a manner that will cause the least damage to adjacent grassed areas, gardens, shrubbery, or fences regardless of whether these are on private property, or on Town, State, or County rights-of-way. Remove all excavated materials from grassed and planted areas and leave these surfaces in a condition equivalent to their original condition.
- C. All existing drainage ditches and culverts shall be reopened and grade and natural drainage restored. Restore culverts broken or damaged to their original condition and location.
- D. Upon completion of pipe laying and backfilling operations, hand-rake and drag all former grassed and planted areas, leaving all disturbed areas free from rocks, gravel, clay or any other foreign material. The finished surface shall be free-draining and free from holes, ruts, rough spots, or other surface features detrimental to a seeded area.

1.02 TREE REMOVAL

- A. No trees except specifically shown on the Drawings to be removed, shall be removed without the express acceptance of the Owner/Engineer.

1.03 FINISHING OF SITE, BORROW, AND STORAGE AREAS

- A. Upon completion of the project, all areas used by the Contractor shall be properly cleared of all temporary structures, rubbish, and waste materials and properly graded to drain and blend in with the abutting property. Areas used for the deposit of waste materials shall be finished to properly drain and blend with the surrounding terrain.

1.04 REMOVAL OF ROCK FROM FINISHED SURFACES

- A. Remove and dispose of all loose rock and boulders larger than 3" diameter occurring on the finished surfaces as a result of the construction operations. Rock shall be disposed of offsite.

1.05 STREET AND SIDEWALK CLEAN-UP DURING CONSTRUCTION

- A. Thoroughly clean all spilled dirt, gravel, or other foreign material caused by the construction operations from all streets, roads, sidewalks, and parking lots at the conclusion of each day's operation or at a more frequent interval if required by the City of Thornton.

1.06 DUST PREVENTION

- A. Give all unpaved streets, roads, detours, or haul roads used in the construction area an approved dust-preventive treatment or periodically water to prevent dust. Applicable environmental regulations for dust prevention shall be strictly followed.

1.07 TRASH CONTROL

- A. Trash generated on site shall be gathered daily and removed from site weekly.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01510 - TEMPORARY CONSTRUCTION UTILITIES AND FACILITIES

PART 1 - GENERAL

1.01 WATER

- A. The Contractor shall coordinate a place of connection for temporary water with the City of Thornton (see Special Conditions Section 42). Water for construction may be available from the Cooley Reservoir, provided no contamination or waste is caused by Contractor.
- B. Potable water is available at a hydrant adjacent to the Cooley Pump Station. Contractor to obtain a backflow prevention meter from the City. A refundable deposit of \$1,400 is required.

1.02 CONSTRUCTION TRAILERS:

A. Due to floodplain regulations, the installation of construction trailers and temporary building facilities is not allowed. The City may allow the installation of a tool storage container to be located by McKay Pump Station or nearby, at an area indicated by the City of Thornton.

1.03 TEMPORARY ELECTRIC POWER

- A. General
 - 1. Electric power may not be available at or near the site. Contractor may need to provide generators to meet his power requirements. The Contractor can determine the type and amount available and make arrangements for obtaining a separate electric power service and pay all costs for the electric power used during the contract period.
- B. Safety Requirements for Temporary Electric Power
 - 1. Temporary electric power installation shall meet the construction safety requirements of OSHA, State and other governing agencies.

1.04 SANITARY FACILITIES

- A. The Contractor shall provide sanitary facilities for his employees, his subcontractors' employees, and Owner/Engineer; and maintain the facility in a sanitary condition at all times. The facility shall conform to code requirements and be acceptable to the sanitary authorities. Upon completion of the work, the sanitary facility shall be removed, and the area restored to its original condition.

1.05 PRODUCT DELIVERY AND STORAGE AND HANDLING

- A. Product Delivery
 - 1. Schedule delivery of products or equipment as required to allow timely installation and to avoid excessive on-site storage. Delivery of products or equipment to be in manufacturers original unbroken cartons or other containers, clearly and fully marked and identified as to manufacturer, item, location where to install, and instructions for assembly, use and storage.
 - 2. The Contractor shall inspect all products or equipment delivered to the site prior to their unloading and shall reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on project.
- B. Storage and Handling

1. Store products or equipment off ground and protected from weather. Provide additional protection as required by manufacturer until the time that the item is to be installed. While storing, take care to avoid creating a humidity chamber by venting area.
2. No storage of fuel, gas or oil onsite is allowed.
3. Store products or equipment in location to avoid physical damage to items while in storage, and to facilitate prompt inspection.
4. Handle products or equipment in accord with manufacturer's recommendations and instructions.
5. Delicate instruments and materials subject to vandalism shall be placed under locked cover, and if necessary, provided with temperature control as recommended by manufacturer.
6. All hazardous and/or toxic materials shall be stored in conformance with Federal, State and local regulations.

1.06 ACCESS

- A. If additional construction access is required beyond that shown on the Drawings, the Contractor shall get approval of the Owner/Engineer.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01700 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 CLOSEOUT PROCEDURES

- A. Project closeout procedures are defined in City of Thornton General Conditions.
- B. Comply with City of Thornton General Conditions and prior to release of final payment, the Contractor shall deliver the following items to the Owner:
 - 1. Maintenance Manuals and Parts Lists, as specified
 - 2. Any spare parts
 - 3. All Guarantees, Warranties and Submittals, as specified
 - 4. Receipts for Extra Materials Delivered to the Owner
 - 5. Miscellaneous Keys, Switches, etc.
 - 6. Project Record Documents and Redlined As-Built Drawings with surveyed as-built x, y, z top of pipe points
 - 7. Written warranty for items requiring more than one-year warranty

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01740 - WARRANTIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers standard warranties on products and special warranties.
- B. Summary of Special Warranties included in the Contract are shown on Table 1, attached.
- C. All other work, materials or equipment not listed herein shall be warranted for one year after initial acceptance as specified in the contract.

1.02 RELATED SECTIONS:

- A. The following Sections contain requirements that relate to this Section:
 - 1. Contract General and Special Conditions.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve Supplier of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve Supplier, and Subcontractors required to countersign special warranties with Supplier.

1.03 DEFINITIONS:

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by manufacturer to Owner.
- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for Owner.

1.04 WARRANTY REQUIREMENTS:

- A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted construction.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. Supplier is responsible for the cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Expressed warranties made to Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the Law. Expressed warranty periods shall not be interpreted as limitations on the time in which Owner can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- F. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, Owner reserves the right to refuse to accept the Work, until Supplier presents evidence that entities required to countersign such commitments are willing to do so.
- G. The equipment Manufacturer shall warrant that all equipment shall be free from defects caused by faulty material or workmanship for a minimum period of One (1) year from the date of Substantial

Completion, unless otherwise specified in the respective equipment specification sections and listed on attached table. Multiple warranties for individual components shall not be acceptable.

- H. Attached to this specification section is a summary of warranty conditions for major equipment and material items that are supplementary to the normal warranty obligations.

1.05 SUBMITTALS:

- A. Submit written warranties to Contractor prior to the date for Substantial Completion.
- B. When the Procurement Documents require Supplier, or Supplier and a Subcontractor to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by required parties. Submit a draft to Owner, through Contractor, for approval prior to final execution.
- C. Form of Submittal: At Initial Acceptance, compile One (1) electronic copy of each required warranty properly executed by Supplier, or by Supplier and a Subcontractor.

SPEC SECTION	SPEC NAME	ITEM	WARRANTY PERIOD	WARRANTY
02635	Submersible Pump and Motor	Wells Pump, Motors, Cables, sensors	5 YEARS	Subcontractor shall warrant pumps, motors, cables and sensors.
15151	Electromagnetic Flow Meter	Mag Meters, sensors, controllers.	5 YEARS	Subcontractor / Vendor shall warrant all Mag meters and related equipment.
16050 and Others	Electrical Installations	All Electrical Installations, cables, boxes, panels	2 Years	Subcontractor shall warrant all electrical installations, panels, wires, etc
16900	Instrumentation and Controls	All instrumentation and Controls not included on 5-year warranty	2 YEAR	Subcontractor shall warranty all instrumentation equipment
16950	PLC	PLC program and PLC modifications	2 YEARS	Subcontractor and Programmer shall warrant modifications to PLC systems and Programming

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

DIVISION 2 - SITE WORK

DIVISION 2 - SITE WORK

SECTION 02100 - MOVE IN AND SITE PREPARATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Prepare the site for construction
- B. Move in personnel and equipment
- C. Set up temporary offices, buildings, facilities and utilities (as required)
- D. Procure all necessary permits

1.03 RELATED WORK

- A. General Conditions
- B. Special Conditions

1.03 SITE CONDITIONS

- A. The Owner has provided the right-of-way, easement or project site for all permanent access or permanent construction for the Cooley Wells Pump Replacement and Meter Vault Installation.
- B. Areas designated on the Construction Plans may be used as storage yard, or base of operations provided that the use of said land meets with all of the requirements and restrictions imposed by the owner at the time of usage. Any waste materials, including petroleum products shall be removed from the area and disposed of in an approved location. Any areas outside the reservoir project used by the Contractor shall be restored to its original condition on completion of the construction. Due to floodplain regulations, the installation of construction trailers and temporary facilities is not allowed within the project site.
- C. Project Area Description:
 - 1. Property around the project site is owned by the City of Thornton
 - 2. The work area is located directly along and within the floodplain limits of the South Platte River. The project area is subject to flooding resulting from the South Platte River, precipitation or snow melt. The Contractor is advised to be aware of potential flooding events along the South Platte River.
- D. Contractor will be required to maintain access to project during winter months including plowing the access road.

1.04 SITE PREPARATION FOR CONTRACTOR OCCUPANCY

- A. The Contractor shall provide all temporary facilities as required for performing the work.
- B. The Contractor shall secure and maintain proper storage areas for equipment and materials in locations he may deem necessary for the proper execution of the job as approved by the Owner. Storage of material shall be in compliance with the City Floodplain regulations and the Floodplain permit issued for the project.
- C. No storage yard or project headquarters site may be utilized in conflict with objections from the adjacent property owners unless the Contractor obtains from the Owner specific written permission for such objectionable use.
- D. No objectionable material will be allowed to blow from, wash off or drain off of any storage yard on to adjacent property or the designated wetlands. The Contractor shall maintain all storage yards in as neat and

orderly manner as possible, allowing no accumulation of waste materials or disposal piles.

- E. The Contractor may construct a temporary security fence for the protection of materials, tools, and equipment. The fence shall be maintained during the construction period. Upon completion of work, the security fence shall be removed from the site.
- F. The Contractor shall provide adequate parking facilities within the designated area for personnel working on the project.
- G. The Contractor shall obtain the necessary permits for connection to necessary services provided by utility companies serving the project area.
- H. Materials, equipment, and work required for temporary storm water management during the construction period shall be provided by the Contractor as required to ensure public safety and to protect the work in progress and materials stored on site.
- I. Prior to commencing work, Contractor shall install reinforced silt fencing and other structures as needed to ensure that designated wetlands are not accessed and that no material washes into the wetlands.

1.05 DAMAGE OR USE-FEE CLAIMS

See General Conditions.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION STAKING

- A. Prior to the commencement of construction surveying, the Contractor shall verify the location and elevation of the project benchmarks and verify that they are consistent with the benchmarks shown on the Construction Plans.
- B. The Contractor shall stake out any designated wetland extents, construction, establish temporary benchmarks, lines, levels, batterboards, reference points, centerlines, and verify all dimensions in relation to connection with existing facilities. The Contractor shall be solely responsible for all errors in connection with this work.
- C. Prior to commencement of the work, the Contractor shall report to the Owner/Engineer any inconsistencies in the proposed lines, levels, grades, dimensions, or locations shown on the Drawings.

3.02 OBSTRUCTIONS

- A. The location of some utilities and obstructions may not be shown. Bidders are advised to carefully inspect the existing facilities before preparing their proposals. The removal and replacement of minor obstructions such as electrical conduits, irrigation lines, and similar items shall be anticipated and accomplished, even though not shown or specifically mentioned. Major obstructions encountered that are not shown on the Contract Drawings or could not have been foreseen by visual inspection of the site prior to bidding should immediately be brought to the attention of the Owner/Engineer. The Owner/Engineer will make a determination for proceeding with the work. If the Owner/Engineer finds that the obstruction adversely affects the Contractor's costs or schedule for completion, a proper adjustment to the Contract will be made in accordance with the General Conditions.

3.03 DEMOLITION

- A. Any existing structures encountered during construction shall be preserved until accepted for removal by the Owner/Engineer. The Contractor shall be required to repair pipes or structures in use that are damaged during construction at no cost to the Owner. The removal of abandoned pipes shall be subject to approval by the

Owner/Engineer.

3.04 REMOVAL AND SALVAGE OF MATERIALS

- A. The Contractor shall carefully remove materials specified to be reused or salvaged so as not to damage the material.
- B. Reuse by the Contractor of salvaged material will not be permitted, except as specifically shown or specified herein.
- C. Unless otherwise noted or requested by the Owner, existing materials to be removed or replaced and not specifically designated for salvage shall become the property of the Contractor and shall be disposed properly offsite.

3.05 CLEARING THE SITE

- A. Upon completion of the project, completion of a particular phase of the project, or termination of the use of any particular area, site, storage yard, right-of-way, or easement, the Contractor shall promptly and neatly clean up the area and re-establish the ground to the contours required by the project or conditions prior to project commencement.

3.06 FUEL STORAGE

The Contractor is not allowed to store any fuel, paint, or other material that can be considered a pollutant or may cause contamination to groundwater or to the adjacent water reservoir. NO exceptions will be granted.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02110 - SITE CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDES

- A. Clearing and grubbing, and salvaging and stockpiling of any topsoil along the pipeline and measuring vault alignments.
- B. Disposal offsite of cleared trees, shrubs, and debris.

1.02 CLEARING LIMITS

- A. The general limits of clearing work areas are shown on the drawings.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that existing plant life and features designated to remain or to be protected are tagged or identified.

3.02 PROTECTION

- A. Protect any trees, plant growth, and features designated to remain as final landscaping. Remove only those trees required to be removed, as determined by the City.
- B. Protect benchmarks and survey monuments from damage or displacement. Repair or replace any benchmarks or survey monuments damaged during clearing by the Contractor at no cost to the City.

3.03 CLEARING

- A. Remove all trees, brush, willows, and shrubs up to 1' in diameter or as designated by the Owner/Engineer as required to reasonably complete the described work.
- B. Clear undergrowth and dead wood.
- C. Grubbing is not considered excavation.

3.04 REMOVAL

- A. Remove extracted trees, debris, roots, and shrubs from the site.
- B. Dispose of all brush, tree trucks, stumps, roots, and debris from clearing operations offsite.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02200 - COMMON EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

A. General

1. To extent of common earthwork is indicated on the Contract Drawings and includes excavation, backfill of any structures shown on the plans, and hauling excess soil.

1.02 RELATED WORK

- A. Section 02100 - Move In and Site Preparation
- B. Section 02222 - Structural Excavation, Backfill and Compaction
- C. Section 02225 - Trenches, Bedding and Backfill
- D. Section 02931 - Seeding

1.03 JOB CONDITIONS

- A. The Contractor shall satisfy himself as to the kind and type of soil to be encountered and any water conditions, which might affect the construction of the project.
- B. The locations of existing utilities are shown in an approximate way only and not all utilities may be shown. The Contractor shall determine the exact location of all existing utilities prior to commencing work. The Contractor shall be fully responsible for any and all damages, which might be occasioned by his failure to exactly locate and preserve any and all utilities. If utilities are to remain in place, the Contractor shall provide adequate means of support and protection during construction.
- C. Should drawn, not drawn, or incorrectly drawn piping or other utilities be encountered during excavation, the Contractor shall advise the Owner/Engineer within 30 minutes of encountering the utility. The Contractor shall cooperate with the Owner/Engineer and utility companies in keeping respective services and facilities in operation to the satisfaction of the respective owners. The Owners reserve the right to perform any and all work required should the Contractor fail to cooperate with the respective companies, and back charge the Contractor for any and all expenses.
- D. Where needed for hauling common fill offsite, the Contractor shall provide barricades and signs in accordance with the Uniform Manual of Traffic Control Devices where applicable. The Contractor shall maintain all devices in a working manner.

PART 2 - MATERIALS

2.01 SOIL MATERIALS

A. Earthfill

1. Soil material for use as backfill around structures or for site grading shall be on-site excavated materials free from frozen lumps, wood, or other organic, extraneous or perishable material and approved by the Owner/Engineer.

PART 3 - EXECUTION

3.01 EARTHFILL CONSTRUCTION

- A. The Contractor shall construct earthfills to lines and grades shown or specified. The fill shall be placed in continuous horizontal layers not exceeding 10" in loose thickness. Where hand operated compaction equipment is used, the layers shall not exceed 6" in loose thickness.
- B. The Contractor shall protect the fill against freezing when atmospheric temperature is less than 35 deg. F. (1 deg. C). No fill may be placed when the fill is frozen, contains snow or ice, or the surface on which the fill is to be placed is snow covered, or is frozen and contains ice lenses.

3.02 COMPACTION

- A. Compaction by equipment traffic shall be adequate for common fill not associated with the diversion structures.
- B. Unless noted otherwise, compaction shall be not less than 95% Standard Proctor at +/- 2% optimum moisture.

3.03 GRADING

- A. The Contractor shall perform all grading to the lines and grades as shown on the Drawings and/or established by the Owner/Engineer, with 6" allowance for topsoil where specified or shown. Shape, trim, and finish slopes of channels to conform with the lines, grades, and cross sections as shown or approved. All slopes shall be free of all exposed roots and stones exceeding 2" diameter, which are loose and liable to fall. Tops of banks shall be rounded to circular curves not less than 6' in radius.
- B. Rounded surfaces shall be neatly and smoothly trimmed.
- C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, the Contractor shall scarify the ground surface, re-shape, and compact to required density prior to further construction.

3.04 DISPOSAL OF EXCESS EXCAVATION AND SPECIAL REQUIREMENTS

- A. The Contractor shall dispose of all excess excavated material not required for use offsite. Broken concrete, asphalt, pipes, and manmade materials are to be disposed of offsite.
- B. The Contractor shall conduct all site grading operations and other construction activities to minimize erosion of site soil materials.

3.05 DISPOSAL OF REMOVED PIPE

- A. Contractor shall dispose offsite of existing pipe removed and any man-made materials from excavation.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02222 - STRUCTURE EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers furnishing of all labor, materials, tools, equipment, and performing all work and services for excavating, over excavating, borrowing, removing undesired or excess materials, filling and backfilling of the soils for the structures shown on the Drawings, in accordance with the Contract Documents.
- B. Although such work is not specifically indicated, perform all supplementary work incidental to the services outlined above.
- C. Foundations include footings, floor slabs, walls, mat foundations, aprons, or any other support placed on or in the soil.

1.02 QUALITY STANDARDS

- A. ASTM D-698 (Standard Proctor)

1.03 SUBMITTALS

- A. See Section 01345.

PART 2 - MATERIALS

2.01 FILLS

- A. Materials for use in the construction of fills shall conform with the fill designation indicated on the plans and specified in the appropriate section of the specifications. Materials excavated for the foundations may be acceptable for use with prior review and acceptance by the Owner/Engineer.

2.02 FOUNDATION BACKFILL (3/4" Gravel)

- A. Materials used for structural backfill shall be of a quality acceptable to the engineer and shall be free from frozen lumps, wood, or other organic, extraneous or perishable material. This material shall meet the following gradation:

<u>Sieve Size</u>	<u>% Passing by Weight</u>
1 1/2"	100
1" - 1/2"	95 - 100
No. 4	25 - 60
No. 8	0 - 5

- B. In addition, a plasticity index of 15 or less when determined in conformity by AASHTO T90 and shall be non-swelling soils. Soils with claystone bedrock are not allowed.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall notify the Owner/Engineer at least 48 hours in advance of the commencement of any phase of the work, as well as any delays or stoppage.

3.02 TOPSOIL

- A. Topsoil shall be removed and stockpiled for use during finish grading. Topsoil which is to be used shall be free from brush, weeds, debris, and stones of any kind larger than 1/2" in diameter. Excess topsoil shall be disposed on-site as directed by the City.

3.03 EXCAVATION

- A. The Contractor shall excavate to elevations shown on the Contract Drawings, allowing additional space as required for construction operations and review of foundation construction. All excavation and side slopes shall conform to all applicable regulations. Where engineered cut slopes are required by OSHA regulations, the Contractor shall retain a Professional Engineer to provide the necessary engineering designs for review by the Owner/Engineer. The Contractor shall remove obstructions including but not limited to old foundations, pipe, unsuitable subgrade soils, and any other materials which may be concealed beneath the present grade, as required to construct an acceptable grade for the foundations.
- B. The Contractor shall protect existing structures from displacement, settlement, or damage caused by excavation work. Protection may include shoring, bracing, and hand excavations or other techniques as approved by the Owner/Engineer.

3.04 OVER-EXCAVATION

- A. The Contractor shall over-excavate subgrade soils, as required or as shown on the Drawings, which in the opinion of the Owner/Engineer, are undesirable or unsuitable for foundation support.

3.05 PREPARATION OF STRUCTURE FOUNDATIONS

- A. Where foundations are to rest on subgrade material, care should be taken to avoid disturbance of the bottom of the excavation. Soils loosened during excavation shall be removed from the excavation, and the excavation restored to a condition at least equal to the undisturbed subgrade. The subgrade shall be moisture conditioned and compacted prior to placement of the structure's foundation components or structural fill.
- B. The Contractor is responsible for notifying the Owner/Engineer as soon as excavations are completed in order that subgrade may be reviewed.
- C. Completed excavations and subgrades shall be protected from becoming unacceptable including but not limited to becoming wet, frozen, or soft due to weather, and or construction operations. Grading around excavations for structures shall be performed to prevent water from running into the excavation or from damaging completed foundations. Should any free water, ground water, or springs be encountered, the Contractor shall be required to keep excavations free from water during construction of the foundations by the use of trenches, well points, or other means as reviewed and accepted by the Owner/Engineer. The subgrades shall be protected from freezing by blankets, a removable "loose lift" of soil, or other means as approved by the Owner/Engineer. Any frozen soil will be required to be removed and the subgrade will be required to be reworked.

- D. The Contractor shall shore, sheet pile, slope, and/or brace excavations as required to maintain a safe site and to conform to all local, State, or Federal agency regulations having jurisdiction over the work. The Contractor is fully and solely responsible for maintaining safe working conditions during construction.
- E. The Contractor is responsible for protecting all monuments, benchmarks, and other reference points to be used to construct the foundations. Reference points disturbed that require restaking, will be restaked by the Owner/Engineer at the Contractor's expense.

3.06 STRUCTURE BACKFILL

- A. Structure backfill shall not be placed until the foundations or other portions of the structure have been reviewed by the Owner/Engineer and accepted for backfilling. The foundation soils shall be tested by density gauge and/or proof-rolled, as approved by the Owner/Engineer, before any backfill material and structures are placed. No backfill materials shall be deposited against foundation walls, abutments, and retaining walls until the structure has reached the strength necessary to sustain backfill and other anticipated loads.
- B. When permitted by the Owner/Engineer, footings may be backfilled to a level equal to the top of the footings or berm elevation where appropriate, upon removal of the forms.
- C. Foundations for rigid frame structures or walls or abutments which are not designed as self-sustaining against soil and backfill loads shall not be backfilled unless the superstructure has been placed and has reached a strength necessary to sustain the anticipated loads.
- D. Foundations shall not be backfilled until the area involved has been cleared of all falsework, sheet piling, cribbing, shoring, bracing, forms, and debris.
- E. Structure backfill shall be performed as to prevent wedging action against the structure. Existing slopes shall be stepped, terraced, or otherwise treated as necessary to prevent slippage and wedging of the backfill.
- F. Unless otherwise provided, backfill shall be placed in continuous horizontal layers not exceeding 10" in loose thickness. Where hand operated compaction equipment is used, the layers shall not exceed 6" thick. Hand operated compaction equipment will be required within 3' of existing or new structures. Each layer shall be brought up uniformly on all sides of the foundation and shall be compacted before the next layer is placed, by means of rollers, tampers or vibrators. No fill shall be placed when the bank soils are frozen, contains snow or ice, or the surface on which the fill is to be placed is snow covered, or is frozen and contains ice lenses. Any frozen soil within the backfill soils shall immediately be removed. Backfill is not allowed until concrete has achieved 75% of design strength.
- G. Backfilling operations shall be performed to minimize live load and compaction effort surcharges to the foundation. Backfill operations shall be performed in such a manner that no portion of the foundation or structure is damaged or deflected out of alignment. All backfill shall be compacted in accordance with the densities shown on the plans, but not less than 95% Standard Proctor at +/- 2% optimum moisture. Soil that does not meet these specifications shall immediately be reworked until the compaction and moisture specifications are met or removed.
- H. The foundation shall be free of any standing water. If water is present, it shall be removed and the foundation reworked, repaired, and retested before any backfill material or structures are placed. Water shall not be used to expedite settlement of backfill. Compaction by jetting is unacceptable.
- I. Backfill materials transported in trucks or other vehicles shall be placed so that the contents of each vehicle are carefully and gradually deposited. All clams, dippers, or containers of backfill shall be lowered to within 5' of the surface of the previously deposited backfill before they are dumped.

- J. The Contractor is responsible for legally disposing of excess excavated materials, rock, organic materials, and soils from the site. The Owner/Engineer may request written confirmation from the Owner of the property where excess and waste materials are deposited.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02225 - TRENCHES, BEDDING, AND BACKFILL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Labor, equipment, and materials necessary for excavating, trenching, bedding, and backfilling.

1.02 RELATED WORK

- A. General Conditions
- B. Section 02610 - Pipe

1.03 REFERENCES

- A. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D4253 and D4254 - Test for calculation of relative density.
- C. ASTM D698 - Standard Proctor Compaction

1.04 TESTING

A. Field Testing - In-Place Density

- 1. In-place density tests will be performed to ensure pipe backfill and bedding complies with specified requirements. The backfill shall be compacted to a minimum of 95% Standard Proctor density (ASTM D-698). The granular bedding shall be compacted to a minimum of 70% +/- 2% of relative density per ASTM D-4254.
- 2. Testing frequency:

Bedding	None required
Backfill	1 per 50 LF per 1' of backfill or 2 per day when backfill is being placed, whichever is larger

B. Quality Control

- 1. All soils testing during construction shall be performed per project specifications by Contractor's Quality Control program. See Specification Section 01400.

1.05 SUBMITTALS

- A. See Section 01345.
- B. The Contractor shall cooperate with the Owner/Engineer in obtaining samples of all bedding and backfill materials. The Contractor shall submit a sample of pipe bedding and backfill soils to the Owner/Engineer prior to construction so gradations and relative and Standard Proctor density can be determined.

1.06 PROTECTION

- A. The Contractor shall protect excavations and existing structures by shoring, bracing, sheet piling, underpinning, or other methods required to prevent any excessive widening or sloughing of the trench which may be detrimental to human safety, to the pipe or appurtenances being installed, or to existing facilities or structures.

- B. The safety of the workers shall be provided for as required by the most recent standards adopted by the Colorado Occupational Safety and Health (COSH) Standards Board as enforced by the Colorado Department of Labor.
- C. Heavy equipment should not be used or placed near the sides of the trench unless the trench is adequately braced.
- D. The Contractor shall protect bottom of trench excavations from frost.
- E. The excavation shall be graded, or otherwise dewatered, to prevent surface water run-off into trench or excavation.
- F. Existing utilities shall be protected from damage due to construction activities. The Contractor shall repair damages to utilities at his own expense to the satisfaction of the Owner/Engineer.

PART 2 - MATERIALS

2.01 PIPE BACKFILL AND BEDDING MATERIALS

- A. Pipeline Backfill for pipes less than 4 inches diameter
 - 1. The material shall be obtained from the required excavations or other sources determined by the Contractor and approved by the Owner/Engineer. The soils shall be free of any deleterious materials, including materials larger than 1", as specified by the Owner/Engineer.

- B. 4" diameter and larger Pipe Bedding

Pipe bedding shall be constructed of free draining, well graded granular material meeting the following gradation, or approved equal.

<u>Sieve Size</u>	<u>% Passing</u>
3/8"	100
No. 4	75 - 100
No. 30	4 - 75
No. 200	≤ 4

PART 3 - EXECUTION

3.01 GENERAL

- A. No more than 50' of trench shall be left open at any time during construction. The trench shall not be backfilled until the pipe installation is reviewed by the Owner/Engineer.
- B. Prior to placement in the trench, all pipe, fittings, and appurtenances shall be cleaned and examined for defects by the Contractor. If found defective, the Contractor shall reject the defective pipe, fitting, or appurtenance. The Contractor shall advise the Owner/Engineer of all defective materials.
- C. Excavated material shall be temporarily placed a minimum of 4' from the top edge of the trench, unless otherwise governed by Federal, State or local safety codes.
- D. All surplus excavation shall be disposed offsite.
- E. The maximum deflection of the pipe, in any direction, that will be permitted at any time shall not exceed 80% of the manufacturer's maximum allowable deflection.

- F. Upon completion of the work, all plants, rubbish, unused materials, concrete forms and other like material shall be removed from the jobsite. All excess excavation shall be disposed of as specified and the areas shall be left in a state of order and cleanliness.

3.02 PROTECTION OF EXISTING UTILITIES

- A. The location of existing utilities is shown in an approximate way only and not all utilities may be shown. The Contractor shall determine the exact location of all existing utilities prior to commencing work. The Contractor shall be fully responsible for any and all damages which might be occasioned by his failure to exactly locate and preserve any and all utilities. If utilities are to remain in place during construction, the Contractor shall provide adequate means of support and protection.

3.03 OBSTRUCTIONS AND DISPOSAL OF WASTE MATERIAL

- A. The Contractor shall remove obstructions that do not require replacement from within the trench or adjacent areas such as tree roots, stumps, abandoned piling, buildings and concrete structures, frozen material, logs, and debris of all types without additional compensation. The Owner/Engineer may, if requested, make changes in the trench alignment to avoid major obstructions, if such alignment changes can be made within the work limits without adversely affecting the intended function of the facility. Excavated materials unsuitable for backfill or not required for backfill shall be disposed of as directed by the Owner/Engineer.

3.04 TRENCH EXCAVATION

- A. The trench shall be excavated so that a minimum clearance as shown on the plans is maintained on each side of the pipe for proper placement and densification of the bedding or backfill material. The maximum clearance measured at the spring line of the pipe shall be as shown on the construction drawings.
- B. All excavations shall be made to the lines and grades as established by the Contract Drawings. Pipe trenches shall be excavated to a minimum depth as shown on the plans below the bottom of the pipe. Deviation from grades will be allowed only when approved by the Owner/Engineer. Over excavation shall be rectified to the satisfaction of the Owner/Engineer at the expense of the Contractor.
- C. Care shall be taken to ensure that the excavation does not extend below established grades. If the trench excavation is made below such grades, the excavation shall be filled with the specified bedding soil for that pipe at the Contractor's expense.
- D. The trench width at the top of the pipe will not be limited, except where specifically shown on the Contract Drawings or where excess width of excavation would cause damage to adjacent structures or property.
- E. Slope sides of excavations shall comply with applicable codes and ordinances. The Contractor shall shore and brace where sloping is not possible because of space restrictions, or to protect adjacent structures, property, workers, and the public.
- F. The Contractor shall maintain sides and slopes of excavation in a safe condition until completion and acceptance of backfill operations.
- G. Materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, shall be in good serviceable condition. Trench widths shall consider the thickness of the shoring.
- H. Requirements for trench shoring and bracing shall comply with local codes and authorities. It is the Contractor's responsibility to determine and coordinate with the appropriate agencies.
- I. The Contractor shall stockpile excavated materials in a safe manner. Stockpiles shall be graded for proper drainage.

- J. The Contractor shall place and grade the trench base to the proper grade ahead of pipe laying. The pipe base shall be compacted to provide a firm unyielding support along entire pipe length.

3.05 SURPLUS EXCAVATION MATERIAL

- A. All surplus excavation shall be disposed of offsite unless agreed by the City of Thornton to be disposed of onsite.

3.06 PIPE BEDDING

- A. For all types of pipe, the limits of granular bedding shall be as shown on the trench section detail on the Drawings. Bell holes shall be dug deep enough to provide a minimum of 4” of clearance between the bell and the trench subgrade. All pipe shall be installed in such a manner as to insure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade and the joint is made, the bedding material shall be carefully placed and tamped under the haunches along the entire pipe length.
- B. Granular bedding shall be compacted in 6-inch lifts with 3 passes with a vibratory plate compactor.
- C. Where Drawings show clay (fine soils) bedding, backfill specifications below apply.

3.07 BACKFILL AND COMPACTION

- A. Pipe trenches shall be backfilled to the limits as shown on the Contract Drawings. Backfill shall be compacted to 95% of the maximum dry density as determined by Standard Proctor testing, ASTM D698. The trench shall not be frozen, have frozen material and all standing water shall be removed prior to backfilling.
- B. All backfill shall be brought up to equal height along each side of the pipe in such a manner as to avoid displacement. Wet, soft or frozen material, asphalt chunks, organic, or other deleterious substances not meeting bedding specifications shall not be used for backfill.
- C. Backfilling shall be conducted at all times in a manner to prevent damage to the pipe or its coating and shall be kept as close to the pipe laying operation as practical.
- D. Backfilling procedures shall conform to the additional requirements, if any, of appropriate or private right-of-way agreements.

3.08 SURFACE RESTORATION

- A. Unsurfaced Areas
 - 1. All surface cuts shall be, as a minimum, restored to a condition equal to that prior to construction.
- B. Surfaced Areas
 - 1. All surface cuts shall be, as a minimum, restored to a condition equal to that prior to construction. All gravel or paved streets shall be restored in accordance with the regulation and requirements of the agency having control or jurisdiction over the street, roadway, or right-of-way.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02230 - CRUSHER FINES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Extent of crusher fines is indicated on the Contract Drawings.

1.02 RELATED WORK

- A. Section 02200 - Common Earthwork

1.03 SUBMITTAL

- A. See Section 01345.
- B. The Contractor shall submit for approval the gradation and Atterberg limits data for the crusher fines, and identify the quantity required to spread 4 inches of crusher fines over designated areas shown on the Construction Drawings.

PART 2 - MATERIALS

2.01 CRUSHER FINES

- A. Imported, hard, durable, natural crushed stone or crushed gravel by product with sufficient finer material for proper compaction, well-graded, and free from deleterious material.
- B. Gradation as determined in accordance with ASTM C 117 and C 136:

<u>Sieve Size</u>	<u>% Passing</u>
3/8"	100
No. 4	90 - 100
No. 16	55-80
No. 30	<u>40-70</u>
No. 200	<u>5-15</u>

- C. Atterberg Limit parameters: Liquid Limit not exceeding 30 and Plasticity Index not exceeding 6 as determined in accordance with ASTM D 4318.
- D. Recycled millings are an acceptable alternative to crusher fines.

PART 3 - EXECUTION

3.01 CRUSHER FINES

- A. Compact crusher fines to a 4-inch thickness as shown on the drawings. Compact to within 95 percent relative compaction (ASTM D 1557) with moisture between 2 percent below and 2 percent above optimum moisture content.
- B. Equipment used for compaction of crusher fines shall consist of a heavy-duty, self-propelled steel drum vibratory roller. The static weight of the roller shall be at least 12,000 pounds. The vertical applied dynamic force shall be at least 4,000 pounds per foot of drum width when operated between 1,300 and 1,800 vibrations per minute.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02240 - DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Handling and removal of surface water and groundwater as necessary to perform excavation, place backfill and concrete, install pipe, and perform other construction work in the dry. Dewater clean uncontaminated water into adjacent reservoir.
- B. All excavations will be lower than the normal flow line of the South Platte River and below the groundwater table. It's anticipated that dewatering operations will need to be occurring throughout the project.
- C. Pre excavation dewatering shall be performed to drop the groundwater level to 2 feet below the proposed excavation.
- D. The dewatering pumping rates shall be anticipated to be in the range of 200-500 gallons per minute. It's anticipated that the highest dewatering rate will occur at Meter Vault #1 and the lowest dewatering rate will occur at Meter Vault #5.

1.02 DESIGN REQUIREMENTS

- A. Contractor shall be responsible for design of dewatering systems.
- B. Accommodate variation in groundwater conditions due to natural spatial and seasonal variations across the site.

1.03 SUBMITTALS

- A. Administrative:
 - 1. Dewatering Permits
 - 2. Discharge Permits
- B. Shop Drawings:
 - 1. Dewatering Plan: Prepare comprehensive dewatering plan. At a minimum, include the following information:
 - a. Proposed materials, methods, and types of equipment to be used for dewatering excavations.
 - b. Sequencing and scheduling requirements.
 - c. Estimated flow rates.
 - d. Sketches showing proposed piping and dewatering facilities layout.
 - e. Certification for flow meter
 - f. Backup generator required to keep the dewatering system working if the primary generator failure.
 - g. Secondary procedures that will be implemented if primary procedures are not adequate to maintain dry excavations.
 - 2. Dewatering Plan Update: Revise if system is modified during installation or operation.
- C. Quality Control:

1. Discharge flow rate measurements; submit weekly.
2. Comply with NPDS and State requirements.
3. All discharge flows shall be measured using calibrated meters provided by the Contractor as accepted by the City.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Review available topographic, subsurface, and hydrogeologic data for the project.
- B. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages and provide adequate backup system to maintain control of water.
- C. At all times during construction, provide ample means and devices to remove promptly and dispose of properly all water entering excavations and keep the bottom of the excavations firm and free of standing water until the structures to be built therein are completed and/or the backfill to be placed therein has been placed.
- D. Pre excavation dewatering shall be performed to drop the groundwater levels to 2 feet below the proposed excavation.
- E. The dewatering system shall be operated continuously as necessary to prevent flotation of partially completed structures or other work.
- F. Discharge water so that it shall not cause siltation, erosion, or other negative environmental impacts.

3.02 DEWATERING SYSTEMS

- A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to low and maintain groundwater level a minimum of 2' below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.
- B. Design and operate dewatering systems:
 1. To prevent loss of ground as water is removed.
 2. To avoid inducing settlement or damage to existing facilities, completed work, or adjacent property.
 3. To relieve artesian pressures and resultant uplift of excavation bottom.
- C. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.
- D. Provide 100% emergency power backup with automatic startup and switchover in event of electric power failure.
- E. Provide supplemental ditches and pumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.03 MONITORING FLOWS

- A. Monitoring volume of water pumped per calendar day from excavation, as work progresses. Also monitor volume of water introduced each day into excavations for performance of work. Monitor flows using a calibrated measuring device acceptable to the Owner/Engineer.

3.04 DISPOSAL OF WATER

- A. If dewatering into a water body other than the reservoir then obtain dewatering permit of water disposal from authorities having jurisdiction.
- B. Contractor may be allowed to dispose water into reservoir as long as water is clean and free of any kind of pollutants.
- C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed work, or adjacent property.
- D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.
- E. Contractor shall measure water discharged to the South Platt River or East Cooley Reservoir using a calibrated flow meter.

3.05 PROTECTION OF PROPERTY

- A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.
- B. Securely support existing facilities, completed work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

3.06 REMOVAL

- A. All elements of the dewatering system shall be removed from the site at the completion of the dewatering work.
- B. All voids left as a result of the dewatering system shall be grouted.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02370 – SEDIMENTATION AND EROSION CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all installation, maintenance, removal, and area cleanup related to erosion and sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, stone filter boxes, stone filter berms, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup.
- B. Comply with City requirements for erosion control and State MS4 permits.
- C. Comply with any applicable State of Colorado permits.
- D. Comply with City Standard requirements as indicated in General and Special Conditions.
- E. The City will inspect erosion control and sediment installation on a bi-weekly basis. Perform corrections as indicated by the City Inspector to be in compliance with MS4 permits.

1.02 RELATED WORK

- A. Move in and Site Preparation is included in Section 02100.
- B. Fill materials are included in Section 02200.
- C. Seeding is included in Section 02931.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01345, within 10 days after award of Contract, technical product literature for all commercial products, including seed mix, fertilizer, erosion control blankets, sediment control logs, and straw mulch tackifier, to be used for erosion and sedimentation control.

1.04 QUALITY ASSURANCE

- A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the Construction Site to offsite areas, or into the stream system or into the reservoir via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment offsite shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the Owner will be considered. The Contractor shall obtain a General Storm Water Management Plan as required by the Colorado Department of Health and Environment for Storm water Discharges Associated with Construction Activity.
- B. Sedimentation and erosion control measures shall conform to the requirements of Urban Drainage and Flood Control District, the Colorado Department of Public Health and Environment, City of Thornton standard specifications, and Adams County. If conflict between standards occurs, Contractor is to use most strict description.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Crushed stone for sediment filtration devices, access ways and staging areas shall conform to Section 03310 (Crushed Concrete).
- B. Silt Fence
 - 1. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as "Envirofence" by Mirafi Inc., Charlotte, NC or approved equal.
- C. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.
- D. Latex acrylic copolymer or organic tackifier shall be a commercial product specifically manufactured for use as straw mulch tackifier.
- E. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the Engineer.
- F. Sediment control log shall be installed as depicted in the Design Drawings and as per manufacturer instructions. Logs shall be staked using wooden stakes. The logs shall be made from straw, compost, excelsior, coconut fiber, or combination thereof.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Silt Fence: Install all materials per Design Details provided and guidance by material manufacturer.
- B. Locate features as per Design Drawings or as required by construction activities.
- C. Any relocation of features is to be redlined on SWMP Plan and implemented only after Construction Manager approval.

3.02 MAINTENANCE AND INSPECTIONS

- A. Inspections
 - 1. Make a visual inspection of all erosion and sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to off Site areas, promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.
- B. Device Maintenance
 - 1. Silt Fences
 - a. Remove accumulated sediment once it builds up to 1/2 of the height of the fabric.
 - b. Replace damaged fabric, or patch with a 2-ft minimum overlap.
 - c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

2. Sediment Logs
 - a. Repair logs and remove sediments when 1/2 of log is buried.
3. Vehicle Tracking Pad and Concrete Washout
 - a. Muck out trapped debris and dewatering pit trench when it has built up to within 6-in of the top of the berm.
 - b. Replace crushed stone filter when saturated with silt and pore space is less than 1/4 of original installation.
4. Add crushed stone to access ways and staging area as necessary to maintain a firm surface free of ruts and mud holes.
5. After initial acceptance, maintain all erosion control and perform monthly inspections with the City Staff. Continue maintenance for a minimum of one year or until seeding is established and Final Acceptance is awarded by the City.

C. Maintenance of Erosion Control after Initial Project Acceptance – 1 year Maintenance

1. Inspection and Quality Control Requirements
 - a. After initial project acceptance and before final acceptance, perform monthly inspections (with City representative) of all erosion and sediment control facilities.
 - b. Repair and correct all identified deficiencies.
 - c. Maintain all sediment and erosion control facilities for one year after initial project acceptance.
 - d. Once seeded areas are established to 80 percent growth and accepted by the City, remove all erosion control items.

3.03 TEMPORARY MULCHING

- A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.
- B. Straw mulch shall be applied at rate of 100-lb/1,000-sq-ft and tackified with latex acrylic copolymer at a rate and diluted in a ratio per manufacturer's instructions.

3.05 REMOVAL AND FINAL CLEANUP

- A. Once the Site has been fully stabilized against erosion and project final acceptance has been awarded, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02610 - PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the furnishing and installation of ductile iron and C900 PVC pipe.

1.02 RELATED WORK

- A. 02225 - Trenches, Bedding and Backfill

1.03 SUBMITTALS

- A. See Section 01345 - Submittals

PART 2 - MATERIALS

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Specifications

- 1. The pipe shall be designed, manufactured, tested, inspected and marked in accordance with the provisions of this Specification and AWWA Standard C-151, "American Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids", except as herein modified.

B. Dimensions

- 1. Nominal pipe lengths shall be 18' or 20', with shorter lengths provided as required by drawings, alignment and profile. Permissible variations in length, diameter, weight, wall thickness and straightness shall comply with the allowable tolerances specified in the applicable AWWA Standards. The minimum finished inside diameter of the pipe, after lining is placed, shall be as set forth in the applicable AWWA Standards.

C. Ductile Iron Pipe Diameter and Pressure Class

<u>Pipe Size (inch)</u>	<u>Pressure Class</u>
3 through 12	350
14 through 20	250
24	200
30 through 64	150

D. Joint Design and Fabrication

- 1. All joints shall be restrained using one of the following: thrust blocks, American Cast Iron Pipe Company's "LOKFAST" joint, U.S. Pipe and Foundry Company's "T.R. Flex" joint, Clow Corporation's "Super-Lock" joint, EBBA Iron's "Megalug," Griffin Pipe Products Company's "Snap-Lok" joint, or approved equal. The joint restraint shall be designed to resist thrusts resulting from internal pressure acting at bulkheads, bends, valves. The joint restraint shall be designed for a minimum working pressure of 250 psi. Note: EBBA Iron's "Megalug" joints shall not be used on the 6" diameter return flow carrier pipe.

2. The manufacturer shall furnish all joint materials including rubber gasket and joint lubricant.
3. Harness rods are to be utilized across closure assemblies in tied sections of the line. Rods are to be connected to the pipe by the use of megalugs attached behind bell and spigot joints. Following installation, the harness rods shall be wrapped with a layer of protective tape conforming to AWWA C-209. Design calculations for the harness rods, are to be submitted to the engineer for approval.

E. Flanges

1. All flanges shall conform to ANSI B16.5 for working pressure of 150 psi. Blind flanges shall be designed in accordance with ASME Unfired Pressure Vessel Code, Section VIII. The design pressure for the blind flanges shall be 150 psi. Flanges shall be designed on the basis of using 1/8-inch ring type compressed gaskets. Bolt holes in all flanges shall straddle field vertical centerline. Insulated flanges shall have bolt holes 3/16" diameter greater than the bolt diameter.

F. Gaskets for Flanges

1. Gaskets shall be 1/8" ring type Garlock No. 3200 compressed non-asbestos sheet packing or approved equal.

G. Specials and Fittings

1. Unless otherwise shown on the plans, all specials and fittings shall conform to the dimensions and requirements of AWWA Standard C-110. Fittings shall be designed for 250 psi working pressure and shall have the same lining and coating as the abutting pipe.
2. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand, using the same materials as are used for the pipe and in accordance with the applicable AWWA Standards. Coatings and linings applied in this manner shall provide protection equal to that specified for the pipe. Areas of lining and coating that have been damaged shall be repaired by hand application in accordance with applicable AWWA Standards.
3. Fittings shall be furnished with mechanical joint, ring tile or flanged ends conforming to referenced specifications and, in addition, the tee-head MJ bolts and hexagon nuts shall be 316 stainless steel or approved equal. Swivel fittings as approved by the Engineering may also be utilized.

H. Cement-Mortar Lining

1. Interior surfaces of all pipe, fittings, and specials shall be lined in the shop with cement-mortar in accordance with AWWA Standard C-104. The cement shall meet the requirements of "Standard Specifications for Type II Portland Cement," ASTM Designation C150. The sand shall conform to that prescribed in AWWA C-104. The cement mortar shall contain not less than one part of cement to two parts of dry sand.
2. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty, the unsatisfactory pipe shall be replaced.

I. Exterior Coating (Buried Pipe)

1. The outside coating shall be a bituminous coating of either coal-tar or asphalt base approximately 1 mil thick. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun and shall be strongly adherent to the pipe.

J. Exposed Pipe Painting

1. The outside coating of exposed piping inside the vault shall be a painted green.

K. Polyethylene Encasement

1. All ductile iron pipe and fittings shall be polyethylene encased. The polyethylene encasement material shall be manufactured in accordance with AWWA Standard C-105, "Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids" with the following additional requirements or exceptions:

- a. Material - The raw material used to manufacturer polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designation D1248.
- b. Physical - The polyethylene film shall meet the following test requirements:

Tensile Strength	1,200 psi minimum
Elongation	300% minimum
Dielectric Strength	800 V/mil thickness minimum
Thickness	0.008" (8 mils) minimum with minus tolerance not exceeding 10% of nominal Melt Index 0.4 max

L. Material Submittals

1. The following submittals shall be required for review and acceptance by the Engineer:
 - a. Restrained Joint Detail
 - b. Pipe laying schedule

2.02 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

A. Specifications

1. C900 PVC pipe shall be designed, manufactured, tested, inspected and marked in accordance with the provisions of this Specification and ASTM Standard D1784," Standard Specification for Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVP) compounds" for water distribution pressure Class 150 psi DR18.

B. Dimensions

1. Nominal pipe lengths shall be 20', with shorter lengths provided as required by drawings, alignment and grade. Permissible variations in length, diameter, weight, wall thickness and straightness shall comply with the allowable tolerances specified in the applicable AWWA standards.

C. Thickness

1. The minimum wall thickness shall be DR18.

- D. Joint Type
 - 1. Unrestrained
 - a. Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint. The joint shall comply with the requirements of AWWA C-900 when tested to 80 psi.
 - 2. Restrained
 - a. Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint. The joint shall comply with the requirements of AWWA C-900 when tested to 80 psi. All pipe joints shall be restrained with EBBA Irons "Megalug", Uni-Flange Corporation "Series 900, 1300, 1350" or approved equal meant for use with PVC pipe. Solvent-cement joints are strictly prohibited.
- E. Where indicated on the Drawings a minimum 16 gage protected tracer wire shall be installed with the pipe and shall be electrically connected to each valve or valve box.
- F. Specials and Fittings
 - 1. All fittings shall be ductile iron conforming to Section 2.01.

PART 3 - EXECUTION

3.01 DUCTILE IRON PIPE INSTALLATION

- A. Handling
 - 1. Ductile iron pipe and fittings shall be handled at all times by lifting with padded cradles of canvas, leather or other suitable material so as to avoid shock or damage. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer. All pipe handling equipment is to be approved by the Engineer. The use of bare metal cables, chains, or hooks, etc. will not be permitted.
 - 2. Stockpiled ductile iron pipe shall be supported on wood blocks and/or sandbags placed under the uncoated ends of the pipe. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any obstruction. Rolling the pipe on coated surface will not be permitted. Adequate strutting shall be provided if necessary, to prevent damage to pipe lining and coating.
- B. Subgrade
 - 1. No blocking of pipe will be permitted. Before the pipe is laid, the subgrade shall be prepared by backfilling with clean uniformly graded sand so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb or otherwise damage the subgrade surface over a maximum length of 18" near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle.
- C. Joining Mechanical Joint Pipe
 - 1. Before joining mechanical joint ductile iron fittings to the ductile iron pipe, the outside of the spigot, the inside of the bell and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter.

2. Normal practice is to lubricate the joint with a soap solution; however, in cold weather the joint may be assembled dry if approved by the Engineer. Extreme care shall be exercised in making the dry joint.
3. The ductile iron gland shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland.
4. The pipe shall be pushed forward until the spigot end fully penetrates the bell. The gasket shall then be pressed into place in the bell evenly around the entire joint. The gland shall be moved along the pipe into position for bolting, the bolts inserted, and the nuts screwed finger tight, then tightened with a torque limiting wrench. The torque for the various sizes of bolts shall be as follows:

<u>Pipe Size (inches)</u>	<u>Bolt Size (inches)</u>	<u>Range of Torque (ft-lbs)</u>
2-3	5/8	60
4-24	3/4	90
30-36	1	120

5. Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.
6. Whenever it is desirable to deflect mechanical joint pipe in order to form a long radius curve, the deflection shall not exceed 80% of the pipe manufacturer's recommendations for maximum deflection.

D. Flanged Joint

1. Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered, and the connecting flanges drawn up watertight without unnecessary stressing of the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence using torque wrenches at settings recommended by the manufacturer (75 lb. min.). Only compressed non-asbestos sheet gaskets with a rubber compound binder shall be used. Where steel flanges are connected to ductile iron flanges, an insulating connection shall be provided.

E. Polyethylene Wrap

1. Except for the outlet pipe, ductile iron pipe and fittings shall be polyethylene encased in accordance with AWWA Standard C-105, "Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids," and as detailed on the Contract Drawings.

F. Cutting and Fitting

1. The Contractor shall make all pipe cuts required to conform to location, line and grade. All cuts on ductile iron pipe shall be made by the use of pipe cutters or pipe saws. All cuts shall be straight and true.

3.02 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE INSTALLATION W/ DUCTILE IRON FITTINGS

A. General

1. All PVC pipe shall be installed in accordance with this specification. All pipe shall be handled and installed in accordance with AWWA C-900.

B. Handling

1. All pipe and fittings shall be handled at all times by lifting with padded cradles of canvas, leather or other suitable material so as to avoid shock or damage. Pipe shall be so handled that the exterior surface, coating and lining will not be damaged. If, however, any part of the exterior surface coating or lining is damaged, the repair or rejection of pipe shall be made by the Contractor at his expense in a manner satisfactory to the Owner/Engineer. All pipe handling equipment is to be approved by the Owner/Engineer. The use of bare metal cables, chains, or hooks, etc. will not be permitted.
2. Stockpiled pipe shall be supported on wood blocks and/or sandbags placed under the uncoated ends of the pipe. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any obstruction. Rolling the pipe on coated surface will not be permitted. Adequate strutting shall be provided if necessary, to prevent damage to pipe lining and coating.
3. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care shall be used in handling PVC pipe during cold weather.
4. Stockpiled PVC pipe stored outside which may be exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover pipe. Air circulation shall be provided under the covering.

C. Bedding

1. No blocking of pipe will be permitted. Before the pipe is laid, the subgrade shall be prepared by backfilling with clean uniformly graded sand so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb or otherwise damage the subgrade surface over a maximum length of 18" near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle.

D. Joining Push-On Joints

1. Immediately before joining two lengths of pipe, the inside of the bell, and the outside of the spigot end and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The rubber gasket shall be flexed inward and properly inserted in the gasket recess of the bell socket. Caution shall be exercised to ensure the correct type of gasket is used.
2. A thin film of gasket lubricant shall be applied to either the inside face of the gasket or the spigot end of the pipe or both.
3. The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to assure insertion to the full depth of the joint. The spigot end of field cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured.
4. Whenever it is desirable to deflect push-on joint pipe in order to form a long radius curve, the deflection shall not exceed 80% of the pipe manufacturer's recommendations for maximum deflection.

E. Joining Mechanical Joint Pipe

1. Before joining mechanical joint ductile iron fittings to the pipe, the outside of the spigot, the inside of the bell, and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter.
2. Normal practice is to lubricate the joint with a soap solution; however, in cold weather the joint may be assembled dry if approved by the Engineer. Extreme care shall be exercised in making the dry joint.

3. The ductile iron gland shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland.
4. The pipe shall be pushed forward until the spigot end fully penetrates the bell. The gasket shall then be pressed into place in the bell evenly around the entire joint. The gland shall be moved along the pipe into position for bolting, the bolts inserted, and the nuts screwed finger tight, then tightened with a torque limiting wrench. The torque for the various sizes of bolts shall be as follows:

<u>Pipe Size (inches)</u>	<u>Bolt Size (inches)</u>	<u>Range of Torque (ft/pounds)</u>
2 - 3	5/8	60
4 - 24	3/4	90
30 - 36	1	120

5. Nuts spaces 180 degrees apart shall be tightened alternatively in order to produce an equal pressure on all parts of the gland.
6. Whenever it is desirable to deflect mechanical joint pipe in order to form a long radius curve, the deflection shall not exceed 80% of the pipe manufacturer's recommendations for maximum deflection.

F. Cutting and Fitting

1. The Contractor shall make all pipe cuts required to conform to location, line and grade. All cuts on pipe shall be made by the use of pipe cutters or pipe saws. All cuts shall be straight and true.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02620 – REHABILITATION OF PITLESS WELL HEAD UNITS

PART 1 - GENERAL

1.01 WORK INCLUDES

Inspect existing pitless unit equipment stored at a City Facility; refurbish compromised equipment; furnish, install, connect, and test the well head pitless unit equipment, which enables the pumped water to discharge below the ground surface to the discharge pipelines to South Cooley Reservoir.

1.02 RELATED WORK

- A. Section 02630 - Well Cleaning and Testing
- B. Section 02635 - Submersible Pump

1.03 SUBMITTALS

In accordance with Section 01345 - Submittals

PART 2 – PRODUCTS (EXISTING)

2.01 DIMENSIONAL REQUIREMENTS

12-inch Pitless Units (Wells 2, 3, 4)

A.	Projection of upper casing above the final grade (feet):	As shown on Drawings
B.	Distance from final grade to centerline of discharge (feet):	As shown on Drawings
C.	Lower casing, O.D. (inches):	12
D.	Discharge connection size, O.D. (inches)	6
E.	Discharge connection type:	PE
F.	Drop pipe connection size, O.D. (inches)	6-5/8
G.	Drop pipe connection thread pattern:	8 RND
H.	Lift out pipe diameter (inches)	4-5/8"
I.	Lift out pipe connection thread pattern:	8 RND
J.	Threaded conduit hub diameter (inches)	2.0 and 1.0
K.	Threaded airline hub diameter (inches)	1.0

20-inch Pitless Unit (Well 1)

A.	Projection of upper casing above the final grade (feet):	As shown on Drawings
B.	Distance from final grade to centerline of discharge (feet):	As shown on Drawings
C.	Lower casing, O.D. (inches):	20
D.	Discharge connection size, O.D. (inches)	6
E.	Discharge connection type:	PE
F.	Drop pipe connection size, O.D. (inches)	6-5/8
G.	Drop pipe connection thread pattern:	Reducer (unknown)
H.	Lift out pipe diameter (inches)	8-5/8"
I.	Lift out pipe connection thread pattern:	Welded
J.	Threaded conduit hub diameter (inches)	3.0 and 1.0
K.	Threaded airline hub diameter (inches)	1.0

2.02 GENERAL REQUIREMENTS

- A. Design Loads

The pitless unit shall be capable of supporting all loads during installation, removal, or operation of the submersible pump. Connection to the well casing shall be by welding directly to the body of the pitless unit or to an intermediate weld by thread nipple.

B. Pitless Piping

The discharge pipe shall have welded tabs to secure 4 rods through the discharge coupling and be equipped with a transition sleeve from the steel to ductile iron. The lift out pipe shall be made of A53 Grade B steel or API 5a J55 and be permanently left in the pitless case. It shall not be less than 1 pipe size smaller than drop pipe and shall have the same thread pattern as the drop pipe.

C. Upper Pitless Case

1. A watertight compression seal ring cap shall be secured to the upper pitless case. The cap shall incorporate a screened well vent extending 6" above the cap or as shown on the Contract Drawings. The cap shall be locking type capable of using 2 padlocks.
2. Passages through the pitless spool shall be sufficiently sized to accommodate all down-hole cables and the 1/4" airline. The upper case shall have a through connection for terminating the airline. This airline tapping block shall have a minimum of 2, 1/4" NPT female taps on the outside of the case. The clear internal diameter of the pitless unit shall be greater than the internal diameter of the well casing.

D. General Material Requirements

1. Cap and conduit box: steel, epoxy finish
2. Well vent: Steel, epoxy finish
3. Lift out pipe: A53 steel or API 5a J55
4. Pitless case: A53 steel pipe
5. Spool: Steel, A53 epoxy painted
6. Discharge body: steel, epoxy painted
7. "O" ring seats: 316 Stainless Steel
8. "O" rings: Neoprene

E. Bolts, Nuts and Washers

All bolts, nuts, washers, and anchors to be 316 SS.

2.03 APPROVED MANUFACTURERS

12" and 20" diameter well pitless units and parts shall be manufactured by Baker Water Systems or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

The pitless equipment shall be installed by the pump installation contractor in strict conformance with the manufacturer's requirements and any regulations of federal, state or local agencies having jurisdiction over the installation of the unit.

3.02 INSPECTION OF PITLESS SPOOLS AND CONNECTIONS TO DROP PIPE

- A. Coordinate with Owner/Engineer on inspection time and place. Existing pitless casings are installed. The downhole pitless equipment is being stored at the Wes Brown Water Treatment Plant.

- B. Open the existing Pitless Casing caps and inspect the bolts and gasket.
- C. Remove and inspect the existing power plugs for the pump motors and the junction boxes for the old transducers.
- D. Perform a video log of the inside of the well and pitless casing and per Section 02630 Well Cleaning and Testing.
- E. Coordinate with Owner to locate and inspect the existing lift out pipe/spool/drop pipe assemblies at the Wes Brown Water Treatment Plant.
- F. Remove all PVC Certalok drop pipe and dispose of per Owner's requirements.
- G. Inspect and inventory the stainless steel Certalok adaptors for later use.
- H. For the Well 1 assembly, disconnecting the drop pipe will include disconnecting a carbon steel coupling in place between the stainless steel Certalok drop pipe adaptor and a carbon steel reducer below the spool. Replace the coupling and inspect the threads on the reducer. Replace the reducer with a 316 stainless steel reducer or as approved by engineer.
- I. Remove, if possible, each lift out pipe from each spool piece for all four existing assemblies from wells 2, 3, 4 and 5. Inspect the threads on the lift out pipes and the spools for corrosion.
- J. Clean any rust or muck from each spool piece, lift out pipe and drop pipe connection threads prior to inspection.
- K. Inspect and replace of O-rings for each spool piece.
- L. Photograph all equipment and pieces removed from each well pitless unit.
- M. Document all equipment and pieces that are not in good condition for replacement with Owner/Engineer.
- N. Installation of lift out pipe, spool piece and drop pipe with pump assemblies per Section 02635 Pumps and Motors.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02630 - WELL CLEANING AND TESTING

PART 1 - GENERAL

1.01 WORK INCLUDES

This section covers and work necessary for cleaning and testing of Cooley Alluvial Wells 1, 3 and 4, including well test pumps. All work in this section shall be performed before installation of new well pumps and motors.

1.02 RELATED WORK

- A. Section 02620 - Pitless Well Head Units
- B. Section 02635 - Pumps and Motors

1.03 QUALITY STANDARDS

- A. The well installation subcontractor shall have the following minimum qualifications:
 - 1. A current Colorado Pump Installation Contractor's License and Bond as required by Colorado statute.
 - 2. Five years of Colorado Licensed experience in setting pumps and motors of similar size. A minimum list of 10 such installations including owner, owner's address, project cost, date of installation, horsepower, and setting depth must accompany the bid documents.

1.04 SUBMITTALS

- A. In accordance with Section 01345 - Submittals
- B. As-Constructed Drawings - Following construction of the well, submit As-Constructed Drawings showing the construction details.
- C. Contractor shall submit well cleaning, pump installation and testing schedule and sequence

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Where model numbers are given in this section, they shall be understood to represent models selected on the basis of past factory specifications and project experience demonstrating that the equipment, including stipulations herein, would meet the performance objectives of this work. Verify with any selected manufacturer that the designated model, or the updated version, meets the design performance outlined by the Drawings and Specifications. The detailed working Drawings and manufacturer's technical specifications submitted in accordance with the Drawings and Specifications or this contract shall comprise the criteria for equipment or materials approval. All materials shall be new.

2.02 WELL INSPECTION AND CLEANING

- A. Well video equipment, including multi-angle submersible camera and lights.
- B. Well swabbing brushes with diameters matching the inside diameter of the existing well screens
- C. Hydrojetting system matching the inside diameter of the existing wells.
- D. Sand pump or bailer appropriate for the inside diameter of the existing wells.

2.03 MAINTENANCE

- A. Immediately repair or replace, as deemed necessary by the Engineer, any damage to installation in progress or installation completed. All repairs or replacements due to damage by the Contractor shall be at the Contractor's expense.
- B. Provide the Engineer reasonable access of installation for initial readings, and at times during construction for periodic monitoring.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify the locations, condition and elevations of the existing wells. Notify the Engineer prior to well inspection if a discrepancy is noted, so that adjustments can be made.

3.03 INSPECTING AND CLEANING COOLEY WELLS 1, 3 AND 4

- A. Open the existing Pitless Casing caps.
- B. Remove and inspect any equipment in the well per Section 02620.
- C. Perform initial video inspection of each well. Allow debris to settle in well prior to video log.
- D. Following the initial video inspection, each well shall be cleaned and developed.
 - 1. Surge and bail each the well. The surging shall be accomplished by a solid or valved surge block approved by the Engineer. Cleaning equipment includes well screen brushes and hydrojetting equipment.
 - 2. Over-pump each well for 4 hours or, as directed by the Engineer.
 - 3. Final determination of the adequacy of development shall be determined by sand content testing during performance testing of the vertical well.
- E. Disinfection
 - 1. Disinfect each well after completing the well cleaning.
 - 2. Place sodium hypochlorite solution into each well and work solution throughout water column and into gravel pack.
 - 3. The Sodium Hypochlorite Solution shall have a minimum concentration of 200 mg/l in all parts of the well based on liquid sodium hypochlorite
- F. Perform confirmation video log of each well to observe well cleaning results.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02635 - SUBMERSIBLE PUMP AND MOTOR

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for the installation of the submersible pumps and motors as shown on the Contract Drawings and as specified in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades.
- B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, and complete installation.
- C. Contractor to video log and clean Wells 1,2, 3 and 4 prior to pump installation.
- D. Contractor to test all pumps, motors in wells per Section 3.05 of this specification.

1.02 RELATED WORK

- A. Division 16 - Electrical

1.03 QUALITY STANDARDS

- A. ANSI/AWWA-E101 Vertical Turbine Pumps, Line Shaft and Submersible Types.
- B. Ensure pumps are produced in full compliance with specified items and any reference to codes and standards. Commonly referenced standards are as follows:
 - 1. ASTM
 - 2. AGMA
 - 3. ANSI
 - 4. AWWA
 - 5. NEMA
 - 6. AISI
 - 7. Hydraulic Institute Standards
- C. The pump installation subcontractor shall have the following minimum qualifications:
 - 1. A current Colorado Pump Installation Contractor's License and Bond as required by Colorado statute.
 - 2. Five years of Colorado Licensed experience in setting pumps and motors of similar size. A minimum list of 10 such installations including owner, owner's address, project cost, date of installation, horsepower, and setting depth must accompany the bid documents.
- D. All equipment and installations must meet prevailing federal, state, and local codes. Should the pump contractor observe that the specifications or drawings are at variance with regulations, the Contractor shall give written notice thereof within 24 hours and any necessary changes shall be as directed by the Engineer.

1.04 SUBMITTALS

- A. In accordance with General Conditions.
- B. Submit shop drawings including performance data curves showing head, capacity, horsepower demand, pump efficiency, and NPSH of the impeller required over the entire operation range of the pump.
- C. Operation and Maintenance manuals in accordance with the General Conditions.
- D. Manufacturer’s Certificate of Proper Installation in accordance with General Conditions.
- E. Copies of Colorado Pump Installation Contractor’s License, bond, and installation list shall be submitted with the Contractor’s proposal.
- F. Pump and motor testing procedures.

1.05 WARRANTY

- A. A 5-year warranty shall be required on all materials, equipment and workmanship which comprise the wells and pump systems.

PART 2 - MATERIALS

2.01 GENERAL

- A. The submersible pumps and motors shall be designed for continuous submerged operation.
- B. The pump shall be driven by a motor attached below the pump section.
- C. The pumps and motors shall be 316 stainless steel. 304 stainless steel is not acceptable.
- D. The pumps and motors shall be as follows, or approved equal:

Well No.	Pump	Motor	Flow Rate Range (gpm)	Dynamic Head
1	Grundfos 300S75 SS ¹	Grundfos 7.5 Hp SS Submersible ¹	100 - 350	50
3	Grundfos 300S75 SS ¹	Grundfos 7.5 Hp SS Submersible ¹	100 - 350	50
4	Grundfos 300S75 SS ¹	Grundfos 7.5 Hp SS Submersible ¹	100 - 350	50
5	Grundfos 300S75 SS ¹	Grundfos 7.5 Hp SS Submersible ¹	100 - 350	50

1. Or approved equal.

2.02 SYSTEM CAPACITY

- A. The pumps and motors shall have a capacity as described above. System curves can be provided upon request to assist in sizing pump and motor.

2.03 PUMP DESIGN

- A. The pump shall have integrated protection against upthrust.

- B. The pumping downthrust shall be absorbed by the motor thrust bearing.
- C. Each impeller shall be fitted with a seal ring around its eye or skirt to prevent hydraulic losses.
- C. A filter screen shall be included as part of the suction inlet assembly.

2.04 PUMP MATERIAL OF CONSTRUCTION

- A. The pump bowls, impellers, guide vanes, and strainer shall be 316 Series stainless steel, no exceptions. The shaft and coupling shall be 400 Series stainless steel. No moving parts shall be constructed from plastic or other brittle materials.
- B. The intermediate and top bearings shall be Nitrile Rubber (NBR).

2.05 MOTOR DESIGN

- A. The motor shall be a Squirrel-Cage induction motor designed for continuous underwater operation in conformance with NEMA standards.
- B. The motor shall have a Kingsbury-type or Michell thrust bearing capable of carrying the maximum pump thrust loads.
- C. The motor shall be water filled for cooling and lubrication. No oils or grease lubrication shall be used.
- D. A flexible diaphragm shall be provided to permit expansion and contraction of the internal motor fluid when the motor heats and cools during operation.
- E. A shaft seal shall be provided to ensure the internal motor fluid is not mixed with the pumped fluid.

2.06 MOTOR MATERIALS OF CONSTRUCTION

- A. The motor diaphragm shall be Nitrile Rubber of Type 11 Hydrin.
- B. The shaft seal shall be a Nitrile Rubber or Type 100 Hydrin.
- C. The motor shall be 316 Series stainless steel, no exceptions.

2.07 ELECTRICAL OPERATION

- A. A NEMA Type #R enclosure sized for the motor shall be provided.
- B. The motors shall be 7.5 hp as described in Section 2.01D, rated for 3-phase x 440-460V, 60 HZ, and Service Factor of 1.15.

2.08 WATER LEVEL MONITORS

- A. Pressure Transducers
 - 1. The submersible pressure transducers shall be an Endress-Hauser “WaterpilotFMX167”, GE Sensing (Druck) “PDCR/PTX- 1730” or approved equal with sufficient cable to connect to the junction box at the top of the well.

2.09 MISCELLANEOUS

- A. Nameplates and other data plates shall be stainless steel, suitably secured to the pump.
- B. All machine bolts, nuts, and capscrews shall be 316 stainless steel of the hex head type. Hardware requiring special tools or wrenches shall not be used.

2.10 SERVICE

- A. Manufacturer shall furnish services of a field engineer to check installation and supervise start-up as required.

2.11 FACTORY TEST OF PUMP AND MOTOR

- A. The pump manufacturer shall perform the following tests on each pump before shipment from the factory. The test shall be conducted accordance to standard AWWA E101.
 - 1. Megger the pumps for insulation breaks or moisture.
 - 2. The pumps shall be checked for correct rotation.
 - 3. Pumps shall be tested on water.
 - 4. Pumps shall be meggered immediately after test for insulation breaks or moisture.
 - 5. Confirm and publish "as-built" pump performance curve indicating the following:
 - a. Pump speed
 - b. Flow vs. head curve
 - c. Efficiency curve
 - d. Horsepower curve(s)
 - e. NPSHR curve
 - 6. A written certified test report giving the above information shall be supplied to the Engineer for review and approval for each pump prior to shipment.

2.12 MOTOR SHROUD

- A. A motor shroud is required for all submersible pumps.
- B. Three 1" wide neoprene rubber centralizers shall be evenly spaced opposite the motor end bell in the annular area between the motor and shroud. These shall be secured to the shroud.
- C. The shroud shall be secured to the pump in such a manner to prevent rotation and loss of the shroud during pump installation and removal operations. All appurtenant fittings shall be of 316 stainless steel. The motor cable shall be protected at the shroud exit point with neoprene rubber.
- D. Complete approved dimensional and material submittals are required prior to installation of the shroud.

2.13 SUBMERSIBLE CABLE

- A. Conductors
 - 1. One continuous length of cable shall connect the submersible motor pigtails to the above ground well head junction box. An additional 5' of cable shall be housed beneath the well head for splicing.
 - 2. This cable shall consist of 3 individual color-coded conductors. Each copper conductor

shall be insulated for 600 VAC by rubber, synthetic rubber, or approved plastic insulation suitable for continuous immersion in water at well temperature. All 3 conductors shall be enclosed in an overall jacket material that is impervious to oil and water and made from rubber, synthetic rubber, metal, or other approved mechanically protective material. All filler material shall be non-hydroscopic. Jute or hemp is not acceptable.

3. Individual cable stranding shall meet ASTM class designations as follows:
 - a. AWG #10 or smaller - Class B - 7 strands minimum
 - b. AWG #1 through 4/0 - Class B - 19 strands minimum
 - c. AWG #9 through #2 - Class C - 19 strands minimum
4. The cable shall have sufficient conductor cross-sectional area to meet the minimum requirements of the Insulated Power Cable Engineers Association Code of Operation in Free Air or shall meet the requirements of the motor manufacturer, as dictated by horsepower, voltage, and well water temperature. A 6" long sample of the proposed cable shall be submitted to the Engineer for approval prior to installation of the submersible pump. This sample shall have the manufacturer's identifying stencil on the outer jacket.

2.14 CABLE AND AIRLINE SUPPORT

- A. The pump cable, water level indicating airline and control cables shall be secured to the drop pipe with synthetic vinyl tape and 3/8" 316 stainless steel banding. Each stainless steel band shall be protected by a nonslip, rubber, protector over the submersible cables.
- B. Mechanical Shielding
 1. The electrical conductors shall be protected by a corrosion/resistant cable guard where they pass the pump bowls. This guard shall be secured to the pump with 316 Stainless Steel bands.
- C. Splices
 1. No splices will be permitted in the submersible cable. The splice, at the motor pigtail, shall be completed in a staggered manner so that no individual conductor splice shall be directly opposite another.
 2. The conductor of the pigtail and power cable shall be joined with rosin core soldered copper butt connectors. The insulating overlay shall be of rubber manufactured by 3M Company of Plymouth or shall be of submersible adhesive heat shrink insulations as made by Sigma Corporation. This insulation shall be a minimum of 12" in length overlaid with vinyl tape and "Scotch-Kote" as made by 3M Company. The entire splice shall be banded to the drop pipe with protected stainless steel banding and vinyl tape.
 3. Termination of the cable at the surface junction box shall be made with electrical split bolts and rubber tape for 600 VAC splices and of the manufacturers approved method for those splices above 600. Each 600 VAC surface splice shall be overlaid with vinyl and "Scotch-Kote". Wire nuts are not acceptable.
- D. Downwell Pipe and Fittings
 1. Pipe: The riser pipe connecting the pump to the pitless unit shall be 6" diameter, Schedule 80, PVC, Certa-Lok drop pipe as manufactured by Certain Teed.
 2. Makeup Torque: All pipe and fittings shall be secured to prevent unthreading during pump start-up. Pipe torque shall be in accordance with API 5C1.
 3. Adapter Fittings: The Contractor shall provide all fittings to adapt to the drop pipe to the

pitless adapter or well head surface plate and pump discharge case. All fittings shall be stainless steel, 316 whenever possible. These adapters shall be of the swedge type, threaded both ends and of stainless steel material equal to or better than the specified riser pipe.

PART 3 - EXECUTION

3.01 FIELD REVIEWS

- A. Field Inspections
 - 1. The Engineer and City shall be present at the following installation inspection points.
 - a. Motor/pump models and serial number
 - b. Meggering of the motor by the Contractor with a 500 volt resistance megger and measurement of the motor winding resistance
 - c. Placement of the airline end of water level transducer assembly
 - d. Start-up
- B. The Contractor is responsible for notifying the Engineer 48 hours in advance of setting the pump and initiating start-up.
- C. Contractor shall provide written reports for all field inspections.

3.02 FACTORY INSPECTION AND TESTS

- A. Factory tests shall be conducted in accordance with Section B6 of the latest issue of ANSI/AWWA E-101 and the Hydraulic Standards Institute. Certified performance reports shall be provided to the Engineer for approval prior to shipment. The specified tests and inspections are as follows:
 - 1. Non-witnessed certified performance test: flow, TDH, voltage, current, BHP, efficiency, etc.
 - 2. Sample calculation from test readings
 - 3. Shop inspection
 - 4. Hydrostatic test of the bowl assembly
- B. Submit all factory reports and tests to Engineer and Owner.

3.03 RESISTANCE READINGS

- A. Resistance readings shall be taken on the motor with pigtail and motor with drop cable attached. A new motor and new cable shall have the minimum insulation resistance as measured with a 500-volt megger after 1 minute of applied voltage.
 - 1. Motor only with pigtail - 10 meg ohms
 - 2. Motor with drop cable attached and installed in well - 2 meg ohms

3.04 START UP, TESTING AND TRAINING

- A. A supplier's and/or manufacturer's representative for the equipment specified shall be at the job site for installation assistance, inspection, and certification of the installation, testing, start-up assistance, and training of Owner's personnel.

3.05 PERFORMANCE TESTING OF WEST COOLEY ALLUVIAL WELL SYSTEM

- A. Within 3 business days after specified pump installation is completed, the full system (all wells pumping at the same time) shall be tested to verify that the expected yield and associated specific capacity have been obtained for each well. Water discharged during the well field test shall be conducted from each well to the adjacent reservoir through the water delivery system at the existing pump station wet well as approved by the Owner and Engineer.
- B. Pumping and Measurement:
 - 1. The testing will use the newly installed pump assemblies. The total dynamic head includes the vertical lift from a pumping water level at least one foot above the tops of the screened intervals shown on the plans, friction losses through valves and flow meters, and friction losses through the discharge piping.
 - 2. The discharge of the test pumping shall be measured by the newly installed and certified instantaneous and totalizing flow meters. Instantaneous and time-averaged (totalizing flow meter readings) flow rates shall be recorded for the duration of the tests.
 - 3. During the tests, water levels in the well being tested shall be measured manually to the nearest 0.01' with a suitable measurement instrument. Manually-measured water levels shall be measured and recorded at intervals of 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 minutes after pumping begins or the pumping rate is changed, and at all succeeding decimal intervals of those increments until the end of the test. Water levels in all the well being tested shall also be measured and recorded with new installed systems.
- D. 6-day Constant Rate Discharge Test
 - 1. A constant rate discharge test shall be conducted after reaching the maximum sustainable well yields of 250 gpm at each well. The test will consist of 6 continuous days of pumping all wells together, followed by 6 continuous days of recovery.
- E. Aborted Tests
 - 1. Whenever continuous pumping at a uniform rate (including the stepped uniform rates of the step test) has been specified, failure of pump operation for a period greater than 1% of the elapsed pumping time shall require suspension of the test until the water level in the pumped well has recovered to its original level or for a period at least equal to the elapsed pumping time of the aborted test.

3.06 DISINFECTION

- A. Disinfect each well prior to performing the constant-rate as-built well field discharge test, including recovery.
- B. Place sodium hypochlorite solution into each well and work solution throughout water column and into gravel pack.
- C. The Sodium Hypochlorite Solution shall have a minimum concentration of 200 mg/l in all parts of the well based on liquid sodium hypochlorite.
- D. Pump the well to remove acid prior to setting the pumps.

END OF SECTION

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DIVISION 2 - SITE WORK

SECTION 02676 - HYDROSTATIC TESTING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The work to be performed includes the hydrostatic testing of the pipelines and fittings associated with the project.

1.02 RELATED WORK

- A. Section 02610 - Pipe and Fittings

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 HYDROSTATIC TESTING FOR PIPELINE

- A. The entire length of the pipe and fittings shall be hydrostatically tested to 75 psi. Air testing is not allowed. Comply with City of Thornton Standard 206.6.
- B. The Owner and Engineer shall be notified at least 24 hours in advance of testing. All testing shall be made in the presence of the Engineer and/or the City.
- C. The Contractor shall furnish the water, calibrated meter and the pump for testing. The pipeline shall be in a state of readiness for testing; all bulkheads, pumps, taps, and appurtenances necessary to fill the pipeline and maintain the required pressure shall be in place. The pipeline shall be filled with water and the test pressure applied to the pipeline by means of a pump, equipped with a suitable pressure regulator. When filling the pipeline, it shall be filled at a rate which will not cause any surges, nor will it exceed the rate at which the air can be released.
- D. All air in the line shall be properly purged. Where blow-offs are not available or effective in purging air from the line, a tap may be required to purge the line. The location and size of tap shall be reviewed and approved by the Engineer/Owner.

3.02 LEAKAGE

- A. While the test pressure is maintained, an examination shall be made of the pipeline in general, and any leaks shall be repaired. Any pipe or fitting found to be cracked shall be removed and replaced. Cutting and replacing of pavement, excavating and backfilling are a necessary part of locating and repairing leaks discovered by pressure testing of pipe and shall be at the Contractor's expense.
- B. Each section of pipe between line valves shall be tested separately. After all visible leaks have been stopped, the full test pressure shall be maintained for 2 continuous hours. Through the test period, the pressure shall not vary by more than +/- 5 psi. The amount of leakage for each test section of the pipeline shall be determined by the following:

$$L = \frac{SD(P)^{1/2}}{133,200}$$

Where: L = maximum allowable leakage in gallons per hour
S = pipe length to be tested in feet
D = nominal pipeline diameter in inches
P = average test pressure during the leakage test in psi (gauge)

- C. Leakage shall be defined as the quantity of water that must be supplied into the pipeline test section to maintain pressure in the pipeline. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
- D. If pressure test fails, Contractor shall repair defects and retest until leakage is less than minimum allowed.
- E. All visible leaks shall be repaired regardless of maximum allowable leakage.

END OF SECTION

DIVISION 2 – SITE WORK

SECTION 02890 – TRAFFIC AND PEDESTRIAN TRAFFIC CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnishing and installing all signs needed for temporary traffic control along the Regional Trail as require during the construction of the project.
- B. Contractor shall submit a Traffic Control permit application to the City of Thornton and Adams County to obtain the respective pedestrian and traffic control permits.
- C. Regional trail shall remain open for public use during the construction of the project.

1.02 RELATED WORK

- A. Section 01500 – Construction Temporary Controls

1.03 REFERENCES

- A. The latest revision of the Manual on Uniform Traffic Control Devices (MUTCD) as adopted by the Colorado Department of Transportation and as adopted by the Colorado Department of Transportation Federal Highway Administration and requirements of Thornton’s Traffic Engineer.

1.03 SUBMITTALS

- A. Shop Drawings
 - 1. Signage Layout Diagram
 - 2. Manufacture’s Product Information (Cut Sheets)
 - a. Sign Face Material
 - b. Pedestal pole and base
 - c. Mounting Hardware

PART 2 - PRODUCTS

2.01 GENERAL

- A. All equipment shall meet the requirements of the MUTCD.
- B. Sign sizes and colors shall be in accordance with MUTCD and City of Thornton Standard Specifications Section 704.

PART 3 – EXECUTION

3.01 GENERAL

- A. Provide trail signage and construction fencing as shown on the Erosion & Traffic Control Plan drawing or as requested in the approved traffic control permit.
- B. Provide gates and if necessary, a traffic control flagman at construction access to wells 4 and 5, as shown on the Erosion & Traffic Control Plan drawing. This is the only concrete trail crossing allowed in the project unless coordinated with City of Thornton and Adams County.

- C. Promptly repair damages that may occur to the existing concrete trail. Coordinate repair with City of Thornton and Adams County.
- D. Do not use concrete sidewalk for site access, haul roads, staging, or stockpiling.
- E. All installations shall be in accordance with MUTCD and City of Thornton Standard Specifications Section 704.
- F. CONTRACTOR shall be responsible to replace damaged or defective signs throughout the duration of construction.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02931 – SITE RECLAMATION, RESTORATION AND SEEDING

PART 1 - GENERAL

1.01 WORK INCLUDES

- A. Reclaiming areas disturbed during construction. Disturbed areas include:
 - 1. Staging areas and temporary access and haul roads.
 - 2. Areas disturbed as a result of the installation of the erosion and sediment control measures.
 - 3. Areas disturbed for the construction of the Work.

1.02 RELATED WORK

- A. Move in and Site Preparation is included in Section 02100
- B. Fill materials are included in Section 02200
- C. Seeding is included in Section 02931

1.03 REFERENCES

- A. Urban Drainage and Flood Control District, Denver, Colorado.
 - 1. Urban Storm Drainage Criteria Manual, Volume 2, June 2001, and Volume 3, June 2002. Hereinafter referred to as “Storm Drainage Manual.”

1.04 DEFINITIONS

- A. Reclaiming disturbed areas shall mean regarding and hauling, placing, and spreading topsoil; revegetating; sod or seed placement; planting; and replacing concrete, as necessary, in all areas disturbed by construction.
- B. Lbs. PLS / acre: Pounds of pure live seed per acre.
- C. Construction Maintenance Period: Begin maintenance immediately after each area is planted and continue until issuance of Initial Acceptance.
- D. Satisfactory Stand: A healthy, established, uniform stand of the specified grasses free of weeds and surface irregularities, with coverage exceeding 80 percent over any 10 square foot area, and bare spots not exceeding 10 inches by 10 inches.
- E. PLS: Pure Live Seed

1.05 SUBMITTALS

- A. Shop Drawings:
 - 1. Sequence of limit of site reclamation.
 - 2. Proposed source and materials for soil amendment, fertilizer, seed, and mulch.

B. Quality Control:

1. Seed certifications including quantity of PLS/Acre/Variety.
2. Fertilizer certification.
 - a. Mycorrhizae: Product lists spores/pound.
 - b. Biosol: Fungal and bacterial produce obtained by fermentation of raw materials.
3. Load tickets for soil amendment verifying quantity and source, upon delivery to site and prior to spreading.
4. Copies of delivery invoices or other proof of quantities of soil amendment, fertilizer, mulch and seed.

1.06 PROTECTION

- A. Protect from damage areas outside the approved limit of site disturbance.
- B. Reclaim any disturbance of vegetation or native ground outside of the limit of site disturbance.
- C. Pay the cost of any fines or damage incurred by Thornton due to work being performed by Contractor outside the limit of site disturbance.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. General: Deliver in original, unopened containers. Protect materials from animals and moisture. Wet, moldy, open or broken packages will not be accepted. Non-flowing materials will be rejected.
- B. Seed:
 1. Furnish in standard container with name and address of supplier, test date; seed and name and variety; lot number; net weight; percentages of purity; germination; crop seed percentage; inert matter percentage; weed seed percentage; and noxious weeds by species and number by pound, clearly marked on each container of seed.
 2. Keep dry during storage.
- C. Biosol with Mycorrhizae product:
 1. Furnish in standard containers with name and address of supplier.

1.08 MAINTENANCE

- A. Operations: Perform after planting until Initial Acceptance, and during warranty period, to include:
 1. Erosion: Repair eroded areas deeper than 4 inches by filling with topsoil, seeding, and mulching.
 2. Mulch: Replace wherever and whenever washed or blown away.
 3. Reseed unsatisfactory areas or portions thereof during the next seeding period.
 4. Watering: Keep seeded areas moist.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall consist of a natural friable surface soil without admixtures of undesirable subsoil or foreign materials. It shall be reasonable free from roots, hard clay, coarse gravel, stones larger than one inch in any dimensions, noxious weeds, tall grass, brush, sticks, stubble or other material which would be detrimental to the proper development of vegetative growth.

B. Topsoil shall not contain toxic materials harmful to grass growth.

C. Amend topsoil from onsite sources under soil amendment.

2.02 SOIL AMENDMENT

A. Mycorrhizae product to be mixed into seed mix at seed supplier or incorporated into seed bed to a minimum depth of 8 inches. Bisol product to be broadcast on planted seed bed. Acceptable products are as follows:

1. 20lbs/ac granular Mycorrhizae and 1800lbs/ac Bisol Mix 7-2-1 from Rocky Mountain BioProducts, Denver, CO 303-696-8964.
2. 60 lbs/ac of Mycorrhizae Innculum AM 120 and Bisol at 1200 lbs/ac from Pawnee Buttes Seed Company, Greely, CO 970-356-7002.
3. Accepted Equal.

2.03 SEED

A. Seed shall be new crop delivered in original containers, unopened, bearing dealer's warranty analysis. Maximum crop and weed content shall be 0.10 percent each. Seed shall be free of all noxious weeds. Minimum germination shall be 85 percent and minimum purity shall be 95 percent. If seed on the market does not meet minimum purity and germination percentage, compensation is to be made for a lesser percentage of purity or germination by furnishing additional seed to equal specified mix. Product comparison shall be made on basis of PLS in pounds. Formula for determining quantity of PLS shall be:

$$\text{Pounds of Seed} \times \text{Purity} \times \text{Germination} = \text{Pounds PLS}$$

B. Urban Drainage and Flood Control District (UDFCD) Native Grass Seed Mix RV-2:

Common Name	Scientific Name	Seeds/lb	Lbs PLS/Acre
Sheep fescue (Durar)	Festuca Ovina	680,000	1.3
Western Wheatgrass	Pascopyrum Smithii	110,000	7.9
Alkali Sacaton	Spolobolus Airoides	1758,000	0.5
Slender Wheatgrass	Elymus Trachycaulus	159,000	5.5
Canadian Bluegrass (Ruebens)	Poa Compressa	2,500,000	0.3
Switchgrass (Pathfinder)	Panicum Vigratum	389,000	1.3

2.04 MULCH

A. Provide clean, fresh straw, free of weeds and grass seeds. Mulch shall not contain more than 5 percent seed by weight and shall not be musty, moldy, decayed, or caked. At least 50 percent by weight shall be 10 inches or more in length. Mulch shall be free of all noxious weeds.

2.05 HYDROMULCH

A. Mulch may be replaced with Hydromulch at Thornton's discretion. Provide natural wood fiber free of weeds and grass seeds. The wood fibers must have the property of becoming evenly dispersed and suspended when agitated in water. Weight specification from suppliers shall refer only to the air dry weight not in excess of 100 pounds. Water shall be free from substances or matter that could inhibit growth of grass.

PART 3 - EXECUTION

3.01 GENERAL

A. Seeding time frames per City of Thornton standard specifications are from April to June 15.

- B. Reclaim areas where construction work has been completed as soon as possible after completion of work. Mulch may be replaced with Hydromulch at Thornton's discretion. Provide natural wood fiber free of weeds and grass seeds. The wood fibers must have the property of becoming evenly dispersed and suspended when agitated in water. Weight specification from suppliers shall refer only to the air dry weight not in excess of 100 pounds. Water shall be free from substances or matter that could inhibit growth of grass.
- C. Grade all areas to drain a minimum of 2 percent slope into the reservoir unless otherwise shown on Drawings. The maximum slope steepness shall be 4.5H:1V unless otherwise shown on the Drawings or accepted in writing by Engineer.
- D. Remove all Contractor's equipment, debris, office, temporary fences or gates, and all other Contractor properties in accordance with Section 01500: TEMPORARY FACILITIES AND CONTROLS.
- E. Eliminate uneven areas and low spots. Remove debris, roots, branches, and stones in excess of 1-inch size.
- F. Scarify subgrade soil to a depth of 8 inches where soil amendment is required.
- G. Upon completion and acceptance of the rough grading, place topsoil over all areas disturbed during construction that are above normal pool elevation, except those areas which will be covered with slope protection.
- H. Double the seeding rate if hand seeding.

3.02 TOPSOIL AND PREPARATION

- A. Topsoil, soil preparation and amendments shall be per City of Thornton Specification 805.4 Sections A through D.
- B. Immediately prior to seeding, loosen to a depth of 8 inches. Remove stones, sticks, roots, debris, and other material in excess of 1-inch in size.
- C. Bring to minimum depth required to meet lines, grades, and elevations shown on Drawings, after light rolling and natural settlement. Grade areas to smooth, even surface with a loose uniformly fine texture. Limit fine grading to areas to be promptly seeded.
- D. Incorporate mycorrhizae product into tops 8 inches if not already mixed with seed at seed supplier.
- E. Thornton will inspect seedbed before seeding.

3.03 GRASS SEEDING

- A. Apply seed with grass drill equipped with satisfactory feeding mechanism including fluff seed box, agitator, double disc furrow openers, depth bands, and packer wheels. Place seed at ¼-inch depth. Operate drill parallel to slope.

3.04 MULCHING

- A. For drill seeded areas, uniformly apply mulch on all areas to be seeded at 4,000 pounds per acre air dry mulch within 24 hours after seeding. After applying mulch, immediately crimp with weighted discs or crimpers operated parallel to the slope. Set disc straight so minimum amount of soil is disturbed. Depth of cut shall be to 4 inches. Apply uniformly at 1.5 tons per acre.

3.05 HYDROMULCHING

- A. For drill seeded areas, uniformly apply Hydromulch at rate of 2,000 lbs/ac. Apply tackifier at a rate of 100 lbs/ac or at the manufacturers recommendation; whichever is greater. Upon completion of the application, soil shall not be visible through the Hyrdomulch.

3.06 MAINTENANCE

- A. Germination during growing season is expected to be within 3 to 6 weeks. Spot regarding, reseeding and mulching may be needed until initial acceptance to repair areas damaged buy erosion, wind, fire or other causes.
- B. Remove weeds by hand over 6 inches tall.
- C. Remove all litter and debris larger than 2 inches in size.

3.07 ACCEPTANCE

- A. Contractor shall maintain seeded areas until Final Acceptance.
- B. All seeded areas shall exhibit 80 percent growth coverage to be considered for final acceptance.
- C. At final acceptance, reseed deficient areas.

END OF SECTION

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DIVISION 3 - CONCRETE

DIVISION 3 - CONCRETE

SECTION 03210 - REINFORCING STEEL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This work shall consist of furnishing and placing reinforcing steel in accordance with these specifications and in conformity with the Contract Documents.

1.02 RELATED WORK

- A. Section 03310 - Structural Concrete

PART 2 - MATERIALS

2.01 GENERAL

- A. Materials used in the work shall meet the requirements for the class of material named. Unless otherwise provided on the plans, in the specifications or in the contract, all bar steel reinforcement shall be of the deformed type. Reinforcing steel shall conform to the requirements of the following specifications:
 - 1. Deformed Billet-Steel Bars for Concrete
 - 2. Reinforcement--AASHTO M31, ASTM A615 (Grade 60)
 - 3. Deformed Steel Wire for Concrete Reinforcement--AASHTO M225 (ASTM A496)
 - 4. Cold-Drawn Steel Wire for Concrete Reinforcement--AASHTO M32 (ASTM A82)

PART 3 - EXECUTION

3.01 BAR LIST

- A. Copies of a list of all reinforcing steel and bending diagrams shall be furnished to the Owner/Engineer at the site of the work at least 2 weeks before the placing of reinforcing steel is begun. The Contractor shall be responsible for the accuracy of the lists and for furnishing and placing all reinforcing steel in accordance with the details shown on the plans.
- B. Bar lists and bending diagrams for structures, which are included in the plans, do not have to be furnished by the Contractor. When bar lists and bending diagrams are included in the plans, they are intended for estimating approximate quantities. The Contractor shall verify the quantity, size and shape of the bar reinforcement against those shown on the plans and make any necessary corrections before ordering.

3.02 STORING AND SURFACE CONDITION OF REINFORCEMENT

- A. Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose scale, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross section area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

3.03 FABRICATION

- A. Fabrication tolerances for straight and bent bars shall be in accordance with the requirements of Subsection 4.3, Tolerance, of the American Concrete Institute Standard 315.

3.04 PLACING AND FASTENING

- A. The placing, fastening, splicing and supporting of reinforcing steel and bar mat reinforcement shall be in accordance with the plans and the latest edition of "CRSI Recommended Practice for Placing Reinforcing Bars". In case of discrepancy between the plans and the CRSI publication stated above, the plans shall govern.
- B. Steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete by means of spacer strips, stays, metal chairs or other approved devices or supports. When metal chairs are used, the part of the chair in contact with the form and at least 1 inch from the form shall be hot dip galvanized or plastic coated. Other coatings or treatments will be acceptable when specifically accepted by the Owner/Engineer. Precast concrete bricks or other accepted bricks or blocking may be used in structures to support reinforcement in footings or slabs placed on grade; however, the bricks or blocking shall not contact the reinforcement over a distance greater than the depth of a standard concrete brick. Reinforcing shall be embedded with 3" of concrete where cast against earth and 2" of concrete elsewhere unless otherwise noted on the Plans.
- C. Bars shall be securely tied at all intersections except where spacing is less than 1' in each direction, when alternate intersections shall be tied. Tying of steel by spot welding will not be permitted unless specifically authorized by the Owner/Engineer. The placing and securing of the reinforcement in any unit or section shall be accepted by the Owner/Engineer before any concrete is placed in any such unit or section. At the time the concrete is placed, the reinforcing steel required shall be free from flaky rust, mud, oil or other coatings that will destroy or reduce the bond.

3.05 SPLICING

- A. Bar Steel reinforcement shall be furnished in the full continuous lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the written acceptance of the engineer. All splicing shall strictly follow and adhere to all ACI codes and requirements. Splices shall preferably be staggered. In cases where permission is granted to splice bars, other than those shown on the plans, the additional material required for the lap shall be furnished by the contractor at his own expense.

MINIMUM LAP LENGTHS	
<u>Bar No.</u>	<u>Splice Lap Length (in.)</u>
4	25
5	31
6	37
7	54
8	62
9	70

3.06 BENDING

- A. All bars shall be bent cold. No bars partially embedded in concrete shall be field-bent.
- B. Bends on all bars shall have a radius on the inside of the bar not less than the value of the following:

<u>Bar Size</u>	<u>Minimum Radii</u>
#3, #4, #5	2 1/2 bar diameters
#6, #7, #8	3 bar diameter
#9, #10, #11	4 bar diameter

3.07 TIES, CHAIRS, SPACERS

- A. Reinforcement shall be accurately placed and adequately supported by concrete, metal or other approved spacers or ties and secured against displacement within the tolerance permitted.

3.08 PLACEMENT

- A. Unless otherwise specified by the Owner/Engineer, reinforcement shall be placed in specified positions within the following tolerances:
 - A. In walls and floors, all reinforcement shall be placed within, plus or minus, one-quarter inch of specified location.
 - B. Longitudinal location of bends and ends of bars, plus or minus, two inches except where specified concrete cover at ends of members shall not be reduced.

END OF SECTION

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DIVISION 3 - CONCRETE

SECTION 03252 - CONCRETE ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish all labor, tools and equipment for the construction and placement of the concrete accessories as shown on the Contract Drawings and as herein specified.

1.02 RELATED WORK

- A. General Conditions - Defective Work
- B. Section 03210 - Reinforcing Steel
- C. Section 03310 - Structural Concrete

PART 2 - MATERIALS AND EQUIPMENT

2.01 PVC WATERSTOPS

- A. Water stops shall be manufactured from extruded virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment. The properties of the polyvinyl chloride compound shall conform to U.S. Army Corps of Engineers water stop specifications (CRD-C572-74). Water stops shall be of the split-ribbed with center bulb type. All water stops shall be as manufactured by Greenstreak Plastic Products or approved equal.

2.02 ADHESIVE WATERSTOPS

- A. Not allowed.

2.03 INSERTS AND ANCHORS

- A. All inserts and anchors shall be stainless steel.

2.04 PANEL TIES

- A. Waterstop panel ties shall be used on all wall forms.

2.05 FIBERBOARD

- A. Bond breaker at joints shown on plans shall be 1" fiberboard specifically made for use with concrete.

2.06 SEALANT

- A. Sealant for horizontal and near horizontal joints shall be a one component, self-leveling, elastomeric polyurethane (Sikaflex 1c-SL or approved equal) applied to all crack control joints and on top of bond breaker fiberboard. Sealant shall be resistant to mountain elements including UV radiation, precipitation, and cold temperatures. Service range shall be -40+170 degrees F. Sealant shall conform to ASTM C-920, Type S, Grade P, Class 25. Sealant for vertical joints shall be Sikaflex Construction Sealant or approved equal.

2.07 "EPOXY" ANCHORING ADHESIVE

- A. Anchoring adhesive shall be a two component 100% solids epoxy based system supplied in manufacturer's standard cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer. Epoxy system shall be suitable for submerged applications. Use Hilti HIT-RE-500 V3 or approved equal.

PART 3 - EXECUTION

3.01 PVC WATERSTOPS

- A. Waterstops shall be placed in the locations as shown on the drawings. Waterstop shall be cut or spliced at least the full length of the concrete joint, if applicable. End cuts shall be straight and square. No nails shall be driven through the center of the waterstop when forming. The bulb shall be positioned in the center of the joint. Sections of water stop shall not be lapped, and all joints shall be spliced utilizing heat sealing method in accordance with the manufacturer's recommendations. All joints shall be swept and cleaned prior to the concrete pour to ensure that foreign material does not interfere with direct contact between the waterstop and the concrete.
- B. The waterstop shall be held securely in place, to prevent a misalignment during concrete placement operations, with wire fasteners at one foot intervals.

3.02 ANCHORS AND INSERTS

- A. Pipe sleeves, inserts for pipe connections, anchor bolts, dowels, steel plate inserts, and forms for pipe holes must be accurately placed and securely fastened to the forms in such a manner that the placing of concrete will not alter their alignment or location. All anchors to be epoxy anchors; mechanical anchors are not allowed. In the event that openings are inadvertently omitted or improperly placed, the Owner/Engineer may require the concrete to be drilled at the proper location. Filling of improperly placed openings shall be done with expansive grout or dry pack or mortar applied with an accepted epoxy adhesive. The surfaces of the opening shall be roughened prior to filling. All anchor bolts shall be stainless steel 316. Mechanical or expansion anchors are not allowed.

3.03 REINFORCING STEEL ANCHORING ADHESIVE

- A. As indicated on the construction plans.
- B. The anchors shall be installed per manufacturer's instructions. Anchor holes shall be clean prior to applying epoxy. Inject adhesive into holes proceeding from the bottom of the hole progressing in such a manner as to avoid introduction of air pockets in the adhesive. Sufficient adhesive shall be injected into the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03310 - STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish all labor, tools, and equipment for the construction of plain and reinforced concrete as shown on the Contract Drawings and herein specified. The Contractor shall strictly adhere to ACI 301.

1.02 RELATED WORK

- A. Section 03210 - Reinforcing Steel
- B. Section 03250 - Concrete Accessories
- C. City of Thornton General and Special Conditions

1.03 SUBMITTALS

- A. See Section 01345.
- B. Submit product data for admixtures, evaporative retardant films, curing compounds, form release agents, ready mix concrete designs, form ties, bonding agents, grouts, coatings, and fibrous reinforcing.

PART 2 - PRODUCTS

2.01 CEMENT

- A. Cement shall be air-entrained Portland Cement in accordance with ASTM C-150, Type II, and ASTM C260.

2.02 AGGREGATE

- A. Fine Aggregate
 - 1. Fine aggregate shall consist of hard, strong, durable particles conforming to the provisions of the Standard Specifications for Concrete Aggregates, ASTM Designation C33.
- B. Coarse Aggregate
 - 1. Coarse aggregate shall consist of hard, strong, durable particles conforming to the provisions of Standard Specifications for Concrete Aggregates, ASTM Designation C33.

2.03 FIBROUS REINFORCING

- A. Fibrous reinforcing shall be used in Portland cement concrete used for curb, gutter, sidewalks, curb turn fillets, cross plans, and valley gutters per City of Thornton specifications.
- B. The following shall be submitted:
 - 1. One copy of manufacturer's printed product data, clearly marked, indicating proposed fibrous concrete reinforcement materials. Printed data should state 1.5 lbs of fiber to be added to each cubic yard of each type of concrete.

2. One copy of manufacturer's printed batching and mixing instructions.
 3. One copy of a certificate prepared by the concrete supplier stating that the approved fibrous concrete reinforcement materials at the rate of 1.5 lbs per cubic yard were added to each batch of concrete delivered to the project site. Each certificate shall be accompanied by 1 copy of each batch delivery ticket indicating amount of fibrous concrete reinforcement material added to each batch of concrete.
- C. Fibrous concrete reinforcement shall consist of (see City of Thornton specifications):
1. 100% virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. Fibrous concrete reinforcement shall be as manufactured by Fibermesh Company, 4019 Industry Drive, Chattanooga, Tennessee 37416, or approved equal.
 2. Physical characteristics:
 - a. Specific gravity = 0.905 grams per cubic centimeter.
 - b. Tensile strength = 70 to 110.
 - c. Fiber lengths: 1/2", 3/4", 1-1/2", 2" per manufacturer.
 - d. Fibrous concrete reinforcement materials provided by this subsection shall produce concrete conforming to the requirements of each type and class of concrete required as indicated.
 - e. Construction methods:
 - (1) Add fibrous concrete reinforcement to concrete materials at the time concrete is batched in amounts in accord with approved submittals for each type of concrete required.
 - (2) Mix batched concrete in strict accord with fibrous concrete reinforcement manufacturer's instructions and recommendations for uniform and complete dispersion.

2.04 WATER

- A. Water shall be clean and free of injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or steel. Mixing water for prestressed concrete or for concrete which will contain aluminum embedment, including that portion of the mixing water contributed in the form of free moisture on the aggregates, shall not contain deleterious amounts of chloride ion.
- B. Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 4" or less if consolidation is by vibration. The slump shall be determined by the "Test for Slump or Portland Cement" ASTM C143.

2.05 ADMIXTURES

- A. Admixtures to be used in concrete shall be subject to prior acceptance by the Owner/Engineer. The admixture shall maintain the same composition and performance throughout the work as the product used in the concrete proportioned established in accordance with ACI 211. Admixtures containing chloride ions shall not be used in pre-stressed concrete or concrete containing aluminum embedments.
- B. Air Entrainment
 1. An air entrainment agent shall be used in all concrete. The agent used shall conform to ASTM Designation C260.

2. The amount of air entraining agent used in each concrete mix shall be such as will affect the entrainment of the percentage of air shown in the following tabulation in the concrete as discharged from the mixer at the point of placement.

<u>Maximum Size of Coarse Aggregate (inches)</u>	<u>Total Air, Percent By Volume, of Concrete</u>
3/8"	7.5 ± 1
3/4"	6.0 ± 1
1-1/2"	5.5 ± 1

B. Water Reducing, Set-Controlling Admixture

1. The Contractor shall use a water-reducing, set controlling concrete. A water-reducing admixture shall be used in all concrete and shall conform to ASTM Designation C494, specifically, Types A, B, C, D, and E.

C. Finely Divided Mineral Admixtures

1. Mineral admixtures shall be limited to fly ash conforming to ASTM Specification C618.

2.06 BATCHING

A. Measuring and batching of materials shall be done at an offsite batching plant.

B. Portland Cement

1. Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. Bulk cement shall be weighed on scales separate and distinct from the aggregate hopper or hoppers. Batching shall be such that the accuracy of batching shall be plus or minus one percent of the required weight.

C. Water

1. Unless water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. In lieu of the volume method, the Contractor will be permitted to use a water metering device.

D. Aggregates

1. Aggregates shall be handled from stockpiles or other sources to the batching plant in such a manner as to secure a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used. Batching shall be so conducted as to result in the weights of material required for each type aggregate within a tolerance of 2%.

2.07 MIXING

A. Concrete shall be mixed at a central-mix plant. Mixing time shall be measured from the time water is added to the mix, or cement contacts the aggregate. All concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or evidence of undispersed cement. Onsite batching and mixing of concrete are not allowed.

B. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94.

C. General

1. The temperature of mixed concrete, immediately before placing shall not be less than 50° F nor more than 90° F. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregate nor mixing water shall be heated to exceed 150° F.
2. When mixed at the site of the work or in a central-mixing plant, the mixing time shall not be less than 50 seconds nor more than 90 minutes.
3. The time elapsing from the time water is added to the mix (or the cement comes in contact with aggregate) until the concrete is deposited in place at the site of the work shall not exceed 45 minutes when the concrete is hauled in non-agitating trucks, nor more than 90 minutes when hauled in truck mixers or truck agitators. If hydration inhibitors are used, this time may be extended. Contractor shall submit all admixtures as part of mix design.
4. The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 1/4 of the specified mixing time.
5. Cement shall be charged into the mixer by means that will not result in loss of cement due to the effect of wind, or in accumulation of cement on surfaced of hoppers or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

2.08 TRANSPORTING MIXED CONCRETE - MIXED CONCRETE OR TRUCK MIXERS

- A. Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.
- B. No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless requested by Contractor and approved by the Owner/Engineer. If additional water is to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.
- C. The Contractor shall furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Owner/Engineer.
- D. Each load of ready mixed concrete delivered at the job site shall be accompanied by the ticket showing volume of concrete, the weight of cement in pounds, the total weight of all ingredients in pounds, and amount of additional water that can be added on-site. The ticket shall also show the time of day at which the materials were batched and the reading of the revolution counter at the time the truck mixer is charged.
- E. Add a concrete washout on site.

2.09 COMPRESSIVE STRENGTH

A. Structural Concrete

1. Structural concrete compressive strength requirements consist of a minimum strength which must be obtained before various loads or stresses are applied to the concrete and, for concrete designated by strength, a minimum strength at the age of 28 days. The compressive strength shall be 4,000 psi for all structures.
2. The mix shall be designed for strengths at least 15% in excess of this minimum. The net water cement ratio of the concrete shall not exceed 0.45 by weight.
3. A minimum of 6.5 sacks of cement per cubic yard of concrete for 4,000 psi concrete.
4. Maximum aggregate size shall be 3/4".
5. Sampling and curing shall be in accordance with ASTM C192, and testing shall be in

accordance with ASTM C39. Slump shall be between 3" and 5", or as approved by the Owner/Engineer, when placed.

B. Testing

1. Concrete field testing will be done by an independent laboratory provided by the Contractor. The Contractor shall notify the Owner 24 hours in advance of concrete placement.
2. Field testing shall include water-cement ratio, air entrainment, unit weight, and slump; and shall be taken as follows:
 - a. Each of the first 3 trucks or batches. If all 3 meet specifications, every 2nd truck will be tested. If any truck/batch fails the specification, all proceeding trucks/batches will be tested.
 - b. Laboratory testing will include compressive strength testing. Six (6) cylinders will be for each pour of 15 cubic yards or more, but not less than one set of tests and 4 cylinders for each structure or project component, or individual placement. For large continuous pours, one set of tests and 4 cylinders will be made for each 20 yards of the pour. Each set of cylinders shall come from a tested truck/batch.
 - c. The cylinders shall be taken from the concrete chute or conveyor used for concrete placement. 4" by 8" cylinders are acceptable if approved by the Owner/Engineer.
3. Compressive strength testing "breaks" will be conducted as follows:
 - a. 1 break = 2 cylinders
 - b. 1 break at 7 days
 - c. 1 break at 28 days
 - d. 2 cylinders held back

2.10 NON-SHRINK GROUT OR DRY PACK

- A. Mortar shall be composed of Portland Cement, sand, and water proportioned and mixed as specified in this section. Mortar shall be furnished and placed in recesses and holes, on surfaces, under structural members, and at other locations specified in these specifications, the special provisions are shown on the plans.
- B. The proportion of cement to sand, measured by volume, shall be 1:2 unless otherwise specified.
- C. The maximum size of sand shall not be larger than 1/2 the size of the recess, holes or spaces where the mortar is to be placed. The mortar shall contain only enough water to permit placing and packing.
- D. Concrete areas to be in contact with the mortar shall be cleaned of all loose or foreign material that would in any way prevent bond between the mortar and the concrete surfaces and shall be kept thoroughly moistened with water for a period of not less than 24 hours immediately prior to placing mortar.
- E. The mortar shall completely fill and shall be tightly packed into recesses and holes, on surfaces, under structural members, and at other locations specified. After placing, all surfaces or mortar shall be cured by the water method as provided in Part 3, 3.05 "Curing and Protection," for a period of not less than 3 days.

- F. Keyways, spaces between structural members, holes, spaces under structural members, and other locations where mortar could escape shall be mortar-tight before placing mortar. No load shall be allowed on mortar that has been in place less than 72 hours unless otherwise permitted by the Owner/Engineer.
- G. All improperly cured, or otherwise defective mortar shall be removed and replaced by the Contractor at his expense.

PART 3 - EXECUTION

3.01 FORMS

- A. The concrete forms shall be constructed to the lines and dimensions as shown on the detailed drawings and shall be of acceptable material and adequately braced and tied to support all of the loads and pressures of the wet concrete without distortion or leaks, and which will produce a smooth, even surface.
- B. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete- form-grade hardboard, metal, plastic, paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed. All exposed concrete corners shall be chamfered 3/4".
- C. A watertight form tie with a neoprene seal shall be used on all walls or slabs that form a water holding space. Ties in these walls or slabs shall remain permanently in the concrete.
- D. Drawings showing the general design and dimensions for forms for structures need not be submitted to the Owner/Engineer for acceptance unless the Owner/Engineer so requests such submittal. Design and construction shall be in accordance with "Recommended Practice for Concrete Formwork" (ACI 347), and "Formwork" (ACI 301, Chapter 4).
- E. Before concrete is placed, the surface of the forms shall be oiled with a commercial form oil that will effectively prevent sticking of the concrete to the forms and will not stain the concrete. All bond breaking materials or processes shall be used only after acceptance by the Owner/Engineer. Care shall be taken in applying form oil to avoid contact with reinforcement steel. Embedded material which becomes coated with form oil shall be thoroughly cleaned or replaced at the expense of the Contractor. Supporting forms and shores shall not be removed from beams, floors, and walls until these structural units are strong enough to support their own weight and any approved superimposed load which at no time shall exceed the design live load. When the forms are stripped, there shall be no excessive deflection or distortion and no evidence of damage to the concrete, due either to removal of support or the stripping operation. Removal time of forms shall be determined by the Owner/Engineer.

3.02 PLACEMENT

- A. Prior to placing the concrete, the Contractor shall remove all trash, pieces of wood, standing water, or other debris and shall dampen areas on which concrete is to be placed.
- B. Placement shall conform to ACI 301, Chapter 8 "Placing," ACI 306 "Recommended Practice for Cold Weather Concreting," and ACI 305 "Recommended Practice for Hot Weather Concreting." No concrete shall be placed until all formwork, reinforcement, installation of parts to be embedded, bracing of forms, and preparation of surfaces involved in the placing have been approved by the

Owner/Engineer. No concrete shall be placed in water, except with the written permission of the Owner/Engineer; the method of depositing the concrete shall be subject to his approval. All surfaces of forms and embedded materials that have become encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed. Immediately before placing concrete, all surfaces upon or against which the concrete is to be placed shall be free from standing water, mud, debris, or loose materials. The surfaces of absorptive materials against or upon which concrete is placed shall be moistened thoroughly so that moisture will not be drawn from the freshly placed concrete.

- C. The concrete shall be placed by equipment which will prevent segregation or loss of ingredients. The stream of concrete shall not be allowed to separate by permitting it to fall freely over rods, spacers, or other embedded materials.
- D. All concrete placed in walls exceeding 6' in height shall be spouted or "tremied" so that the maximum free fall shall be 5'.
- E. Concrete shall be placed in continuous layers of approximately 12" and the total elapsed time between placing of successive layers shall not exceed 30 minutes.
- F. All wood blocking, spreaders, and screens shall be removed as the concrete is poured and before the concrete sets.
- G. Form oil shall be approved for potable water applications.

3.03 CONSTRUCTION JOINTS

- A. The location of all construction joints will be subject to the acceptance of the Owner/Engineer. The surface of all construction joints shall be power washed until thoroughly clean and all latence and standing water removed. Clean aggregate shall be exposed by abrasive blast cleaning. Wire brushing and air water jets may be used while concrete is fresh provided results are equal to abrasive blast cleaning. Construction joints shall be keyed at right angle to the direction of shear. Except where otherwise shown on the plans, keyways shall be at least 1-1/2" in depth over at least 25% of the area of the section.

3.04 CURING AND PROTECTION

A. General

1. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to acceptance by the Owner/Engineer.
2. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing:
 - a. Ponding or continuous sprinkling.
 - b. Application of absorptive mats or fabric kept continuously wet.
 - c. Application of sand kept continuously wet.
 - d. Continuous application of steam (not exceeding 150° F or mist spray).
 - e. Application of waterproof sheet materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" (ASTM C171). Not acceptable during cold temperatures.
 - f. Application of other moisture retaining covering as accepted. Not accepted during cold temperatures.

- g. Temperature dependent application of a curing compound conforming to “Specifications for Liquid Membrane Forming Compounds for Curing Concrete” (ASTM C309) and approved for potable water applications. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proven that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.
3. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the curing time by one of the previously described curing methods.
 4. Curing shall be continued for at least 7 days in the case of all concrete except high-early strength concrete for which the period shall be at least 3 days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70% of the specified concrete strength.
- B. Cold Weather
1. When the mean daily outdoor temperature is less than 40° F, the temperature of the concrete shall be maintained between 50 and 70° for the required curing period. When necessary, arrangements for heating, covering, insulation, or housing the concrete work slab grade preparation shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide. Cold weather concrete placement shall conform to ACI 306.
- C. Hot Weather
1. When necessary, provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow. Hot weather concrete placement shall conform to ACI 305.
- D. Rate of Temperature Change
1. Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5° F in any 1 hour or 50° F in any 24 hour period.
- E. Protection from Mechanical Injury
1. During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

3.05 REPAIR OF SURFACE DEFECTS

- A. Surface defects, including tie holes, unless otherwise specified by the Contract Documents, shall be repaired immediately after form removal.
- B. Repair of Defective Areas
 - 1. Exposed concrete defects and surface cracks on flat work are not allowed. Refer to City of Thornton Special Condition sections.
- C. Tie Holes
 - 1. After being cleaned and thoroughly dampened, the tie holes shall be filled solid with patching mortar.
- D. Proprietary Materials
 - 1. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations.

3.06 FINISHING OF FORMED SURFACES

- A. Immediately after removing the forms, the form ties shall be cut back 3/4" from the surface and patched with 1:2 cement-sand mortar. All honeycombs, voids, and other defects shall be so patched. The surfaces shall then be thoroughly wetted and rubbed with a No. 16 Carborundum stone or equal abrasive brining the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth, dense surface without pits or irregularities. After setting sufficiently, the surface shall then be rubbed with a No. 30 Carborundum stone until the entire surface is of a smooth texture and uniform in color. Only exposed surfaces in habitable areas need be rubbed. Surfaces to be waterproofed or hidden from view shall be patched, but not rubbed.

3.07 PATCHING

- A. The total patched area shall not exceed two square feet in each 1,000 square feet of surface. This is in addition to form tie patches.
- B. Any patches shall closely match the color and texture of surrounding surfaces. The mix formula for patching mortar shall be determined by trial to obtain a good color match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces and patches shall be dressed manually to obtain the same texture as surrounding surfaces.

END OF SECTION

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DIVISION 9 - FINISHES

DIVISION 9 - FINISHES

SECTION 09900 - PROTECTIVE COATINGS AND FINISHES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, equipment and incidentals necessary to paint and finish all exterior surfaces for the pitless casings above ground, bollards, pipe exposed to view (inside vaults), and pipe stands. Buried pipe shall be coated per spec 02610.
- B. Painted steel will not be accepted for submerged conditions.

1.02 SPECIAL PROVISIONS

- A. Any material supplied under other sections of these specifications with a factory applied shop coat primer shall be painted with a finish coat only provided the factory primer is compatible with the finish paint. If the primer is not compatible it shall be completely removed.
- B. Any equipment supplied with a factory applied finish paint generally shall not be repainted unless the original finish is marred during shipment, during installation or as directed by the Engineer. Marred surfaces shall be touched up or entirely repainted with a compatible paint at the discretion of the Engineer.

1.03 QUALITY STANDARDS

- A. Comply with the most current, applicable regulations of:
 - 1. Steel Structure Painting Council (SSPC)
 - 2. National Fire Protection Association (NFPA)
 - 3. American National Standards Institute (ANSI)
 - 4. Occupations Safety and Health Act (OSHA)

1.04 SUBMITTALS

- A. Comply with Section 01345.
- B. Provide detailed product data sheets, recommended application procedures, and coverage.
- C. Confirm final color choices with Owner prior to ordering.

PART 2 - MATERIALS

2.01 PAINT SYSTEMS

- A. All materials specified herein and approved for use are manufactured by the Tnemec Company, Inc. Equivalent materials of other manufacturers may be used with the prior written approval of the Engineer. Requests for substitution shall include Manufacturer's literature for each product giving the name, generic type, descriptive information, solids by volume, recommended dry film thickness and a list of 10 projects where each product has been used and rendered satisfactory service for at least 3 years. No request for substitution shall be considered that would decrease film thickness and/or number of coats or offers a change in the generic type of coating specified. Colors, where not specified, shall be selected by the City.

<u>Item</u>	<u>Type</u>	<u>Paint</u>	<u>Dry Film (mils)</u>
SS	Epoxy-Polyamide Aliphatic-Polyurethane	1st coat: 66 Hi-Build Epoxoline 2nd coat: 70 Endura Shield	4.0 - 6.0 <u>1.5 - 2.5</u> 5.5 - 8.5
IS	Epoxy-Polyamide	1st coat: 20 Pota-Pox Undercoat 2nd coat: 20 Pota Pox	3.0 - 5.0 <u>4.0 - 6.0</u> 7.0 - 11.0

Symbols: SS - Structural steel
IS - Immersed structural steel

2.02 COLOR SCHEDULE

A. General

<u>Item</u>	<u>Color</u>	<u>Number</u>
Pitless, Piping & Supports	Light Green	
Immersed Metals	**	*
Bollard	Canary Yellow*	14YW

* Or as directed by Owner.

** Immersed metal shall be stainless steel or galvanized steel.

PART 3 - INSTALLATION

3.01 SURFACE PREPARATION

- A. All ferrous metal surfaces which are to be painted, shall be prepared in strict compliance with the applicable specifications of the Steel Structures Painting Manual, Volume 2, published by the Society for Protective Coatings (formerly Steel Structures Painting Council -SSPC). All fabricated steel shall be solvent cleaned in accordance with SSPC-SP1 prior to blast cleaning. Any surface that becomes contaminated by oil, grease or other foreign matter after blast cleaning shall be solvent cleaned again before painting.
- B. Fabrication defects including weld imperfections, delaminations, scabs and silvers shall be corrected prior to surface preparation. Dust and blast cleaning media shall be removed from cleaned surfaces by high pressure air or vacuum cleaning. Mill coated steel shall not require surface preparation beyond that provided by the manufacturer unless the surface is damaged or contaminated during installation or erection. The following surface preparation procedures shall be required:
1. Submerged steel shall not be painted. Submerged steel shall be galvanized or stainless steel.
 2. Structural steel SSPC-SP6 commercial blast cleaning
 3. Galvanized SPC-SPI Solvent Cleaning

3.02 APPLICATION

- A. All materials shall be delivered to the job site in original sealed and labeled containers of the paint manufacturer.
- B. Coatings shall be applied during good painting weather. Air and surface temperatures shall be within limits prescribed by the manufacturer for the coating being applied and work areas shall be reasonably free of airborne dust at the time of application and while the coating is drying. Each coat shall be allowed to dry thoroughly before the next coat is applied.

- C. All work shall be cut in neatly and finish coats shall be uniform in color and texture without streaks, laps, heavy build-ups, runs, sags or missed areas. All materials shall be mixed, thinned and applied in strict compliance with the manufacturer's printed instructions.

3.03 ACCEPTANCE OF WORK

- A. Each coat of paint shall be inspected before the next coat is applied. If any coat is deemed unacceptable by the Engineer, it shall be corrected and reinspected before painting is resumed. Acceptable painted surfaces shall be uniform in texture and color, shall not have dust embedded in the paint nor have any brush strokes, laps, runs or sags. Paint overspray, spills or drips onto any areas adjacent to the painted surfaces shall be entirely removed before the paint work is accepted.

END OF SECTION

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DIVISION 15 - MECHANICAL

DIVISION 15 - MECHANICAL

SECTION 15060 - INTERIOR PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section covers the furnishing and installation of all interior ductile iron pipe and fittings.

1.02 RELATED WORK

- A. General Conditions and Division 1 - General Requirements
- B. Section 09900 - Protective Coatings and Finishes

PART 2 - MATERIALS

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. All Piping shall be mechanically restrained pipe
- B. All bolts, nuts, rods, washers shall be 316 stainless steel.
- C. Specifications
 - 1. The pipe shall be designed, manufactured, tested, and inspected and marked in accordance with the provisions of this specification and AWWA Standard C-151, "American Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids," except as herein modified.
- D. Dimensions
 - 1. Permissible variations in length, diameter, weight, wall thickness, and straightness shall comply with the allowable tolerances specified in the applicable AWWA standards. The minimum finished inside diameter of the pipe, after lining is placed, shall be as set forth in the applicable AWWA standards.
- E. Ductile Iron Thickness

Pipe Size (inch)	Pressure Class
3 through 12	350
14 through 20	250
24	200
30 through 54	150

- F. Joint Design and Fabrication
 - 1. The standard joint shall be flanged conforming with AWWA Standard C-110. The joint shall be suitable for a minimum of 250 psi working pressure. The manufacturer shall furnish all joint materials including gasket.
 - 2. Harness rods with steel plate flange lugs shall be utilized across flexible couplings, flange adaptors, flex connectors, and as shown on the Drawings.
- G. Specials and Fittings

1. Unless otherwise shown on the plans, all specials and fittings shall conform to the dimensions and requirements of AWWA Standard C-110. Fittings shall be designed for 250 psi working pressure and shall have the same lining and coating as the abutting pipe.
2. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand, using the same materials as are used for the pipe and in accordance with the applicable AWWA standards. Coatings and linings applied in this manner shall provide protection equal to that specified for the pipe. Areas of lining and coating that have been damaged shall be repaired by hand application in accordance with the applicable AWWA standards.
3. All rods, bolts and nuts shall be 316 stainless steel.

H. Flanges

1. All flanges shall conform to ANSI B16.5. Blind flanges shall be designed in accordance with ASME Unified Pressure Vessel Code, Section VIII. Flanges shall be designed on the basis of using 1/8" ring type compressed gaskets. Bolt holes in all flanges shall straddle field vertical centerline. Insulated flanges shall have bolt holes 3/16" diameter greater than the bolt diameter.

I. Gaskets for Flanges

1. Gaskets shall be 1/8" full face type, Garlock No. 3200 compressed non-asbestos sheet packing or approved equal. Red rubber gaskets will not be allowed.

J. Cement-Mortar Lining

1. Interior surfaces of all pipe, fittings and specials shall be lined in the shop with cement-mortar in accordance with AWWA Standard C-104. The cement shall meet the requirements of "Standard Specifications for Type II Portland Cement," ASTM C-150. The sand shall conform to that prescribed in AWWA C-104. The cement-mortar shall contain not less than one part of cement to two parts of dry sand. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty, the unsatisfactory pipe shall be replaced.

K. Material Submittals

The following submittals shall be required for review and acceptance by the Engineer:

1. Standard joint detail
2. Restrained joint detail
3. Pipe laying schedule
4. Bolts and anchor bolts

PART 3 - EXECUTION

3.01 DUCTILE IRON PIPE INSTALLATION

A. Handling

1. Ductile iron pipe and fittings shall be handled at all times by lifting with padded cradles of canvas, leather, or other suitable material so as to avoid shock or damage. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating

or lining is damaged, the damaged pipe shall be replaced at no cost to the owner. All pipe handling equipment is to be approved by the Engineer. The use of bare metal cables, chains, hooks, etc. will not be permitted.

2. Stockpiled pipe shall be supported on wood blocks and/or sandbags placed under the uncoated ends of the pipe. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any obstruction. Rolling the pipe on coated surface will not be permitted. Adequate strutting shall be provided if necessary, to prevent damage to pipe lining and coating.

B. Flanged Joint

1. Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The pipe shall be set level, plumb, and aligned. Flange fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall straddle the vertical centerline of the pipes. The gasket shall be centered, and the connecting flanges drawn up watertight without unnecessary stressing of the flanges. All bolts shall be tightened in a progressively diametrically opposite sequence using torque wrenches at settings recommended by the manufacturer (75 lb. min.). Where dissimilar flanges are connected, an insulating connection shall be provided.

C. Cutting and Fitting

1. The Contractor shall make all pipe cuts as required per the Drawings. All cuts on ductile iron pipe shall be made by the use of pipe cutters or pipe saws. All cuts shall be straight and true.

D. Pipe Tap Connections

1. Taps to the pipe barrel are unacceptable. Connect only at service saddle or at a tapping boss of a fitting, valve body, or equipment casting.

END OF SECTION

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DIVISION 15 - MECHANICAL

SECTION 15100 - VALVES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish, install, and test all valves and appurtenances as shown on the Contract Documents, and completely coordinated with work of all other trades.
- B. All valves shall be in compliance with City of Thornton standard section 200.

1.02 RELATED WORK

- A. General Conditions
- B. Section 15060 - Pipe and Fittings

1.03 SUBMITTALS

- A. In accordance with General Conditions.
- B. Shop Drawings: Shop drawings shall include product data sheets for make and model including information on operable pressure ranges, temperature tolerances, standard service operating conditions, and functions of the particular valve and required operating appurtenances.
- C. Operation and maintenance manuals in accordance with General Conditions.
- D. Manufacturer's Certificate of Proper Installation for all automatic valves in accordance with General Conditions.
- E. The manufacturer of valves supplied under this specification shall furnish to the Engineer, an affidavit of compliance in accordance with all applicable provisions of AWWA C-509 and City of Thornton standards as modified or supplemented herein.

1.04 QUALITY STANDARDS

- A. Ensure valves contained in this and referenced sections are produced in full compliance with specified items and any references to codes and standards. Abbreviated forms of more commonly referenced standards are as follows:
 - 1. AGMA - American Gear Manufacturers Association
 - 2. ANSI - American National Standards Institute
 - 3. ASTM - American Society for Testing and Materials
 - 4. AWWA - American Water Works Association
 - 5. MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
- B. Furnish valves with end connections as shown on Drawings and ensure type complies with following specifications:

End Type	Specification Reference
Soldered	ANSI B16.18
Screwed	ANSI B2.1
Flanged	Cast Iron ANSI B16.1; Steel ANSI B16.5
Bell and Spigot	ANSI 21.11 (AWWA C111)

PART 2 - MATERIALS

2.01 GENERAL

- A. All valves shall be in compliance with City of Thornton standard section 200 unless approved otherwise by the Owner.
- B. Valves shall be manually operated with a standard non-rising stem handwheel actuator unless otherwise specified.
- C. Valves shall be designed to be flange mounted to ductile iron pipe as specified in Section 15060.
- D. Valves and required operating appurtenances shall be the product of the same manufacturer.
- E. All valves shall have the manufacturer and size of the valve visibly cast on the body or on a plate attached to the body of the valve.
- F. Valve components shall withstand the environmental conditions in contact and provide continuous trouble-free service.
- G. Valve seals shall be able to provide tight closure and prevent metal-to-metal contact.
- H. Brass and bronze components of valves and appurtenances in contact with water and brass and bronze used in any part of a valve in buried or submerged service shall be alloys containing less than 16% zinc and 2% aluminum.
 - 1. Acceptable alloys are of the following ASTM designations: B61, B62, B98 (Alloy A), B143 (Alloy 1-B), B164, B194, B292 (Alloy A), and B127.
 - 2. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer with the acceptance of the Engineer.
- I. Ends and Trim:
 - 1. When indicated, provide cavitation trim designed to minimize cavitation damage and noise at service conditions. The trim shall be that recommended by the valve manufacturer.
 - 2. Flanges shall be machined to a flat face with a finish of 250 micro-inches, AARH maximum, or machined to a flat surface with a serrated finish in accordance with AWWA C-207.
- J. Operators:
 - 1. Valve operators shall open by turning counter-clockwise (left) unless otherwise noted.
 - 2. Worm operators and gear operators shall be of permanently lubricated, totally enclosed design proportioned to permit operation of the valve under full operating head with a maximum pull of 40 pounds on the handwheel or crank. If required, valves shall have a 2-inch square nut to match the City of Thornton Standards.
 - 3. All operator components shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chainwheel operators and an input torque of 300 ft-lb for operating nuts when operating against the stops.
 - 4. Stop-limiting devices shall be provided in the operators for the open and closed positions.
 - 5. Unless otherwise specified, the valve operators shall be of the self-locking type.
 - 6. Self-locking worm gears shall be a 1 piece design of gear bronze material. The worm shall be hardened allow steel, with thread ground and polished.

7. Reduction gears shall run in a lubricant which has been manufactured tested and found to be suitable.
8. Valve operators shall be provided with position indicators, where specified, to show the position of the valve disc or plug.
9. Where valve handwheels are shown, valve orientation shall be as shown. Where valve handwheels are not shown, valve shall be oriented to permit easy access to the handwheels, and to avoid interference with pipe appurtenances.
10. Operator extensions may be required as indicated on the Drawings. Operator extensions shall be mechanically fastened to the operating nut.

K. Protective Coatings

1. All valves shall have fusion bonded epoxy linings in accordance with AWWA C550.

2.03 STAINLESS STEEL CHECK VALVES

A. General

1. Manufacturer shall have a minimum of 5 years' experience in the manufacture of stainless steel check valves.

B. Product

1. The valve shall be rated for 250 psi, have a Certalok grooved type pipe connection. The valve shall be manufactured for vertical installation. The body shall have a "full waterway" with a flow area not less than the nominal pipe area through the valve. A 6" valve shall be used with an outside diameter of 6-5/8" and a length of 13-5/8".
2. Permanent raised arrow should be cast into the body indicating direction of flow.

C. Materials

1. Comply with the City of Thornton Standards.
2. Valve bodies and covers shall be made from stainless steel ASTM 316.
3. The disc shall be made from Buna-N (NBR) rubber.

D. Manufacturer

1. Valves shall be Stainless Steel Check Valve Model 80S6CL manufactured by Flomatic Corporation or approved equal.

2.04 CORPORATION STOPS

A. Comply with City of Thornton Standards.

B. Provide corporation stops as specified to isolate combination air/vacuum valves.

C. Corporation stops shall be manufactured by Mueller Company Style H-10003, H-10012, or H-10045 or Engineer approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Prior to installation, carefully inspect in open and closed position, and clean valve of all foreign material. Installation practices shall conform to the manufacturer's recommendations.

3.02 PRESSURE TESTING

- A. Valves shall be pressure tested at the same time the pipe is tested. If there are any special parts of the valve that might be damaged by the pressure testing, they shall be properly protected. The Contractor is responsible for any damage which occurs during testing. Joints shall show no visible leakage under the pressure testing. Any joints which show signs of leakage shall be repaired prior to final acceptance.
- B. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the material options furnished and/or that he has complied with these and other referenced specifications.

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15121 - FLEXIBLE COUPLINGS, FLANGE ADAPTORS, AND FLEXIBLE CONNECTORS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install all flexible couplings, flange adaptors, flexible connectors and insulating couplings as shown in the Drawings or as required. The coupling and adaptor materials shall be the same strength rating as the pipe to be joined.

1.02 RELATED WORK

- A. Section 09900 - Protective Coatings and Finishes
- B. Section 15060 - Interior Pipe and Fittings

1.03 SUBMITTALS

- A. In accordance with Section 01345.

PART 2 - MATERIALS

2.01 GENERAL

- A. Flexible Couplings and Flange Adaptors
 - 1. Flexible couplings and flange adapters shall be designed to relieve mechanical stress in pipelines due to thermal expansion and contraction, differential settlement or misalignment and mechanical vibration. Flexible couplings shall consist of a sleeve which shall fit over the ends of the two pipe sections to be joined. The coupling shall form a watertight seal by compressing resilient wedge-shaped gaskets between the ends of the sleeve and the pipe sections. The gaskets shall be compressed by 2 retainer rings bolted to one another on the outside of the coupling sleeve. Flange adaptors shall be equivalent to flexible couplings except that one retainer ring and gasket shall be replaced with a flanged connection on the coupling sleeve. Harness rods with steel plate flange lugs shall be utilized across flexible couplings.
- B. Insulating Couplings
 - 1. Shall be used when joining pipes of dissimilar metal, either above or below grade.
- C. Flexible Connectors
 - 1. Flexible connectors shall be used to isolate vibration and noise in piping systems.
- D. Transition couplings shall be used when joining different size pipes.
- E. All sleeves shall be fusion coated or stainless steel and all bolts and rod shall be SS 316.

2.02 ACCEPTABLE MANUFACTURERS

- A. All couplings and connectors shall be 316 stainless steel or fusion coated per AWWA C213
- B. Flexible Couplings - Dresser Style 38, Smith-Blair Product No. 411, Ford Style FC

- C. Flange Adaptors (DI Pipe) - Smith-Blair Product No. 912, Dresser Style 127, Ford Style FCA
- D. Flange Adaptors (Steel Pipe) - Smith-Blair Product No. 913, Dresser Style 128, Ford Style FCA
- E. Transition Couplings - Dresser Style 162, Smith-Blair Product No. 413, Ford Style FC.
- F. Insulating Couplings - Dresser Style 39, Ford Style FIB
- G. Flexible Connectors - Proco Series 240, Metraflex Style R
- H. Bolts, nuts, and rods shall be 316 stainless steel.

2.03 SLEEVE AND FLANGE ADAPTOR BODIES

- A. Sleeves and flange adaptor bodies shall be fabricated from cast iron, malleable iron, or carbon steel in conformance with one of the following Standards: ASTM A126, Grade B; ASTM A47; ASTM A53; ASTM A512
- B. Interior lining of all sleeve and flange adaptor bodies shall be liquid epoxy coated (Tnemec Pota-Pox or approved equal, 16.0 dry film mils) in accordance with AWWA C210 or fusion-bonded epoxy coated in accordance with AWWA C213. Exterior coating shall be shop applied Tnemec 66 Epoxoline Primer or approved equal, 3 to 5 mils.
- C. Bolts, nuts, and rods shall be 316 stainless steel.

2.04 RETAINER RINGS

- A. Retainer rings shall be malleable iron, ductile iron, or high carbon steel conforming to one of the following Standards: ASTM A47; ASTM A536; ASTM A715; AISI C1018. Retainer rings shall be fusion coated.

2.05 BOLTS

- A. Bolts and nuts shall be 316 stainless steel.

2.06 GASKETS

- A. Gaskets shall be 1/8" full face type Garlock No. 3200 compressed non-asbestos sheet packing or approved equal.

2.07 FLEXIBLE CONNECTORS

- A. Units shall be constructed of neoprene and nylon. Flanges shall be tapped or drilled to mate with ANSI 150 lb. companion flanges. Units shall be capable of operating at up to 240° F and 125 psi pressure/vacuum service condition.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install all flexible couplings, flange adaptors, flexible connectors and insulating couplings in accordance with the Manufacturers' recommendations.
- B. Prior to installation, thoroughly remove all oil, scale, and dirt from the coupling or adaptor and provide a clean seat for the gasket.
- C. Wipe gasket clean prior to installation.

- D. Tighten bolts progressively around the retainer ring until all bolts have a uniform tightness. Final tightening shall be performed with a torque-limiting wrench to the torque level recommended by the Manufacturer.
- E. Install restraint rods, and rods with insulating kits where required with insulating couplings, to provide restraint against pipe thrust.

END OF SECTION

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DIVISION 15 - MECHANICAL

SECTION 15123 - PIPE SEALS AND SLEEVES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The work covered under this specification includes the furnishing and installation of pipe concrete penetration seals.
- B. Unless otherwise shown on the drawings, all pipe penetrations through concrete floors and walls shall consist of a galvanized or stainless steel sleeve with weep ring, and a modular synthetic rubber seal composed of interlocking links joined by bolts. The links shall completely seal the annular space between the pipe and sleeve to provide a completely watertight seal. The seal shall be capable of resisting a hydrostatic pressure equal to two (2) times the height of the wall, a minimum hydrostatic pressure of 20 psi or as indicated on the Contract Drawings. The seal shall provide electrical insulation between the pipe and the floor or wall.

1.02 RELATED WORK

- A. Section 02610 – Pipe and Fittings
- B. Section 03252 - Concrete Accessories
- C. Section 15060 - Interior Pipe and Fittings

PART 2 - MATERIALS

2.01 GENERAL

- A. Rubber sealing elements shall be manufactured from EPDM (Ethylene Propylene Diene Monomer) synthetic rubber. Pressure plates shall be glass reinforced nylon plastic. Bolts and nuts shall be 316 stainless steel. The pipe sleeve for use in the walls, shall be manufactured from 1/4 inch thick mild steel epoxy coated with welded weep ring. Weep ring outside diameter shall be 4 inches greater than outside diameter of the pipe sleeve.

2.02 ACCEPTABLE MANUFACTURERS

- A. Thunderline Corporation - "Link-Seal" with EPDM seal elements Model C and model WS steel wall sleeve, or approved equal.
- B. Bolts, nuts, and rods shall be 316 stainless steel.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall strictly follow the manufacturer's recommended installation procedure. The Contractor shall be responsible for providing the appropriate size and model of wall seal for each size pipe and pipe material utilized.

3.02 SUBMITTALS

- A. The Contractor shall submit product data and drawings detailing each pipe seal for each slab/wall penetration.

END OF SECTION

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DIVISION 15 - MECHANICAL

SECTION 15151 - ELECTROMAGNETIC FLOW METERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish, install, and test the electromagnetic flow meter and appurtenances as shown on the Contract Documents, and completely coordinated with work of all other trades.
- B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation.
- C. The furnished 6-inch diameter electromagnetic flow meter shall be capable of measuring flow rates between 10 - 1,000 gpm and the 12-inch diameter electromagnetic flow meter shall be capable of measure flow rates between 10 - 5,000 gpm. The meter shall operate off of AC power and shall be furnished with a readout that display flow rate and totalized flow. The readout is to be located in the pump station. The meter shall have a data logger that will record flow rates and a time stamp every 5 minutes to provide total flows by the day, week, and month for a minimum of three months without losing data. The data logger will be mounted in a waterproof enclosure near the near the readout display.
- D. Pressure transducer for well water level measurement and recording. The pressure transducer must be compatible with data logger and flow meter.
- E. All programming and testing to allow the system to record flow data from the flow meter and water levels from the pressure transducer.

1.02 RELATED WORK

- A. General Conditions
- B. Section 15060 - Interior Pipe and Fittings

1.03 SUBMITTALS

Contractor shall submit manufacturer product information and technical specifications to Owner/Engineer for approval prior to ordering product.

1.04 WARRANTY

All suppliers shall warrant their hardware, equipment and installations for a period of five years from the date of system Initial Acceptance.

PART 2 - MATERIALS

2.01 GENERAL

- A. Electromagnetic flow meter model Promag W 400 manufactured by Endress and Hauser or approved equal shall be of the high impedance (100,000 Megohms) bipolar pulsed DC coil excitation with auto zeroing each half cycle. Units shall be suitable for continuous or intermittent use on either potable water or raw water. Units shall be suitable for submerged operation.
- B. Units shall be microprocessor based with integral electronics. Units shall have pushbutton

programming and integral LCD readout for display of programmed values, flow rate, totalized flow and error codes as required; programmed flows and totalization shall be entered directly in engineering units. The microprocessor shall safeguard against entering invalid flow rate data for the particular meter size. The system shall be self-standardizing two to three times per hour to maintain system accuracy. One LCD display shall be provided to indicate both flow rate in gpm or totalized flow in MG non-simultaneously. Equipment shall include non-full indication. Include appropriate size grounding disk.

- C. Pressure Transducer model number "WaterpilotFMX167" manufactured by Endress and Hauser, GE Sensing (Druck) "PDCR/PTX-1730" or approved equal.

2.02 PERFORMANCE

- A. Repeatability: +/- 0.1% of rate; +/- 0.005% of maximum full scale
- B. Linearity: +/- 0.1%
- C. Accuracy: +/- 0.5% of rate down to 5% of full scale
- D. Adjustable response time of 0.4 to 100 seconds on analog output
- E. Unit shall operate within liquid conductivity down to 5 microohms/cm

2.03 POWER REQUIREMENTS

- A. Pro-Mag 10W
 - a. Voltage: 11-40 VDC
 - b. Power Consumption <10 VA (Including Sensor)
- B. Data Logger
 - a. Voltage: 11-30 VDC
 - b. Power Consumption <360 mW

2.04 CONSTRUCTION

- A. Flowtube: 321 stainless steel with integral grounding electrodes
- B. Flanges: ANSI B16.5; Class 150 carbon steel
- C. Liner: Teflon or neoprene
- D. Transmitter: Remote mount unit, enamel coated die cast aluminum; NEMA 4X housing, suitable for intermittent immersion; 4-20 ma DC output into 800 ohm load proportional to flow rate plus scaled pulse
- E. Electrodes: 316 SS

2.05 OPERATING CONDITIONS (1 unit required)

- A. Flow temperature: 32 to 100 F
- B. Solids Content: 1%
- C. Operating Pressure: up to 150 psi
- D. Size: 6" and 12"
- E. Flow Range: 10 - 5,000 gpm actual condition, depending on the meter size
- F. Cable Length: Shall be submitted by Contractor

2.06 ACCEPTABLE MANUFACTURERS

The electromagnetic flow meters shall be PROMAG as manufactured by Endress + Hauser, Inc. or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

Prior to installation, carefully inspect and clean meter of all foreign material and thoroughly clean the flange faces. Installation practices shall conform to the manufacturer's recommendations. After cleaning flanges, insert the gasket and tighten the nuts progressively and uniformly.

3.02 PRESSURE TESTING

Meters shall be pressure tested at the same time the pipe is tested. If there are any special parts of the meter that might be damaged by the pressure testing, they shall be properly protected. The Contractor is responsible for any damage which occurs during testing. Joints shall show no visible leakage under the pressure testing. Any joints which show signs of leakage shall be repaired prior to final acceptance.

3.03 CALIBRATION AND START UP

- A. Factory Calibration: Meters shall be flow calibrated across the specified range at the manufacturer's factory and five (5) copies of the certified test results must be submitted and approved by the Owner/Engineer prior to shipment.
- B. Field Calibration: Provide the services of factory-trained instrumentation technicians, tools, and equipment to field calibrate each flow meter to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration. Each flow meter shall be calibrated at 10%, 50%, and 90% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the flow meter being calibrated to its published specified accuracy. This report shall include a listing of the published specific accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerances, defects noted, corrective action required, and correction made.
- C. Programming: Provide all necessary programming required for the flow meter, pressure transducer and data logger to read and record flows and water levels. All equipment shall be compatible with one another and use the same software.

3.04 TRAINING

- A. Provide 1 day of training for the owner on site by a factory-trained instrumentation technician on use of the electromagnetic flow meter, level sensors, pressure transducer data logger, and software.

END OF SECTION

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DIVISION 16 - ELECTRICAL

DIVISION 16 - ELECTRICAL

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Coordination of all electrical installations and designs. Installation and placement of the electrical equipment accurately in position, level and plumb. Connecting and adjusting the electrical equipment and making the electrical installations ready for service.
- B. Selection of equipment based on proposed equipment ratings, locations, and conditions to provide for estimated equipment loads and proposed power and lighting circuit ratings.
- C. Selecting the equipment and preparing the equipment location, outline and layout drawings.
- D. Checking, coordinating, and revising, as needed, the electrical equipment ratings and lighting power circuits based on the selected equipment and layout drawings.
- E. Power and Metering Components.
- F. Cutting and patching for electrical construction, and touchup painting.

1.2 REFERENCES

- A. The following standards and codes, standard publications of professional organizations, and the local authorities having jurisdiction may be referenced in this section.
 - 1. American National Standards Institute (ANSI)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. Institute of Electrical and Electronic Engineers (IEEE)
 - 4. National Electrical Manufacturer's Association (NEMA)
 - 5. National Fire Protection Association (NFPA)
 - 6. NFPA 70, The National Electrical Code (NEC)
 - 7. Underwriters' Laboratories, Inc. (UL)
 - 8. State, City, and Local Authorities

1.3 DEFINITIONS

- A. Provide: Shall mean furnish and install.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Furnish shop drawings, data, and instructions for the proposed equipment. Provide shop drawings for all power distribution, conduit and wiring, instrumentation, grounding plan, and control equipment. Include bills of material, front views, assembly drawings, mounting details, schematic diagrams, elementary diagrams, block diagrams, wiring diagrams, and the following. Show overall dimensions and minimum clearances for all electrical equipment. Full-size drawings shall be submitted.
 - a. Equipment locations, outlines, and layout drawings: Equipment locations with respect to the structure, enclosure construction, conduit entries where applicable, grounding plan showing ground rod locations, dimensions, arrangement of components within the enclosures, and section arrangement.

- b. Bills of material: Information for each piece of equipment including type, style, manufacturer, and other pertinent information such as scales, trip ratings, settings, and other information, as applicable.
- c. Nameplates: Provide information on material, sizes, and engraved lettering.
- d. Schematic Diagrams: Show complete functional operation of the equipment including equipment devices and components that are identifiable by reference to the bill of material item.
- e. Wiring diagram: Show complete wiring of the equipment devices and components including terminal block numbers and wire (conductor) designations.
- f. Manufacturer's data: Clearly mark catalog cut sheets and other data to indicate the item being provided. The data shall provide sufficient comprehensive product information to fully demonstrate that the product meets the requirements of these specifications.
- g. Luminaire data: Data on luminaries other than those specified shall include tabulated candlepower and angle data that describe the photometry distribution of the luminaries. Multiplane candlepower and angle data shall be furnished for luminaries having an asymmetrical distribution. Candlepower distribution curves are not acceptable.
- h. Lighting standard data: Data for lighting standards shall include dimensions and installation information including anchor bolt arrangement and luminaries mounting details.

2. Final Drawings:

- a. Furnish final as-built redline drawings in for all electrical system design drawings. Show all changes and revision dates made up to the time the drawings are furnished. Show "as-built" equipment and installations that apply specifically to the equipment actually furnished. No equipment shall be shipped until the drawings have been updated to show the equipment at the time of shipment. Provide the following final drawings:
 - i. Outlines, and location of equipment relative to the structure.
 - ii. Grounding plan and location of ground rods and grounding connections.
 - iii. Schematic diagrams.
 - iv. Wiring diagrams.
3. All drawings shall be prepared using graphical symbols and device function numbers conforming to the latest applicable standards of ANSI Y32.2, Y32.9 and C37.2.

B. Quality Control:

- 1. Certified copies of test reports, where required, for the grounding system and equipment. Ground resistance or equipment, that does not successfully pass the testing requirements, will be rejected. Equipment tests are defined within the specific equipment requirement Sections elsewhere in these Specifications.
- 2. Operation and Maintenance Instructions, Descriptive Data, and Bills of Material
 - a. Each set of material shall be assembled into one encasing cover with a front index sheet.
 - b. The operation and maintenance instructions shall be descriptive data that apply specifically to the equipment furnished and shall include the features pertaining to operation, maintenance, control, relaying, instrumentation, programming, and other features.
 - c. Descriptive data and bills of material shall describe the components furnished. These data shall be such that the components can be identified as to manufacturer, type, rating, characteristics, and other identification so that a component to be replaced could be ordered from the description furnished.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70, the National Electrical Code.
- C. All equipment and materials will be new and unused and shall conform with the current applicable industry standards. Workmanship and neat appearance shall be as important as electrical and mechanical operation. Defective or damaged materials shall be replaced or repaired prior to final acceptance in a manner meeting approval of Architect and/or ENGINEER and at no additional cost to OWNER.

1.6 SEQUENCING AND COORDINATION

- A. The electrical system construction sequence shall follow the general project sequence.
- B. Plan work to ensure that the existing walls and other facilities remain operational throughout construction.
- C. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in structures during progress of construction to facilitate the electrical installation.
- D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the structures.
- E. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- F. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, expose work, obtain inspections and approvals, and restore the concealed work.
- G. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment nameplates shall be in English. All signs and symbols shall be in accordance with ANSI Y32.2.
- B. Mounting bolts, nuts, and washers for items of electrical equipment shall be ASTM A276Type 316 stainless steel. Cadmium-plated mounting hardware will not be permitted.
- C. Furnish and install shims, grout, expansion anchors, wood blocking, anchor bolts, screws, nuts, washers, and all other hardware and incidentals required to complete the electrical installation.
- D. If furnished electrical equipment and materials are of such size, type, ratings, or other physical properties that changes are required in the CONTRACTOR's approved designs, it shall be the responsibility of Contractor to effect all changes necessary as required and approved by Engineer.

2.2 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Service Entrance Feeders, Commercial Service Pedestal, Cold Sequence Disconnecting Means, Meter Sockets, Meters, Service Grounding: Comply with requirements of Xcel Energy and their Standard For Electrical Installation and Use Book.

2.3 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.4 TOOLS

- A. Furnish all special tools and appliances as required for maintenance and adjustment of electrical equipment.
- B. Furnish all additional tools and equipment as necessary to properly install, adjust, and check the operation of the electrical equipment.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. General

1. Installation of electrical equipment shall be in accordance with the manufacturer's installation instructions. Nuts and bolts used in electrical equipment assembly and installation shall be tightened by the use of torque wrenches to torque values recommended by the equipment manufacturer.
2. Make all electrical wire, cable, conduit, and grounding connections and furnish all miscellaneous materials that are required for making these connections to the equipment.
3. Drill all holes and provide all fastenings required for mounting or installing electrical equipment and materials.
4. Any electrical equipment installed on concrete foundations shall be given full and even bearing by being grouted in place. Grouting shall be in accordance with Section 03601.
5. Repair of damage to painted and/or galvanized surfaces shall be made in accordance with Section 09900.

B. Equipment Identification

1. The completed electrical installation shall be provided with adequate identification of circuits and equipment to assist personnel during maintenance in compliance with Section 16075.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Adhere to clearances required by the NEC, NFPA 70. Connect for ease of disconnecting, with minimum interference with other installations.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.3 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.4 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Coordinate the repair and refinish of disturbed finish materials and other surfaces with the appropriate trade to have areas restored to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.5 FIELD TESTING AND STARTUP

- A. After the electrical installations have been completed, operationally test the electrical equipment and circuits installed under these specifications, unless specifically indicated otherwise herein, to demonstrate that the requirements of these specifications have been fulfilled. Prior to the operational tests, check out the electrical equipment and wiring and provide service, equipment, and materials as indicated below, and the sequence of this work and service shall be as follows:
 - 1. Make a complete wiring check, including conductor continuity checks, of the entire installation and, when necessary, make wire changes, adjust settings, and make equipment replacements for the proper functioning of the installation so that it conforms to specifications requirements.
- B. After the electrical installations have been completed, operationally test the electrical equipment and circuits installed under these specifications, unless specifically indicated otherwise herein, to demonstrate that the requirements of these specifications have been fulfilled. Prior to the operational tests, check out the electrical equipment and wiring and provide service, equipment, and materials as indicated below, and the sequence of this work and service shall be as follows:
 - 1. Make a complete wiring check, including conductor continuity checks, of the entire installation and, when necessary, make wire changes, adjust settings, and make equipment replacements for the proper functioning of the installation so that it conforms to specifications requirements.
 - 2. Identify and test each electrical control circuit and furnish certified test sheets.
 - 3. During a period of time agreed to by Contractor and Engineer, a representative of Contractor shall examine and check all electrical protective devices and sequence of operation of electrical controls for proper functioning and settings.
- C. Have available at the construction site drawings that show the electrical installation at the time of the examination, instruction books, equipment tests reports, coordination curves, and data.
- D. Immediately prior to the acceptance tests, clean all luminaries, replace all broken and/or burned-out lamps, and service all electrical equipment in accordance with manufacturer's instructions.
- E. While performing the functions of testing and checkout, retain full responsibility for the removal and replacement of any wiring connections.
- F. Make wiring changes, setting adjustments, equipment replacements, or other revisions, which are necessary for the proper and adequate functioning of the installation.

- G. Replace any wiring, instruments, or equipment that may be damaged in the checkout process, unless this damage results from the negligence of Owner.
- H. The wiring checkout shall include the insulation test of all insulated conductors.
- I. Provide competent personnel at the site to process the checkout and complete the following:
 - 1. Test all switches for correct operation.
 - 2. Test all plug receptacles for correct polarity and grounding system continuity. Ground fault interrupter (GFI) outlets shall be tested for proper operation.
 - 3. Test all luminaries for faulty connections and bad or broken components.
 - 4. Test and calibrate all instrumentation systems for proper operation.
 - 5. Test all motor control circuits for proper operation and all motors for proper shaft rotation.
 - 6. Test grounding system for proper resistance.

3.6 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Raceways
 - 2. Conductors and Cables
 - 3. Supporting Devices for Electrical Components
 - 4. Electrical Identification
 - 5. Electricity-Metering Components
 - 6. Concrete Equipment Bases
 - 7. Cutting and Patching for Electrical Construction
 - 8. Touchup Painting

3.7 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.2 REFERENCES

- A. The following is a list of standards that may be referenced in this Section:

- 1. American National Standards Institute (ANSI)
 - a. ANSI/UL 467 - Grounding and Bonding Equipment
- 2. NFPA70 - National Electrical Code (NEC)

1.3 SUBMITTALS

- A. Shop Drawings

- 1. Product Data for the following:
 - a. Ground rods
- 2. Manufacturers' catalog data for the grounding materials, grounding drawing, and test reports.
- 3. Comply with requirements of Section 16050.

- B. Administrative:

- 1. Statement of Qualifications for firms and persons specified and will be responsible for Quality Assurance.

- C. Quality Control:

- 1. Field Test Reports:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- 1. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. ILSCO.
 - b. Kearney/Cooper Power Systems.
 - c. Lyncole XIT Grounding.
 - d. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - e. Raco, Inc.; Division of Hubbell.
 - f. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section 16120.
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Sectional type; copper-clad steel.
 - 1. Size: 5/8 in diameter by 120 inches (16 by 2400 mm).
- B. Ufer Ground: The Ufer ground electrode shall consist of a minimum of 40 feet of #4 AWG bare copper conductor or larger installed as a single run and encased with a minimum of two inches of concrete cover in all directions.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Underground Grounding Conductors: Use tinned- copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and branch circuits. This grounding conductor shall be in addition to the ground path provided by the continuously grounded metallic raceway system that encloses the phase and neutral conductors. Where there are parallel feeders installed in more than one raceway, each raceway shall have a green insulated equipment ground conductor.
- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches (600 mm) below grade.
- D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- G. Bond interior metal piping systems to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Where metallic piping and duct systems are rendered metallicity non-continuous by non-conductive couplings, provide bonding jumpers to restore grounding continuity. Use braided-type bonding straps.
- I. Uffer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c)

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Tests: Perform the following field quality control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each at service disconnect enclosure grounding terminal, the maximum ground-resistance shall not exceed 10 ohms. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify ENGINEER promptly and include recommendations to reduce ground resistance.

END OF SECTION

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DIVISION 16 - ELECTRICAL

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.2 REFERENCES

- A. The following is a list of standards that may be referenced in this Section:

1. NFPA 70 National Electrical Code (NEC)
2. NESC National Electrical Safety Code

1.3 SUBMITTALS

- A. Shop Drawings:

1. Product Data for each electrical identification product indicated.
2. Comply with requirements of Section 16050.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16-inch (1.6 mm) thick for signs up to 20 square inches (129 square cm) and 1/8-inch (3.2 mm) thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
- C. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.2 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
- B. Paint: Formulated for the type of surface and intended use.
 1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 2. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

- C. Detectable Warning Tape: Red, Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Install painted identification according to manufacturer's written instructions and as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime surfaces using type of primer specified for surface.
 - 3. Apply one intermediate and one finish coat of enamel.
- E. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
 - 1. Apply the following colors to the systems listed below:
 - a. Fire Alarm System: Red
- F. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- G. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.
 - 1. Color-code 208/120-volt system as follows:
 - a. Phase A: Black
 - b. Phase B: Red
 - c. Phase C: Blue
 - d. Neutral: White
 - e. Ground: Green
 - 2. Color-code 480/277-volt system as follows:
 - a. Phase A: Yellow
 - b. Phase B: Brown
 - c. Phase C: Orange

- d. Neutral: White with a colored stripe or gray
- e. Ground: Green

3. Factory applied color the entire length of each conductor.

H. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

- 1. Panelboards, electrical cabinets, and enclosures
- 2. Electrical switchgear and switchboards
- 3. Disconnect switches
- 4. Enclosed circuit breakers
- 5. Motor starters

END OF SECTION

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DIVISION 16 – ELECTRICAL

SECTION 16095 – TESTING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 PROVISIONS

- A. The drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Common Work Results for Electrical included in Section 16050
- B. Grounding and Bonding included in Section 16060
- C. Conductors and Cables included in Section 16120

1.3 TEST REPORT SUBMITTALS

- A. Provide a single submittal with examples of test reports for each system to be tested to the Owner/Architect/Engineer prior to testing in accordance with Division 1.
- B. Submit results of testing (1 hard copy and 1 electronic (PDF) copy) for each system to the Owner/Architect/Engineer when complete in accordance with Division 1.

1.4 RESPONSIBILITY

- A. The Contractor shall perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment prior to any acceptance testing.
- B. The Contractor shall perform visual and mechanical inspections, verifying that the equipment nameplate information meets the intent of the drawings and specifications.
- C. The Testing Firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
- D. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications and manufacturer's requirements.
- E. The tests and inspections shall determine suitability for energization.
- F. The Contractor shall supply a suitable and stable source of power to each test site. The testing firm shall specify the specific power requirements.
- G. The Contractor shall maintain a written record of all tests, and upon completion of the project shall assemble and certify a final test report to Architect/Engineer/Owner.

1.5 SAFETY AND PRECAUTIONS

- A. Safety practices shall include, but are not limited to, the following requirements:
 - 1. Occupational Safety and Health Act
 - 2. Accident Prevention Manual for Industrial Operations, National Safety Council
 - 3. Applicable state and local safety operating procedures
 - 4. Owner's safety practices

5. National Fire Protection Association - NFPA 70E
6. American National Standards for Personnel Protection

B. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

1.6 QUALIFICATIONS OF TESTING PERSONNEL

- A. The testing personnel shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- B. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing or equal.

1.7 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers - IEEE
4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1999
5. American National Standards Institute - ANSI C2: National Electrical Safety Code
6. Codes and ordinances of the State, County, and City
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration - OSHA
10. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code
 - b. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
 - d. ANSI/NFPA 780: Lightning Protection Code
 - e. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references:

1. Project design specifications
2. Project design drawings
3. Manufacturer's instruction manuals applicable to each particular apparatus

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SWITCHGEAR, MOTOR CONTROL CENTERS, AND PANELBOARDS

A. Visual and Mechanical Inspection:

1. Inspect for physical damage.
2. Verify proper installation. This includes alignment, anchorage, clearances, grounding, bending radius of cables, wiring aesthetics, etc.
3. Inspect for proper identification, nameplate ratings, sizes of protective devices, switches, and busses, and adherence to one-line diagrams.
4. Check tightness of accessible bolted bus joints, cable connections, and anchor bolts.

5. Physically test all electrical or mechanical interlocks to assure proper function.
6. Inspect for proper operation of space heaters and thermostat settings (if applicable)
7. Clean interior and insulator surfaces.
8. Exercise all active components and verify proper barrier and shutter installation and operation.
9. Verify proper neutral and ground connections.

3.2 NEW AND REUSED VAULT EQUIPMENT POWER FEEDER CABLES - LOW-VOLTAGE

A. Visual and Mechanical Inspection:

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
3. Check cable color coding with applicable Engineer's specifications and National Electrical Code standards.

B. Electrical Tests:

1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
2. Perform continuity test to insure proper cable connection.
3. Perform phase rotation tests. Color code conductors.

C. Test Values:

1. Bolt torque values should be in accordance with NETA Table 10.12 of ATS 1999 unless otherwise specified by the manufacturer.
2. Evaluate insulation-resistance results by comparison with cables of same length and type. Investigate any values less than 100 megohms.

3.3 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Inspect ground system for compliance with codes, drawings and specifications.

B. Electrical Tests:

1. Perform fall-of-potential test or alternative in accordance with IEEE 81 on the main grounding electrode and the perimeter ground.
2. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
3. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

C. Test Values:

1. The maximum ground-resistance shall not exceed 5 ohms. If resistance to ground exceeds specified values, notify Owner/Architect/Engineer promptly and include recommendations to reduce ground resistance.

3.4 LOW VOLTAGE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Inspect for physical damage.
2. Mechanical operational test will be made in accordance with manufacturer's instructions.
3. Check tightness of all hardware connections.
4. Check cell fit and element alignment (if applicable).

3.5 WIRING DEVICES

A. Visual and Mechanical Inspection:

1. Inspect relays for physical damage, presence of foreign material, moisture, and corrosion.
2. Clean cover glass and relay components as required.
3. Check for freedom of movement, proper travel and alignment and tightness of mounting hardware and tap screws.

B. Electrical Tests:

1. Perform wiring continuity test on each receptacle.
2. Perform ground fault interruption test on each GFI receptacle using external ground fault simulation testing equipment.

3.6 SYSTEM FUNCTION TESTS

A. General: Perform system function tests upon completion of equipment component tests as defined in this specification. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.

B. Implementation: Contractor is to notify the Engineer when system testing is to begin. Commissioning Agent shall provide to the Contractor test procedures for the equipment and systems to be functionally tested. The test procedure shall be reviewed and approved by the Owner and Engineer 10 days prior to beginning the system testing.

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600V and 15kV.

1.2 REFERENCES

- A. The following is a list of standards and codes that may be referenced in this Section.
 - 1. Insulated Cable Engineer's Association (ICEA)
 - 2. National Electrical Testing Association (NETA ATS)
 - 3. National Electrical Contractors Association (NECA)
 - 4. National Electrical Manufacturer's Association (NEMA)
 - 5. National Fire Protection Association (NFPA)
 - 6. NFPA 70, The National Electrical Code (NEC)
 - 7. Underwriters' Laboratories, Inc. (UL)

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Manufacturers' catalog data for the wire and cables.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Insulated conductors of the proper voltage rating, type, and size for the application, that have been manufactured within twenty four (24) months prior to installation.
- B. All conductors shall be stranded copper unless specifically stated otherwise.
- C. All conductors shall be suitable for installation in a vertical position.
- D. All conductors shall have an AWG or KcMil designation.
- E. 600-Volt, Single Conductor for General Use Other Than Direct Burial: The insulated conductors shall conform to the requirements of NEC, shall bear the UL label, shall be suitable for general use other than direct burial, and shall be NEC type THWN or XHHW.

- F. 600-Volt, Single Conductor for Direct-Burial Use: The insulated conductors shall be type USE-RHW in accordance with NEC and shall bear UL label.
- G. Multiconductor Power and Control Cable: Multiconductor cables shall be provided as noted on the Drawings. The multiconductor cables shall be as follows:
 - 1. 600 volts insulated.
 - 2. Multiconductor type suitable for installation in trays, conduits and direct burial.
 - 3. Individual conductors shall be insulated with NEC type XHHW insulation and color-coded.
 - 4. Polyester tape, or equivalent, over the conductor group.
 - 5. Shielded with 100 percent aluminum foil taper and with minimum No. 18 AWG tinned and copper drain wire.
 - 6. An overall covering (jacket) of thermoplastic or neoprene.
 - a. Cable with No. 14 AWG individual conductors:
 - i. 3/C and smaller - 45 mils thick.
 - ii. 4/C to 12/C - 60 mils thick.
 - iii. Over 12/C - 80 mils thick.
- H. Instrumentation Cable: The instrumentation cable shall be suitable for all uses and shall be as follows:
 - 1. Twisted pair, individually shielded, having varying lengths of lay to minimize crosstalk.
 - 2. UL listed and labeled, Type TC.
 - 3. Voltage: 300V.
 - 4. Conductors tinned copper, stranded, No. 18 AWG minimum.
 - 5. Pair Shield: Aluminum coated Mylar with tinned copper drain wire, No. 18 AWG minimum.
 - 6. Jacket: Flame-retardant PVC with ripcord, or equal.
 - 7. Conductor Identification: ICEA S-61-402, black and white in pairs. White conductor printed numerically for group identification.
 - 8. Rome Cable Corporation Series 4874 or approved equal.
- J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Wires and Cables:
 - a. Alcan Aluminum Corporation; Alcan Cable Div.
 - b. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - c. Senator Wire & Cable Company.
 - d. Southwire Company.
 - e. Rome Cable Corporation
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.
 - e. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.

- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
- E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- F. Conductor Material: Copper.
- G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated.
- B. Electrical Tape:
 1. Plastic tape, 8.5 mils maximum thickness, 1,000,000 megohms minimum insulation resistance, oil-resistant vinyl backing, oil-resistant acrylic adhesive, incapable of supporting combustion per ASTM D-568 Test Method B.
 2. 3M, Plymouth, or approved equal
 3. All insulating tape used on circuits of 600 volts and less shall be 3-M #88 or Plymouth Slipknot Grey.
- C. Cable Lubricants:
 1. Wire pulling lubricants shall be specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic-insulated cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.
 2. Ideal Yellow #77 or approved equal.

2.4 MISCELLANEOUS WIRING MATERIAL

- A. Miscellaneous Connecting and Splicing Devices: Miscellaneous products, such as heat shrink tubing, electrical insulation, plug caps, splices and kits, tapes, terminal blocks, and terminations, shall be approved for the specific application.
- B. Joint compounds shall be approved for the specific type metal joint to be prepared.
- C. Cable ties, clamps, and identification shall be nylon, self-locking.

PART 3 - EXECUTION

3.1 GENERAL

- A. All wiring shall be routed through an UL-listed raceway regardless of voltage application, unless specified otherwise on the drawings or under other sections of these Specifications.
- B. Derate conductor ampacities based on the NEC when more than three current carrying conductors are installed in one raceway.
- C. No conductors or cable shall be pulled into any portion of conduit system until all construction work, which might damage the wire, has been completed.

- D. Unless otherwise indicated, all wiring for branch circuits shall be #12 AWG protected by 20-ampere circuit breakers.
- E. Increase wire size to account for voltage drop for all 120-volt circuits over 75 feet, and all 277-volt circuits over 150 feet to the first outlet.
- F. Wire size shall be uniform for the entire length of the circuit unless noted otherwise.
- G. Homeruns that indicate upgrading circuit conductors for voltage drop, e.g., #10AWG wire on 20-ampere circuit, shall have the conductor size indicated carried throughout the circuit to the last device or fixture.
- H. Do not splice feeders or dedicated branch circuits unless otherwise indicated. Install all wire continuous from outlet to outlet or terminal to terminal. Splices in cables when required shall be made in handholes, pull boxes or junction boxes and shall be in strict accordance with cable manufacturer's recommendations utilizing solderless connectors UL approved for the use.
- I. Make up splices in outlet boxes with 8 inches of correctly color-coded tails left in box. Splices in wires size #8 AWG and smaller shall be made with insulated spring type wire connectors, "Scotchlok." Splices in larger wire and cables shall be made with indent connectors approved for the purpose.
- J. Make connections, splices, taps and joints with solderless devices, mechanically and electrically secure.
- K. Lubricate cables to facilitate pulling. Lubrication material shall be inert to cable and raceways.
- L. Install compression connectors with hydraulic die, embossing die code into connector. Connect to bus with Belleville type washers for positive pressure over complete contact area. Insulate with heat shrink tubing.
- M. Provide a separate neutral for dimmer branch circuits, ground fault interrupter branch circuits, lighting branch circuits serving electronic ballasts and branch circuits serving isolated ground and isolated ground surge suppressor type receptacles.
- N. All phase, neutral, and ground conductors shall be tagged with corresponding circuit numbers at panelboard and all junction and outlet boxes.
- O. Sizes of conduits, unless specifically shown otherwise, shall be determined from Chapter 9 of National Electrical Code.
- P. Make all ground, neutral, and line connections to receptacle and wiring device terminals by means of the side terminal screw connections. Branch conductors shall not be connected to the device with backside "push-in" connectors. Provide ground jumper from outlet box to ground terminal of receptacle.

3.2 STORAGE AND HANDLING

- A. Store wiring materials in a protected environment not subject to physical damage or the effects of sunlight or inclement weather.

3.3 FIELD QUALITY CONTROL

- A. Wire And Cable Tests (600 Volts):
 1. Measure the insulating resistance of service entrance conductors, feeder circuit conductors, and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads.
 2. Tests and procedures shall meet the approval of Engineer and shall be in accordance with the applicable ICEA standards for the wires and cables to be installed.

3. Conduct tests in the presence of Engineer and submit written reports of the tests and results to Engineer.
- B. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- C. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

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DIVISION 16 - ELECTRICAL

SECTION 16130 - RACEWAYS BOXES

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Electrical conduits; boxes, and accessories required for the installation of conductors for the power, control, and instrumentation services.

1.2 DEFINITIONS

- A. The term "conduit" shall be considered synonymous with the term "raceway" as defined in Article 100 of the NEC.**

1.3 REFERENCES

- A. Following is a list of standards and codes that may be referenced in this Section.
 - 1. ZANSI C80.1 - Rigid Steel Conduit, Zinc-coated
 - 2. ANSI C80.6 - Intermediate Metal Conduit, Zinc-coated
 - 3. ANSI C80.3 - Electrical Metallic Tubing, Zinc-coated
 - 4. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
 - 5. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - 6. NEMA TC2 - Rigid Nonmetallic Conduit (Schedule 40 and Schedule 80)
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - 8. NFPA No. 70 - National Electrical Code (NEC)
 - 9. UL-651 - Standard for Safety Schedule 40 and 80 PVC Conduit
- B. Sizes of conduits, unless specifically shown otherwise, shall be determined from Tables in Chapter 9 of latest National Electrical Code.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Drawings, catalog data, and descriptive information for raceways, fittings, and boxes.

PART 2 - PRODUCTS

2.1 RACEWAYS AND FITTINGS

- A. Metallic Conduit Systems:
 - 1. Electrical Metallic Conduit (EMT). EMT shall be zinc-coated steel, galvanized on the outside and coated on the inside with a hard smooth lacquer finish. EMT fittings shall be steel compression type with insulated throats.
 - 2. Flexible Metal Conduit (FMC): FMC shall be single strip, continuous, flexible interlocked double-wrapped steel, zinc-coated inside and out forming smooth internal wiring channel with steel compression fittings.
 - 3. Intermediate Metal Conduit (IMC): IMC shall be hot-dipped galvanized with a zinc-coating. Fittings shall be steel threaded type.
 - 4. Liquidtight Flexible Steel Conduit (LFSC): LFSC shall be zinc-coated steel the same as FMC except with sunlight-resistant and mineral-oil-resistant plastic jacket. Fittings shall be cast malleable iron or steel body and gland nut, cadmium-plated with one-piece brass grounding bushings threaded to

interior of conduit. Provide spiral molded vinyl sealing ring between gland nut and bushing and nylon insulated throat.

5. Rigid Steel Conduit (RSC): RSC shall be heavy wall, hot dipped galvanized steel inside and out with threaded ends. RSC fittings shall be steel, threaded type. Plastic-coated Rigid Steel Conduit shall be rigid galvanized steel conduit having a 0.030" (.762 mm) minimum thick factory-bonded PVC jacket, using pre-jacketed couplings as manufactured by Pittsburgh Robroy, Plastic Applicator, Occidental or approved equal.

B. Nonmetallic Conduit Systems:

1. Rigid Nonmetallic Conduit (RNC): RNC shall be polyvinyl chloride (PVC) Schedule 40 or 80 suitable for 90°C. Provide solvent cemented type fittings matched to conduit type and material.
2. Liquidtight Flexible Nonmetallic Conduit (LFNC): LFNC shall comply with UL3.

C. Surface metal raceway shall be Wiremold or Walker-Parkersburg. Raceways, fittings, and components shall be of one manufacturer and designed for use together.

D. Metal Wireways: Wireways shall be hinged cover or screw cover complete with all necessary manufactured fittings which shall be of one manufacturer. Wireway shall be G.E. Type HS or ITE KEL Duct or acceptable equal.

1. Material: Sheet metal sized and shaped as indicated.
2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system. Provide wire retainers at not greater than 12 inches (300 mm) on center.
3. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
4. Wireway Covers: Hinged type
5. Finish: Manufacturer's standard enamel finish

E. Bushings: For rigid steel conduit larger than 1/2-inch (16 GRC) size, provide insulated type bushings, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system. Grounding bushings shall be locking type and shall be provided with a feed-through compression lug for securing the ground cables. Unions shall be electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or equal.

F. Sealing Fittings: Provide threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2.2 OUTLET, JUNCTION AND PULL BOXES

A. Acceptable Manufacturers:

1. Boxes and Cabinets: Bowers, Raco, Steel City, Appleton, Hoffman, or approved equal.

B. Outlet, Junction and Pull Boxes:

1. Cast Type Boxes: Cast type boxes shall be ferrous alloy and have gasketed cast covers and inside threaded hubs with adapters as necessary. Cast-metal boxes shall comply with NEMA FB 1, Type FD.
2. Galvanized Pressed Steel Type Boxes: Boxes shall be pressed steel, galvanized or cadmium-plated, 4-inch (100 mm) minimum octagonal or square with galvanized cover or extension ring as required. Knockout type shall be used with knockouts removed only where necessary to accommodate the conduit entering. Boxes shall comply with NEMA OS 1. Provide a grounding terminal in each box containing a green equipment ground conductor, or serving motors, lighting fixtures, or receptacles. Grounding terminal shall be green-colored washer-in-head machine screw or grounding bushing.

4. Cover and Device Plates: Provide device plates for each switch, receptacle, and special purpose outlet. Do not use sectional gang plates. Provide multi-gang outlet plates for multi-gang boxes. Provide high impact thermoplastic or nylon for devices in finished areas, and galvanized steel on surface-mounted devices in unfinished areas, unless otherwise directed. Surface outlet coverplates shall have beveled edges.
- C. Metal Pull boxes: Pullboxes shall be screw cover complete with all necessary manufactured fittings which shall be of one manufacturer.
1. Material: Sheet metal sized and shaped as indicated.
 2. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 3. Exterior, wet, or damp locations shall be NEMA 250 Type 3R
 4. Finish: Manufacturer's standard enamel finish
- D. Underground enclosures and pull boxes shall be QUAZITE® as manufactured by Strongwell or approved equal. The pull/splice box shall be constructed of polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement may be provided by means of steel, fiberglass, or a combination of the two. Boxes and covers shall be concrete gray and sustain a minimum vertical test load of 22,568# over a 10" square. Boxes shall be stackable for extra depth.

PART 3 - EXECUTION

3.1 GENERAL

- A. Electrical system layouts indicated on drawings are generally diagrammatic but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served.
- B. All home runs to panelboards are intended to be started from outlet nearest panel and continuing in general direction of that panel. Continue such circuits to panel as though routes were completely indicated. Terminate homeruns of signal, alarm, and communications systems in a similar manner.
- C. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of ENGINEER and conform to all structural requirements when cutting or boring structure.
- D. Install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc. required for equipment specified.

3.2 RACEWAYS

- A. Protect all non-PVC coated metallic raceway in earth or fill from corrosion with two coats of corrosion resistant paint or tape wrap.
- B. Elbows for conduit installed below grade or embedded within floor slabs shall be rigid steel conduit with factory PVC coating or two coats of corrosion resistant paint or tape wrap.
- C. Tie embedded raceways securely in place prior to concrete placement. Raceways installed below or within floor slabs shall extend a minimum of 4 inches (100 mm) above the finished slab or housekeeping pad to the first connector. Install capped bushings on conduit stub ups.
- D. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb. (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire. Tag both ends noting destination.
- E. Use temporary raceway caps to prevent foreign matter from entering conduits.

- F. Make all bends using an approved bending tool. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated. Cut all conduits square and ream all cuts to remove burrs. Exercise all necessary precautions during the construction period to prevent entry or accumulation of moisture, dust, concrete, and all foreign matter into the raceway system. CONTRACTOR shall pull a mandrel through each raceway to ensure the raceway interior is clean and dry prior to pulling conductors or cable.
- G. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
- H. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72 inch (183 cm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
- I. Above grade - defined as areas above finished grade for a building exterior and above top surface of any slabs (or other concrete work on grade) for a building interior. Installation of and materials for above-grade raceways shall conform with the following:
 - 1. Route exposed raceways and raceways parallel or perpendicular to building lines with right angle turns and symmetrical bends.
 - 2. Route raceways below or within floor slabs in a direct line, and where possible, with long sweep bends and offsets.
 - 3. Install raceways a minimum of 6 inches (150 mm) away from parallel runs of flues and steam pipes or other heated lines. Locate horizontal raceway runs above water and steam piping.
 - 4. Provide for waterproofing of all raceways, outlets, fittings, etc. which penetrate exterior walls or the roof to preserve the weatherproof integrity of the building. Provide pockets for waterflashing and counterflashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc. which penetrate roof. Wherever conduits penetrate concrete walls to outdoors, provide a watertight seal as manufactured by O.Z. Gedney Company, Type CSMC; Thunderline Corporation, Link Seal, or equal.
 - 5. Raceways between cabinets, fittings or boxes shall not exceed 200 feet (60 m) for straight runs or 100 feet (30 m) for runs with the maximum number of bends.
 - 6. Rigid metallic steel conduit shall be installed in the following above-grade areas:
 - a. Where exposed to mechanical injury.
 - b. Where specifically required by the National Electrical Code.
 - 7. Electrical Metallic Tubing (EMT): May be installed in dry areas only in:
 - a. Concealed locations in furred or masonry walls or ceilings.
 - b. Embedded in poured insulating fills.
 - c. Exposed areas at least 8 feet (2.5 m) above floor.
 - 8. Flexible liquid-tight metal conduit shall be provided in sufficient lengths for makeup of motor, or equipment, and/or raceway connections where isolation of sound and vibration transmission is required. Flexible liquid-tight metal conduit shall contain a separate equipment grounding conductor, sized per NEC requirements.
 - 9. Flexible metallic 3/8-inch (10 mm) fixture whip connections to recessed lighting fixtures shall not exceed 6 feet (1.8 m) in length.
 - 10. Surface raceways, where indicated on drawings, shall be metal and of a size approved for number and size of wires to be installed and shall be installed in a neat, workmanlike manner, with runs parallel or perpendicular to walls and partitions. Raceways, elbows, fittings, outlets and devices shall be of same manufacturer, and designed for use together.

11. Conduit Supports and Fasteners:

- a. Supports: Provide supports for horizontal steel conduits and EMT not more than 8 feet (2.5 m) apart with one support near each elbow or bend, including runs above suspended ceilings.
- b. Straps: Install one-hole pipe straps on conduits 1-1/2 inch (40 mm) or smaller. Install individual pipe hangers for conduits larger than 1-1/2 inch (40 mm). Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.
- c. Trapezes: Install multiple (trapeze) pipe hangers where two or more horizontal conduits run parallel and at the same elevation. Secure each conduit to the horizontal hanger member by a U-bolt, one-hole strap or other specially designed and approved fastener.
- d. Hanger Rods: Install 3/16-inch (5 mm) diameter or larger steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit.
- e. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Wooden plugs and shields shall not be used. Power-driven fasteners may be used to attach pipe straps and hanger rods to concrete where approved by Architect. Install raceway on steel construction with approved clamps which do not depend on friction or set-screw pressure alone.

12. Fittings: Use approved type couplings and connectors in all conduit runs and make all joints tight. Provide insulated bushings or rain-tight connections with insulated throats for all terminations in pipe sizes 1-1/4" (32 mm) and larger. Provide waterproof fittings for all runs in wet locations, such as exposed to weather, buried in slabs, etc. Provide raceway expansion joints with necessary bonding conductor at building expansion joints, between structures, and where required to compensate for raceway or building thermal expansion and contraction.

- J. Below Grade: Defined as area below finished grade for a building exterior and below bottom floor slab for a building interior. Installation of and materials for below-grade raceways shall conform with the following:

1. Below-grade raceways shall project 4 inch (100 mm) minimum above floor or equipment foundation.
2. Install exterior underground conduits 30 inch (760 mm) minimum below finished grade unless shown otherwise on the drawings.
3. Make all penetrations through concrete with plastic-coated rigid steel conduit.
4. Non-encased Raceways: Unless specifically noted on drawings for concrete encasement, provide either of the following raceway systems for installation below slabs on grade or in earth or gravel.
 - a. Rigid, heavy-wall, Schedule 40 or 80, polyvinyl chloride PVC plastic conduit, suitable for direct burial. All offsets and 90-degree ells shall be rigid plastic-coated conduit. Provide continuous ground wire for all non-metallic conduits.
 - b. Rigid steel conduit that is not completely encased in concrete but is in contact with ground or on a vapor barrier shall be wrapped with Scotchrap 51 half-lapped or shall have an additional outside factory coating of polyvinyl chloride with a minimum coat thickness of 30 mils (0.762 mm). Other PVC or Phenolic-resin-epoxy coating material, which is equally flexible and chemically resistant, may be used providing approval by ENGINEER is obtained prior to installation. Provide pre-jacketed couplings to provide a substantially watertight jacketing system.
 - c. All underground conduits and ducts 2 inches (50 mm) and larger shall be proven clear by pulling through a ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt or similar material. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. Clean empty raceways similarly. Clear or replace any raceway which rejects ball mandrel.
 - d. Provide seal-off fittings where conduits enter or leave hazardous wiring area or areas of widely different temperature and/or humidity.

5. Non-Metallic Raceway Installations:

- a. Joints shall be made using the material recommended by the raceway manufacturer. Components shall be cleaned prior to assembly.
- b. Raceway cutoffs shall be square and shall not deform conduit. Ream rough surfaces.
- c. Provide male box adapters to terminate raceways.
- d. Where separable terminations are required, provide PVC threaded adapters with locknuts or bushings. Provide "O" rings for watertight installations.
- e. Bends shall be made by methods that do not deform or damage the conduit.
- f. Provide expansion fittings where required.
- g. Raceway supports shall be installed to allow the non-metallic conduit to slide through the supports.
- h. Non-metallic raceway is not permitted within the building.

3.3 OUTLET, JUNCTION AND PULL BOXES

- A. Provide galvanized or zinc-coated, pressed steel outlet boxes for all locations except where otherwise indicated or where cast metal boxes are required by the NEC. Boxes are to be minimum 4-inch (100 mm) square or octagonal, and of depth as required. Provide outlet boxes of proper type and design for the particular fixture or device to be installed.
- B. Outlets for exterior application shall be cast, weatherproof type, with gasket and cast coverplate.
- C. Structural conditions and obstructions or other equipment items shall govern exact location of outlets and equipment. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc. with ENGINEER.
- D. Equip light fixture outlet boxes with 3/8-inch (10 mm) no-bolt fixture studs. Provide a minimum 4-inch (100 mm) octagon box. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface.
- E. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted.
- F. Junction and Pull Boxes: Use outlet boxes as junction boxes wherever possible. Larger junction and pull boxes over 12 inches (300 mm) in any dimension shall be fabricated from sheet steel, sized according to code, and have screw-on covers. All junction boxes shall be accessible.

END OF SECTION

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SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Wiring and wiring devices including lighting switches, plug receptacles, multi-outlet assemblies, and miscellaneous wiring devices including cover plates and all other materials and accessories required for the complete wiring device installations

1.2 REFERENCES

- A. The following is a list of standards and codes that may be referenced in this section:

1. NEMA WD 1-83: General Requirements for Wiring Devices
2. NEMA WD 6-88: Wiring Device – Dimensional Requirements
3. UL 486A-91: Wire Connectors and Soldering Lugs for Use with Copper Conductors
4. UL 20: General-Use Snap Switches
5. UL 498: Electrical Attachment Plugs and Receptacles
6. UL 943: Ground-Fault Circuit Interrupters

1.3 SUBMITTALS

- A. Shop Drawings:

1. Drawings, data, and descriptive information for wiring devices and switches.

1.4 QUALITY ASSURANCE

- A. Qualifications:

1. Provide products specified in this Section that are “listed and labeled” (as defined by the National Electrical Code, Article 100).
2. Comply with NEMA WD 1. Comply with NFPA 70.

1.5 DEFINITIONS

- A. GFCI: Ground-Fault Circuit Interrupter
- B. TVSS: Transient Voltage Surge Suppressor

1.6 COORDINATION

- A. Receptacles for Equipment: Match plug configurations.
- B. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Items of material furnished for the Work, subject to compliance with requirements, items listed or equal approved from manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Wiring Devices:
 - 1. Bryant Electric, Inc.
 - 2. Eagle Electric Manufacturing Co., Inc.
 - 3. GE Company; GE Wiring Devices.
 - 4. Hubbell, Inc.; Wiring Devices Div.
 - 5. Leviton Manufacturing Co., Inc.
 - 6. Pass & Seymour/Legrand; Wiring Devices Div.

- C. Multioutlet Assemblies:

- 1. Wiremold

2.2 COMPONENTS

- A. Straight-Blade and Locking Receptacles: Heavy-Duty grade: Comply with NEMA WD 6.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6 Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
- C. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of equipment being connected. Rubber-insulated cord, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent. Nylon plug body and integral cable-clamping jaws. Match cord and receptacle type for connection.
- D. Snap Switches: General-duty, quiet type. Switch shall be rated at 20 A, 120/277-VAC.
- E. Multioutlet Assemblies: Products from a single manufacturer designed as a complete, matching assembly of raceway, and receptacles. Raceway shall be constructed of sheet metal with manufacturer's standard finish.
- F. Wall Plates: Single and combination types match corresponding wiring devices. Metal plate-securing screw with head color to match plate finish.
 - 1. Material for Finished Spaces: Nylon, color to match wiring devices.
 - 2. Material for Unfinished Spaces: Galvanized steel.
 - 3. Material for Wet Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in "wet locations."

2.3 FINISHES

- A. Color: Manufacturers standard grey.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure all devices and assemblies plumb and secure
- B. Arrange devices and assemblies, unless otherwise noted, mounted flush with long dimension vertical, and grounding terminal of receptacles on top.

- C. Provide adequate protection for devices and assemblies prior to commencement of painting. Install device wall plates and assembly cover plates upon completion of painting.
- D. Connect wiring device and assembly grounding terminal to outlet box with bonding jumper. Connect wiring device and assembly grounding terminal to branch circuit equipment grounding conductor.
- E. Tighten all electrical connectors and electrical terminals according to manufacturer's publishes torque-tightening values. If torque values are not published, use torque values as specified in UL 486A and UL 486B.

3.2 IDENTIFICATION

- A. Comply with Section 16075.

3.3 FIELD QUALITY CONTROL

- A. Site Tests, Inspections:

1. Test wiring devices for proper polarity and ground continuity. Operate each device and assembly at least six times.
2. Test GFCI operation with both local and remote fault simulations in accordance with manufacturer's written testing procedures.

3.4 ADJUSTING

- A. Replace damaged and/or defective components. Adjust all floor service outlets, flush poke-through assemblies and telephone/power service poles to suit arrangement of partitions and furnishing.

3.5 CLEANING

- A. Keep all items protected before, during, and after installation. Clean area and remove all debris. Remove all paint overspray and/or spattering from devices and assemblies.

END OF SECTION

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SECTION 16900 – INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing and installation of metering and control equipment which shall include the following principal items:
 - 1. Metering and Control Systems. Principal components of the metering and control systems shall be as listed on the “Instrument List” at the end of this section and shall include modifications and improvements and programming of an existing PLC as is shown on the Drawings.
 - 2. Miscellaneous. One lot of test equipment, spare parts, and miscellaneous devices as set forth herein. Supplementing this section, the drawings indicate locations and arrangement of panels and instruments, and provide functional diagrams and schematics regarding connection and interaction with other equipment.
 - 3. Contractor shall inspect existing PLC and become familiar with existing conditions and existing PLC installations to provide all equipment and systems required to implement the intent of the project. The PLC was installed by other City and purchased by Thornton as is.

- B. Related Sections
 - 1. Electrical – Section 16050
 - 2. Programmable Logic Controllers – Section 16950
 - 3. Control Narratives – Section 16951

1.2 REFERENCES

- A. Codes & Permits
 - 1. All work and materials shall comply with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. All panels shall be listed by Underwriters Laboratories (UL) or other testing organizations acceptable to the governing authority. The Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

1.3 SUBMITTALS

- A. Complete fabrication, assembly, and installation drawings: wiring and schematic diagrams: and details, specifications, and data covering the materials used and the parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. Submittal data shall be grouped and submitted in two separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Instrument tag numbers indicated on the contract drawings shall be referenced where applicable. Submittal data for multifunctional instruments shall include complete descriptions of the intended functions and configurations of the instruments.
 - 1. First-stage Submittal. The first-stage submittal shall include the following items.
 - a. Product catalog cut sheets clearly marked to show the applicable model number, operational features, and intended service of the device.
 - b. A detailed list of any exceptions, functional differences, or discrepancies between the Supplier’s proposed system and the contract requirements.
 - c. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall include overall dimensions, metal thickness, door swing, mounting

- details, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.
- d. System wiring and installation drawings for all interconnecting wiring between components of the systems furnished and for all interconnecting wiring between the related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections.
 - e. If panel terminal designations, interdevice connections, device features and options, or other features are modified as a result of the fabrication process or factory testing, revised drawings shall be resubmitted.
 - f. A total of five (5) copies for the submittal shall be provided.
2. Second-stage Submittal. Complete system documentation, in the form of operation and maintenance manuals, shall be provided. Manuals shall include complete product instruction books for each item of equipment furnished.
- a. Where instruction booklets cover more than one specific model or range of instrument, product data sheets shall be included which indicate the instrument model number, calibrated range, and all other special features. A complete set of "as-built" wiring, fabrication, and interconnection drawings, calibration and startup sheets shall be included with the manuals.
 - b. A copy of all final O&M manuals shall be provided in PDF format in a CD-ROM or DVD. All AutoCAD drawings shall be provided in PDF and DWG formats.
 - c. A total of three (3) printed copies, and five (5) softcopies of final O&M manuals shall be provided.

1.4 QUALITY ASSURANCE

A. Supplier's qualifications

1. The entire system shall be designed, coordinated, and supplied by a qualified system integrator (Integrator) who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The Contractor's intended Integrator shall meet the following qualifications.
 - a. The Integrator shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
 - b. The Integrator shall have the physical plant and fabricating personnel to complete the work specified. The Integrator's fabrication capabilities and arrangements shall be acceptable to the Engineer.
 - c. The Integrator shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
 - d. The Integrator shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

B. Coordination

1. Instrument and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All instruments and control devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufactured and the manufacturer of related equipment.
2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
3. The Integrator shall provide coordination with other contractors and supervision of installation as required during construction.
4. Coordination shall be provided between the Integrator and the process system supplier.

5. Instrument and control systems shall be designed and coordinated for proper operation with other sections of these specifications. These shall include but not be limited to Materials and Equipment – Section 01600, Electrical – Section 16050, and Programmable Logic Controllers – Section 16950.

1.5 WARRANTY

- A. All suppliers shall warrant their hardware, equipment and installations for a period of two years from the date of system initial acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
 1. Power and Instrument Signals. Unless specified otherwise, electrical power supply to the instrumentation equipment will be unregulated 120 VAC at the locations noted on the one-line and functional diagrams. All transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.
 2. Metering Accuracy. System metering accuracy, as compared to the actual process value, shall be determined from the value read at the principal readout device such as the recorder or totalizer. System requirements shall not preclude any requirements specified herein for individual devices.
 - a. For systems where the primary measuring device, transmitter, and receiver are furnished under this section, the accuracies shall be within the following limits:
 - i) Level: 1.0% percent of measured span.
 - ii) Flow Rate: magnetic or transit time ultrasonic metering
 - a) Repeatability: +/- 0.1% of rate; +/-0.005% of maximum full scale
 - b) Linearity: +/-0.1%
 - c) Accuracy: +/- 0.5% of rate down to 5% of full scale
 - d) Adjustable response time of 0.4 to 100 seconds on analog output
 - e) Unit shall operate within liquid conductivity down to 5 microohms/cm
 3. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation requirements shall be furnished and installed as required for proper performance of the equipment.
 4. Interchangeability and Appearance. Instruments used for the same types of functions and services shall be of the same brand and model line insofar as possible. Similar components of different instruments shall be from the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished. Recorders, process indicators, control stations, and similar panel-mounted instruments shall be of the same style and shall be products of the same major instrument manufacturer.
 5. Programming Devices. A programming or system configuring device shall be provided for systems that contain any equipment which required such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete and in like-new condition and shall be turned over to the Owner at completion of the startup.
 6. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the instrument device schedules and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanels, and rack-mounted devices shall have laminated plastic identification tags securely fastened to the device. Hand lettered labels or tape labels will not be acceptable.

7. Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2.2 PANEL FABRICATION

- A. General Fabrication Requirements. All panels furnished hereunder shall conform to the requirements of NEMA ICS-6-1988. The following paragraphs describe general fabrication requirements for the instrument panels, consoles, enclosures, and subpanels:

1. Wiring.

- a. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded tinned copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90°C.
- b. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 VAC. Surge protectors shall be of a non-faulting and non-interrupting design, with a response time of not more than 5 nanoseconds. Surge protectors shall be Phoenix Contact Part PLUGTRAB type protectors, or equal.
- c. Panels that are over 15 cubic feet in total volume shall have panel lighting above each door of the panel.
- d. Power distribution wiring on the line side of the panel's protective devices shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 16 AWG. Wiring for control circuits shall be minimum 16 AWG. Electronic analog circuits shall be 18 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color coding legend on the system supplier's panel wiring diagrams.
- e. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with a marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 20% percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fused or circuit breakers shall be clearly labeled and located for easy maintenance. Terminal block shall be Phoenix Contact UT 4-MTD series.
- f. All wiring shall be grouped and firmly supported inside the panel. Wiring shall be routed in nonmetallic slotted wire duct or similar. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables. Wire duct shall be Thomas & Betts Ty Duct or approved equal.
- g. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams.
- h. All analog input signals coming from external from the building where the panel is located shall have surge protection.
- i. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.
- j. All wires in the panel shall be identified at both ends of the wire. These labels shall agree with the labels shown on the wiring diagrams. The wire labels shall be of the heat-shrink tube type of wire marker as manufactured by Brady thermal labels.
- k. All instruments that require 120vac power that have the signal from the instrument going to a panel, shall be provided 120vac from that panel. The 120vac circuit to these instruments shall be individually fused.

2. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends, as indicated on the drawings, letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified herein under the Device Tag Numbering System paragraph.
3. Painting. Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust-inhibitive primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils.
4. Factory test. Panels shall be factory tested electrically by the panel fabricator before shipment.

2.3 METERING & CONTROL SYSTEMS

- A. Principal components for the metering and control systems are indicated on the "Instrument List" at the end of this specification.

2.4 MATERIALS & EQUIPMENT

A. Panel Front-Mounted Devices

1. SELECTOR SWITCHES. Selector switches shall be a minimum 30 mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts ac. Contact configuration shall be as indicated on the drawings or as required for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Cutler-Hammer "Series 10250T", Square D "Class 9001", or approved equal.
2. INDICATING LIGHTS. Indicating lights shall be a minimum 30 mm, heavy-duty, oil-tight type, Push-to-Test, which uses a low voltage lamp. A built-in transformer shall be used for AC service. Legends shall be engraved on the lens or on a legend faceplate. Lamps shall be easily replaceable from the front of the indicating light. Indicating lights shall be Cutler-Hammer "Series 10250T", Square D "Class 9001", or approved equal.
3. PUSH BUTTONS. Push buttons shall be a minimum 30 mm, heavy-duty, oil-tight type. Legends shall be engraved on push button faceplate. Contacts shall be rated 10 amperes continuous at 120 VAC. Push buttons shall be Cutler-Hammer "Series 10250T", Square D "Class 9001", or approved equal.
4. TOTALIZERS. Totalizers shall have miniature, rectangular, semi-flush counters, designed for use in conjunction with miniature indicators and recorders, and shall be of such a design that only the counter is flush-mounted and the associated integrating mechanism is located in the rear of the panel. The counter shall contain not less than seven digits; with a multiplier of a power of 10 plainly engraved on the face of the counter, or on a nameplate below the counter, so that a full range of 9,999,999 is reached before repeating. Totalizers actuated by DC powered coils shall be equipped with a reverse voltage protection device. Totalizers shall not reset upon power failure. Totalizers shall be as manufactured by Red Lion CUB7T series or Action Instruments.
5. RUN TIME METERS. Run time meters shall have miniature, rectangular, semi-flush counters. The counter shall contain not less than seven digits, with a nameplate plainly engraved on the face of the counter, or below the counter identifying it as a run time meter. Run time meters shall not reset upon power failure. Run time meters shall be as manufactured by Red Lion "CUB7" series or Action Instruments.

B. Panel Interior-Mounted Devices

1. POWER SUPPLIES. Regulated DC power supplies for instrument loops shall be provided as needed. Power supplies shall be suitable for input voltage variation of plus or minus 10 percent. The DC power supplies shall be Idec "PS5R Slim line", or Phoenix Contact "Quint".
2. RELAYS. Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL listed. Relays shall have a minimum rating of 10 amperes at 120 VAC.

- Time-delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of +/- 2.0 percent of setting. Latching and special purpose relays shall be as required for the specific application. Relays shall have a light to indicate when coil is energized. Relays shall be Idec "RH or RTE Series" or approved equal.
3. ELECTRONIC SIGNAL BOOSTERS AND ISOLATORS. Electronic Signal Boosters and Isolators shall have all solid-state circuitry and complete electrical isolation between the power supply and the input and output signals. Accuracy shall be +/-0.15 percent of span. Isolators shall be manufactured by Acromag, Moore, or Phoenix Contact.

C. Flow Instrumentation

1. Magnetic Flow Meters

- a. The Magnetic Flow Meter shall be a completely obstructionless, in-line flow meter with no constrictions in the flow of fluid through the meter.
- b. Flowtube Construction
- i) 321stainless steel with integral grounding electrodes
 - ii) Electrodes: 316 Stainless steel
 - iii) Flanges: ANSI B16.5; Class 150 carbon steel flanges
 - iv) Liner: Teflon or Neoprene
- c. Operating Conditions
- i) Flow Temperature: 32-100 F
 - ii) Solids Content: 1%
 - iii) Operating range: up to 150 PSI
 - iv) Size 6" and 12"
 - v) Flow Range: 10-5,000 GPM actual condition, depending on the meter size
 - vi) Each meter shall be factory calibrated, and a copy of the calibration report shall be submitted as part of the operation and maintenance manual submittal.
- d. The meter shall be capable of standing empty for extended periods of time without damage to any components.
- e. The meter housing shall be a submersible design
- f. Magnetic Flow Meter Signal Converters
- i) Converters shall be separately mounted from the flow tube.
 - ii) Converters shall be microprocessor-based signal converters.
 - iii) The signal converters shall include output dampening, self-testing, integral digital indicator, built-in calibration capability, and an "empty pipe zero" contact input.
 - iv) The overall accuracy of the magnetic flow meter transmitter and signal converter shall be +/- 0.5 percent of actual flow rate for full-scale settings of 0.3 to 30 fps.
 - v) The signal cable between the converter and the magnetic flow meter shall be furnished by the meter manufacturer.
 - vi) The signal converter shall be housed in NEMA Type 4X housing with enamel coated die cast aluminum and shall be suitable for operation over an ambient temperature range of -30° to +140°F, and relative humidity of 10 to 100 percent.
 - vii) The converter shall provide an analog output of 4-20 mA DC proportional to the flow rate.
 - viii) The converter shall have a totalized flow pulsed output for totalized flow.
 - ix) Power supply to the meter shall be 120 VAC, 60 Hz, single phase
 - x) Adequate cable shall be provided as required between the flow tube and the signal converter
 - xi) Units shall have push button programming and integral LCD readout for display of programmed values, flow rate, totalized flow and error codes as required; programmed flows and totalization shall be entered directly in engineering units. The microprocessor shall safeguard against entering invalid flow rate data for the particular meter size. The system shall be self-standardizing two to three times per hour to maintain system accuracy. One

LCD display shall be provided to indicate both flow rate in gpm or totalized flow in MG non-simultaneously. Equipment shall include non-full indication. Include appropriate size grounding disk.

- g. Meters shall be Endress-Hauser Promag W400 or approved equal and shall be of the high impedance (100,000 Megohms) bipolar pulsed DC coil excitation with auto zeroing each half cycle.
- h. Certified calibration test sheets for every meter shall be provided.

2. Pressure and Level Instrumentation

a. Hydrostatic Level Transducers

- i) Each transducer shall be a hydrostatic pressure sensor for level measurement of fresh water and wastewater applications. The sensor shall be a permanently sealed submersible probe and cable combination. The transducer shall be a of the two-wire type which requires no direct power connection to the transducer. Transducer output shall be 4-20mA DC. The transducer shall be capable of the ranges and pressures for which the application will require. The sensor shall be mounted as shown on drawings or as required for application. The transducer shall be an Endress-Hauser "WaterpilotFMX167", GE Sensing (Druck) "PDCR/PTX- 1730", or approved equal.

b. Weighted Float Level Switches

- i) Each level switch shall consist of a single-pole, double-throw switch, rated not less than 3 amperes AC, sealed and housed in a chemical-resistant polypropylene casing. The switch assembly shall be weighted and suspended on its own cable. The flexible support cable shall be waterproof, three-conductor, synthetic covered cable with 18AWG conductors, and shall be of sufficient length so that no splice or junction box is required in the wetwell. Switches shall be suitable for operation up to 150 volts within an ambient temperature range of 0° to 60° C. Switches shall be suitable for use in a sanitary or wastewater wetwell environment. Installation hardware shall be provided as shown on the drawings or as necessary for application. Switches shall be Flygt "Type EMN-10", Siemens Water Technologies "Model 9G-EF", or approved equal.

3. Miscellaneous Equipment

a. Beacon Light

- i) The light shall be a red rotating beacon type light.
- ii) The light shall be powered by 120VAC.
- iii) All accessories as needed for a complete system and for the proper installation shall be provided with the light.
- iv) The light shall be Edwards 52 Series AdaptaBeacon Rotating Light or equal.

b. Data Logger

- i) Data logger shall be a Campbell Scientific CR300-Cell210 (Verizon) and no equal.
- ii) Data logger Verizon Sim card and cellular service to be provided by owner.
- iii) Data logger shall be installed outside Arvada Pump Station inside a NEMA 4 box, provided and installed by contractor.
- iv) The data logger shall be powered by 12VAC.
- v) Reference Instrumentation and Control Plan Drawing for more information.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements

1. The instrumentation equipment shall be installed by the Contractor or his subcontractors in accordance with the manufacturers' instructions. The services of the system Supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.
 2. Prior to installation, carefully inspect and clean meter of all foreign material and thoroughly clean the flange faces. Installation practices shall conform to the manufacturer's recommendations. After cleaning flanges, insert the gasket and tighten the nuts progressively and uniformly.
- B. Pressure Testing
1. Meters shall be pressure tested at the same time the pipe is tested. If there are any special parts of the meter that might be damaged by the pressure testing, they shall be properly protected. The Contractor is responsible for any damage which occurs during testing. Joints shall show no visible leakage under the pressure testing. Any joints which show signs of leakage shall be repaired prior to final acceptance.
- C. Inspection.
1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
 - a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.
- D. Equipment Installation.
1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
 - a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
 - b. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
 - c. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.
 - d. Field Piping. Field piping materials and installation shall conform to the requirements of the miscellaneous piping section.
 - e. Field-Mounted Instruments. Instruments shall be mounted so they may be easily read and serviced and all appurtenant devices are easily operated. Installation details for some instruments are indicated on the drawings. Unless otherwise indicated on the drawings, instruments which include local indicators shall be mounted approximately 5 feet above the floor and shall be oriented for ease of viewing. Transmitters shall be mounted on corrosion-resistant pipe supports suitable for floor, wall, or bracket mounting.
- E. Factory Calibration
1. Meters shall be flow calibrated across the specified range at the manufacturer's factory and five (5) copies of the certified test results must be submitted and approved by the engineer prior to shipment.
- F. Field Calibration

1. Provide the services of factory-trained instrumentation technicians, tools, and equipment to field calibrate each flow meter to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration.
2. Each meter shall be calibrated at 10%, 50%, and 90% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the flow meter being calibrated to its published specified accuracy.
3. This report shall include a listing of the published specific accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerances, defects noted, corrective action required, and correction made.

G. **Systems Check.** A technical representative of the system supplier shall participate in the checkout of metering and control systems. If interrelated devices furnished by other suppliers, such as valve actuators, motor controls, chemical feeders, or primary measuring devices, do not perform properly when placed in service, the technical representative shall use suitable test equipment to introduce simulated signals to verify or measure signals from such devices as required to locate the source of trouble or malfunction. A written report stating the results of such tests shall be furnished, if requested by the Engineer, to assign responsibility for corrective measures.

1. **Installation Test Equipment.** Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by the Contractor for the duration of the testing work. Unless specified otherwise, test equipment will remain the property of the Contractor or the system Supplier.

H. **Adjustment and Cleaning**

1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

3.2 CUSTOMER TRAINING

A. The coordinating supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training session shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of one 4-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 FLOW METER CERTIFICATION TESTING

- A. Within 3 business days after flow meter installation is completed, each meter installation shall be inspected and tested for accuracy by a Qualified Well Tester according to the SEO's "Rules for Governing the Measurement of Tributary Ground Water Diversions by Wells Located in the South Platte River Basin within Water Division No. 1". The Qualified Well Tester shall be certified by the State Engineer's Office.
- B. Contractor shall submit SEO Form 3.1 "Notice of Totalizing Flow Meter Installation" to Engineer and City for review prior to submittal to the SEO.

3.4 INSTRUMENT LIST

West Cooley Wells
Instrument List

<u>Tag #</u>	<u>Description</u>	<u>Service</u>	<u>Scale</u>	<u>Provided Under Specification</u>
FE/FIT-101	Well #1 - Flow	Magnetic Flow Meter – 6”	0-1000 GPM	16900
FE/FIT-103	Well #3 - Flow	Magnetic Flow Meter – 6”	0-1000 GPM	16900
FE/FIT-104	Well #4 - Flow	Magnetic Flow Meter – 6”	0-1000 GPM	16900
FE/FIT-105	Well #5 - Flow	Magnetic Flow Meter – 6”	0-1000 GPM	16900
FE/FIT-200	Station Discharge Flow	Magnetic Flow Meter – 12”	0-5000 GPM	16900
LT-101	Well #1 - Level	Hydrostatic Level Transducer	0-60 FT	16900
LT-103	Well #3 - Level	Hydrostatic Level Transducer	0-60 FT	16900
LT-104	Well #4 - Level	Hydrostatic Level Transducer	0-60 FT	16900
LT-105	Well #5 - Level	Hydrostatic Level Transducer	0-60 FT	16900
YAL-200	Alarm Beacon Light	Beacon Light		16900
	Data Logger	Data Logger		16900

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16950 – PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes the items listed below and all other components necessary for a complete system as noted herein and indicated on the drawings
 - 1. Programmable Logic Controllers (PLCs)
 - 2. Communication equipment
 - 3. OIT software
 - 4. Programming
 - 5. Spare parts
- B. Related Sections
 - 1. Electrical – Section 16050
 - 2. Instrumentation & Controls - Section 16900

1.2 REFERENCES

- A. ISA 5.1 – Instrumentation Symbols and Identification
- B. NEMA ICS 1 – General Requirements for Industrial Control and Systems
- C. NEMA ICS 2 – Standards for Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts
- D. DEMA ICS 3 – Industrial Control and Systems: Factory Built Assemblies
- E. NEMA ICS 6 – Industrial Controls and Systems: Enclosures

1.3 DESIGN REQUIREMENTS

- A. Discrete input/output signals shall all be 24VDC
- B. Analog input/output signals shall all be 4-20mA
- C. Analog signal isolators shall be independently powered units capable of driving two 4-20mA signals
- D. All required buffers, isolators, signal converter, and amplifiers for coordination with other equipment furnished under other sections, and between items of equipment needed for a complete system shall be furnished under this section of the specifications whether indicated on the Drawings or not or detailed in these specifications or not

1.4 SYSTEM DESCRIPTION

- A. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
 - 1. The PLC on this project is existing. The existing PLC shall be modified as required to accomplish all the controls and monitoring indicted in the specifications and drawings.
 - 2. I/O List. An I/O list is attached at the end of this section

1.5 SUBMITTALS

- A. Submittals shall be required as noted in Section 16900.

1.6 QUALITY ASSURANCE

A. Supplier's qualifications

1. The entire system shall be designed, coordinated, supplied, and programmed by the system integrator supplier.

B. Coordination

1. The PLCs and PLC system shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the manufacturer of related equipment.
2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
3. The Contractor shall provide coordination with other contractors and supervision of installation as required during construction.

1.7 WARRANTY

- A. The Supplier shall warrant the contractor supplied hardware, software, and configuration related to the operational performance of the facility for a period of 5 years from the date of project final acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.

1. Interchangeability. All PLC systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules shall be interchangeable among all I/O panels and systems.
2. Installed I/O requirements. The PLC has all the I/O modules needed already installed.

2.2 MATERIALS AND EQUIPMENT

A. Programmable Logic Controller (PLC)

1. There are no additions anticipated to the PLC system

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements

1. It shall be the Supplier's responsibility to ensure that the entire PLC and OIT system is modified to accomplish the needs of the contract in a satisfactory condition per these specifications.

B. Inspection

1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.

C. Equipment Installation

1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
 - a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
 - b. Perform all work in accordance with manufacturer's instructions.
 - i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
 - ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.

D. Adjustment and Cleaning

1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

E. PLC and OIT Programming.

1. The Contractor shall be responsible for all PLC and OIT programming.
2. Refer to section 16951

3.2 CUSTOMER TRAINING

1. The system supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training session shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of one 2-hour session. The schedule shall be arranged and coordinated with the Engineer.

3.3 I/O LIST

West Cooley Wells PLC
I/O List

<u>Tag #</u>	<u>Description</u>		<u>DI</u>	<u>DO</u>	<u>AI</u>	<u>AO</u>	<u>Scale</u>	<u>Notes</u>
M-101	Well #1 - Run Status	I:1/1	1					Existing - No Change
MA-101	Well #1 – VFD Fault	I:1/2	1					Existing - No Change
	Spare	I:1/3	1					Spare
	Spare	I:1/4	1					Spare
M-103	Well #3 - Run Status	I:1/5	1					Existing - No Change
MA-103	Well #3 – VFD Fault	I:1/6	1					Existing - No Change
M-104	Well #4 - Run Status	I:1/7	1					Existing - No Change
MA-104	Well #4 – VFD Fault	I:1/8	1					Existing - No Change
M-105	Well #5 - Run Status	I:1/9	1					Existing - No Change
MA-105	Well #5 – VFD Fault	I:1/10	1					Existing - No Change

M-201	PS - Discharge Pump #1 - Run Status	I:1/11	1					Existing - No Change
<u>Tag #</u>	<u>Description</u>		<u>DI</u>	<u>DO</u>	<u>AI</u>	<u>AO</u>	<u>Scale</u>	<u>Notes</u>
MA-201	PS - Discharge Pump #1 – VFD Fault	I:1/12	1					Existing - No Change
M-202	PS - Discharge Pump #2 - Run Status	I:1/13	1					Existing - No Change
MA-202	PS - Discharge Pump #2 – VFD Fault	I:1/14	1					Existing - No Change
M-203	PS - Discharge Pump #3 - Run Status	I:1/15	1					Existing - No Change
MA-203	PS - Discharge Pump #3 – VFD Fault	I:1/16	1					Existing - No Change
	Spare	I:1/17	1					Spare
	Spare	I:1/18	1					Spare
	PS - Wetwell Low-Low Level Alarm	I:1/19	1					Existing - No Change
	PS - Water-on-the-floor	I:1/20	1					Existing - No Change
	Low Building Temperature	I:1/21	1					Existing - No Change
	High Building Temperature	I:1/22	1					Existing - No Change
	Door limit switches	I:1/23	1					Existing - No Change
	Power Meter – Alarm one	I:1/24	1					Existing – New Equipment
	Spare	I:1/25	1					Spare
	Power Meter – Pulse	I:1/26	1					Existing - New Equipment
	Harmonic Correction system fault	I:1/27	1					Existing - No Change
	Mag Meter Well #1 – Flow Total, Pulse Input	I:1/28	1					New Signal
	Mag Meter Well #3 – Flow Total, Pulse Input	I:1/29	1					New Signal
	Mag Meter Well #4 – Flow Total, Pulse Input	I:1/30	1					New Signal
	Mag Meter Well #5 – Flow Total, Pulse Input	I:1/31	1					New Signal
	Spare	I:1/32	1					
	Slot 2 – 32 point DI module – all spares		32					
MC-101	Well #1 – Start/stop control	O:3/1		1				Existing - No Change
	Spare	O:3/2		1				Spare
MC-103	Well #3 – Start/stop control	O:3/3		1				Existing - No Change
MC-104	Well #4 – Start/stop control	O:3/4		1				Existing - No Change
MC-105	Well #5 – Start/stop control	O:3/5		1				Existing - No Change
MC-201	PS - Discharge Pump #1 – Start/stop control	O:3/6		1				Existing - No Change
MC-202	PS - Discharge Pump #2 – Start/stop control	O:3/7		1				Existing - No Change
MC-203	PS - Discharge Pump #3 – Start/stop control	O:3/8		1				Existing - No Change
	Spare	O:3/9		1				Spare
	Power Meter	O:3/10		1				Existing - No Change

	Fan Control	O:3/11		1				Existing - No Change
	DOs 12-32 Spares			11				
LT-101	Well #1 - Level	I:7.1			1			Existing - New Instrument
LT-102	Well #2 - Level	I:7.2			1			Abandoned - Spare
LT-103	Well #3 - Level	I:7.3			1			Existing - New Instrument
LT-104	Well #4 - Level	I:7.4			1			Existing - New Instrument
LT-105	Well #5 - Level	I:7.5			1			Existing - New Instrument
<u>Tag #</u>	<u>Description</u>		<u>DI</u>	<u>DO</u>	<u>AI</u>	<u>AO</u>	<u>Scale</u>	<u>Notes</u>
FT-101	Well #1 - Flow	I:7.6			1			Existing - New Instrument
FT-103	Well #3 - Flow	I:7.7			1			Changed signal
LT-200	Wetwell - Level	I:7.8			1			Existing Signal - New Instrument
FT-200	Station Effluent Flow	I:7.9			1			Existing Signal - New Instrument
PT-200	Station Effluent Pressure	I:7.10			1			Existing - No Change
FT-104	Well #4 - Flow	I:7.11			1			New signal
FT-105	Well #5 - Flow	I:7.12			1			New Signal
SC-101	Well #1 - Speed Control					1		Existing - No Change
SC-102	Well #2 - Speed Control					1		Abandoned - Spare
SC-103	Well #3 - Speed Control					1		Existing - No Change
SC-104	Well #4 - Speed Control					1		Existing - No Change
SC-105	Well #5 - Speed Control					1		Existing - No Change
SC-201	Discharge Pump #1 - Speed Control					1		Existing - No Change
SC-202	Discharge Pump #2 - Speed Control					1		Existing - No Change
SC-203	Discharge Pump #3 - Speed Control					1		Existing - No Change

END OF SECTION

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DIVISION 16 - ELECTRICAL

SECTION 16951 – CONTROL DESCRIPTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes the items listed below and all other components necessary for a complete system as noted herein and indicated on the drawings
 - 1. General Programming Requirements
 - 2. PLC Programming
 - 3. OIT Programming
- B. Related Sections
 - 1. Instrumentation and Controls - Section 16900
 - 2. Programmable Logic Controllers - Section 16950
- C. All the hardware for the PLC and OIT system is existing. The system integrator shall be responsible for reprogramming the system as needed to have it operator as noted in this specification. The program for the existing Bristol PLC is not available.

1.2 REFERENCES

- A. ISA 5.1 – Instrumentation Symbols and Identification
- B. NEMA ICS 1 – General Requirements for Industrial Control and Systems

1.3 SYSTEM DESCRIPTION

- A. All the programming performed under this section shall be done in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the software manufacturer, unless exceptions are noted by engineer.

1.4 SUBMITTALS

- A. Submittals shall be required as noted in section 16900.

1.5 QUALITY ASSURANCE

- A. Supplier's qualifications
 - 1. The entire system shall be programmed by the system integrator.

PART 2 EXECUTION

2.1 SYSTEM DESCRIPTION

- A. The system consists of one Bristol ControlWave system PLC and one Maple systems Operator Interface Terminal (OIT) (Maple Systems HMI550H-004). Both of these components are existing and are mounted in the existing site control panel.

2.2 GENERAL PROGRAMMING REQUIREMENTS

- A. Tag database structure and configuration.

1. The process control system tag database development shall include the definition of all devices, derived and soft tags, and the required alarm processing and data logging definitions for each tag.
2. Tag naming convention.

a. The tag naming convention shall be:

- i) Tag numbers shall be grouped as follows:
 - a) 100's – Wells
 - b) 200's – Wetwell and discharge pumps
- ii) Tag names shall minimally consist of two distinct components. The leading component shall be an abbreviated description of the associated process variable or the function of the tag represent. The trailing component shall be the tag equipment number.

3. All logic and control shall be done in the PLC

B. PLC Programming standards.

1. General Considerations

a. Program Documentation

- i) Documentation for all PLC programs shall include comments, tag/register descriptions, or any other programming tags. All PLC programs shall be documented with comments provided for each subroutine, function and/or section. Use of abbreviations in comments and subroutine/section titles should be avoided. At the completion of the project, copies of programming, I/O list, memory map and communications map shall be provided in both printed and electronic format.

b. Motors

- i) All motors shall have runtime totalizers and start counters. Both values shall be totalized regardless of whether the motors are in auto and manual control modes.
- ii) Every motor that has PLC control shall have a manual or automatic operation for the motor. If manual is selected then the operator shall be able to start or stop the motor. If the motor is controlled from a VFD then the operator shall be able to enter a speed set point for the VFD. In automatic operation the control logic shall start and stop the motor as well as control the speed as noted in the following requirements.
- iii) The following signals shall be determined for all motors.
 - a) Run Indication
 - b) Fault Indication.
 - c) Motor fail to start. PLC calling the motor to run but no run signal report for 20 sec.
 - d) Motor fail to stop. PLC not calling the motor to run but a run signal report for 20 sec.

c. Analog signals

- i) All analog inputs shall be scaled in engineering units to be used in the logic.
- ii) A low level and high level alarm shall be generated for each analog signal. Each alarm shall have separate alarm and reset set points.

d. All control to any devices will be stopped if there is a phase failure condition. After a time delay when the phase failure is normal, then normal operation shall proceed.

C. Operator Interface Terminal (OIT) standards.

1. General Considerations

- a. In general, when the term OIT is used it indicates the local operator terminal display on the control panel.
 - b. All alarms will be displayed and logged on the OIT.
 - c. All analog signals will be trended and logged and displayed on the OIT in engineering units.
 - d. Motors
 - i) All motors shall be displayed on the OIT and have dynamic graphical indication whether they are on or off. The motors shall be green for running and red for off.
 - ii) All motors shall have runtime totalizers and start counters displayed near the motor's graphical display.
 - iii) Every motor that has PLC control shall have the associated set points and control criteria entered at the OIT. This shall also allow the operator to select manual or automatic operation for the motor. If the motor is controlled from a VFD then the operator shall be able to enter a speed set point for the VFD when the motor is in the manual control mode.
 - e. The control signals for all motors shall be displayed on the OIT. They shall include but not limited to:
 - i) Run Indication
 - ii) Fault Indication.
 - iii) Motor fail to start. PLC calling the motor to run but no run signal report for 20 sec.
 - iv) Motor fail to stop. PLC not calling the motor to run but a run signal report for 20 sec.
 - f. Alarming
 - i) All alarms shall be displayed and logged on the OIT.
 - ii) Selected alarms shall initiate the red beacon light on the outside of the pump building.
2. Specific Device Control Criteria
- a. Overall site topics:
 - i) There are currently 5 wells and 3 discharge pumps on this site.
 - ii) The wells are numbered 1-5 and the discharge pumps 1-3.
 - iii) Well #2 will be inactive. Well #2 abandonment is a bid alternative.
 - iv) The existing flow meters will be removed.
 - v) Each active well will have a new flow meter added to its discharge piping.
 - vi) One flow meter will be added for the total station discharge flow.
 - vii) Each well will have a new well level transmitter installed.
 - b. Well System:
 - i) Each well shall have continuously monitored and displayed
 - a) Well Number
 - b) Depth of water in well
 - c) Motor frequency
 - d) Water Flow rate
 - e) Totalized volume of water(in thousands of gallons) – Totalized from a pulse input.

- ii) The well system shall be programmed for each well to have the following states:
 - a) Idle state – the well is off
 - b) Run state – the well shall run based on a manual start from the OIT and operate at the speed set by the operator
 - c) Abort and hold states – if the water level in the well drops below an operator entered level (typically about 1 foot above the screen) for an operator entered amount of time the well shall be turned off and an ‘ABORT’ state alarm for that pump shall be initiated. This well will then be put in a ‘HOLD’ state to await a manual start by an operator.

c. Discharge System:

- i) The same type of system shall be used for the discharge pumps.
- ii) Instead of the low well level to shut off the pumps, it will be a low wet well level.

3. Logging

- a. Information shall be logged in the OIT for the flows, levels and pressures, at a minimum rate of once every 10 minutes.

4. Alarms

- a. All alarms as noted above
- b. The alarm beacon light shall be turned on by the PLC on the occurrence of any alarm.

END SECTION

APPENDIX A

WELL PERMITS

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES
818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 78774 -F -
DIV. 1 WD2 DES. BASIN MD

APPLICANT

CITY OF THORNTON
C/O WATER RESOURCES DIVISION
12450 WASHINGTON STREET
THORNTON, CO 80241-

(720) 977-6500

APPROVED WELL LOCATION

ADAMS COUNTY
NE 1/4 SW 1/4 Section 17
Township 2 S Range 67 W Sixth P.M.

DISTANCES FROM SECTION LINES

1415 Ft. from South Section Line
2450 Ft. from West Section Line

UTM COORDINATES (Meters, Zone: 13, NAD83)

Easting: Northing:

CHANGE/EXPANSION OF USE OF AN EXISTING WELL

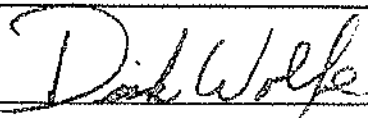
ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

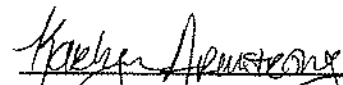
CONDITIONS OF APPROVAL

- 1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
- 2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
- 3) Approved pursuant to CRS 37-90-137(2) for the well constructed under permit no. 59852-F and subsequently re-permitted under permit no. 65288-F on the condition that this well is operated in accordance with the City of Thornton Augmentation Plan approved by the Division 1 Water Court in case no. 04CW326. If this well is not operated in accordance with the terms of said decree, it will be subject to administration including orders to cease diverting water. This well shall be known as Cooley West Well No. 1.
- 4) Upon issuance of this permit, the State Engineer will cancel permit no. 65288-F.
- 5) The use of ground water from this well is limited to municipal purposes directly or after storage in the Cooley West Complex, as described in Paragraph 26 of case no. 04CW326.
- 6) The pumping rate of this well shall not exceed 9,874 GPM in combination with Cooley Well nos. 2 through 11.
- 7) The average annual amount of ground water to be appropriated shall not exceed 8,823 acre-feet in combination with Cooley Well Nos. 2 through 11, of which up to 4,411.37 acre-feet may be stored in the Cooley West Complex.
- 8) Production is limited to the alluvium of the South Platte River.
- 9) The owner shall mark the well in a conspicuous place with well permit number(s), name of the aquifer, and court case number(s) as appropriate. The owner shall take necessary means and precautions to preserve these markings.
- 10) A totalizing flow meter must be installed on this well and maintained in good working order. Permanent records of all diversions must be maintained by the well owner (recorded daily and submitted to the Division Engineer monthly or upon request).
- 11) This well shall be constructed at least 600 feet from any existing well, completed in the same aquifer, that is not owned by the applicant.
- 12) This well shall be constructed not more than 200 feet from the location specified on this permit and not more than 200 feet from the location decreed for Cooley West Well No. 1 in case no. 04CW326 (decreed location is 1,415 from the south section line and 2,450 from the west section line).
- 13) This well is subject to administration by the Division Engineer in accordance with applicable decrees, statutes, rules, and regulations.

KA 1-22-15

APPROVED
KAA


State Engineer


By

Receipt No. 3667639A

DATE ISSUED 01-22-2015

EXPIRATION DATE N/A

ORDER OF THE STATE ENGINEER

IN THE MATTER OF WELL PERMIT NO. 65288-F

RECEIPT NO. 3611985A

LOCATION: NE¼ SW¼ SECTION 17, TOWNSHIP 2 S, RANGE 67 W, 6th P.M.

APPLICANT: CITY OF THORNTON

THE STATE ENGINEER FINDS:

Well permit no. 65288-F was issued on April 2, 2007 for the use of an existing well constructed under permit no. 59852-F (canceled). On December 12, 2014, the well owner submitted an application to the SEO for the reapplication of an existing well, referencing well permit no. 65288-F. Well permit no. 78774-F was issued pursuant to that application.

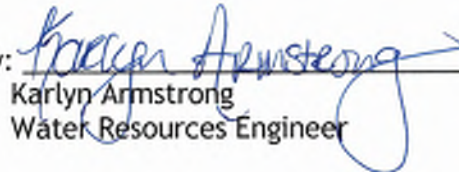
Well permit no. 65288-F is hereby canceled and is of no further force or effect.

Dated this 22nd day of January, 2015.



Dick Wolfe, P.E.
Director/State Engineer

By:



Karlyn Armstrong
Water Resources Engineer

Prepared by: KAA

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES
818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 78775 -F -
DIV. 1 WD2 DES. BASIN MD

APPLICANT

CITY OF THORNTON
C/O WATER RESOURCES DIVISION
12450 WASHINGTON STREET
THORNTON, CO 80241-

(720) 977-6500

APPROVED WELL LOCATION

ADAMS COUNTY
NE 1/4 SW 1/4 Section 17
Township 2 S Range 67 W Sixth P.M.

DISTANCES FROM SECTION LINES

1440 Ft. from South Section Line
2490 Ft. from West Section Line

UTM COORDINATES (Meters, Zone: 13, NAD83)

Easting: Northing:

CHANGE/EXPANSION OF USE OF AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

- 1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
- 2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
- 3) Approved pursuant to CRS 37-90-137(2) for the well constructed under permit no. 55693-F-R and subsequently re-permitted under permit no. 65289-F on the condition that this well is operated in accordance with the City of Thornton Augmentation Plan approved by the Division 1 Water Court in case no. 04CW326. If this well is not operated in accordance with the terms of said decree, it will be subject to administration including orders to cease diverting water. This well shall be known as Cooley West Well No. 2.
- 4) Upon issuance of this permit, the State Engineer will cancel permit no. 65289-F.
- 5) The use of ground water from this well is limited to municipal purposes directly or after storage in the Cooley West Complex, as described in Paragraph 26 of case no. 04CW326.
- 6) The pumping rate of this well shall not exceed 9,874 GPM in combination with Cooley Well nos. 1 and 3 through 11.
- 7) The average annual amount of ground water to be appropriated shall not exceed 8,823 acre-feet in combination with Cooley Well Nos. 1 and 3 through 11, of which up to 4,411.37 acre-feet may be stored in the Cooley West Complex.
- 8) Production is limited to the alluvium of the South Platte River.
- 9) The owner shall mark the well in a conspicuous place with well permit number(s), name of the aquifer, and court case number(s) as appropriate. The owner shall take necessary means and precautions to preserve these markings.
- 10) A totalizing flow meter must be installed on this well and maintained in good working order. Permanent records of all diversions must be maintained by the well owner (recorded daily and submitted to the Division Engineer monthly or upon request).
- 11) This well shall be constructed at least 600 feet from any existing well, completed in the same aquifer, that is not owned by the applicant.
- 12) This well shall be constructed not more than 200 feet from the location specified on this permit and not more than 200 feet from the location decreed for Cooley West Well No. 2 in case no. 04CW326 (decreed location is 1,440 from the south section line and 2,490 from the west section line).
- 13) This well is subject to administration by the Division Engineer in accordance with applicable decrees, statutes, rules, and regulations.

KA
1-22-15

APPROVED
KAA

D. D. Delle
State Engineer

Karen Armstrong
By

Receipt No. 3667639B

DATE ISSUED 01-22-2015

EXPIRATION DATE N/A

ORDER OF THE STATE ENGINEER

IN THE MATTER OF WELL PERMIT NO. 65289-F

RECEIPT NO. 3611985B

LOCATION: NE¼ SW¼ SECTION 17, TOWNSHIP 2 S, RANGE 67 W, 6th P.M.

APPLICANT: CITY OF THORNTON

THE STATE ENGINEER FINDS:

Well permit no. 65289-F was issued on April 2, 2007 for the use of an existing well constructed under permit no. 55693-F-R (canceled). On December 12, 2014, the well owner submitted an application to the SEO for the reapplication of an existing well, referencing well permit no. 65289-F. Well permit no. 78775-F was issued pursuant to that application.

Well permit no. 65289-F is hereby canceled and is of no further force or effect.

Dated this 22nd day of January, 2015.



Dick Wolfe, P.E.
Director/State Engineer

By:



Karlyn Armstrong
Water Resources Engineer

Prepared by: KAA

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES
818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 78776 -F-
DIV. 1 WD 2 DES. BASIN MD

APPLICANT

CITY OF THORNTON
C/O WATER RESOURCES DIVISION
12450 WASHINGTON STREET
THORNTON, CO 80241-

(720) 977-6500

APPROVED WELL LOCATION

ADAMS COUNTY
NW 1/4 SE 1/4 Section 17
Township 2 S Range 67 W Sixth P.M.

DISTANCES FROM SECTION LINES

1507 Ft. from South Section Line
2783 Ft. from West Section Line

UTM COORDINATES (Meters, Zone: 13, NAD83)

Easting: Northing:

CHANGE/EXPANSION OF USE OF AN EXISTING WELL

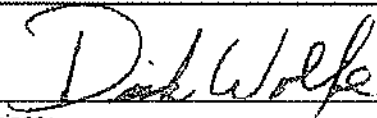
ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

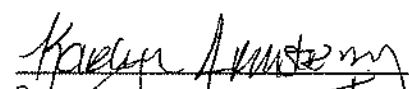
CONDITIONS OF APPROVAL

- 1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
- 2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
- 3) Approved pursuant to CRS 37-90-137(2) for the well constructed under permit no. 56813-F and subsequently re-permitted under permit no. 65290-F on the condition that this well is operated in accordance with the City of Thornton Augmentation Plan approved by the Division 1 Water Court in case no. 04CW326. If this well is not operated in accordance with the terms of said decree, it will be subject to administration including orders to cease diverting water. This well shall be known as Cooley West Well No. 3
- 4) Upon issuance of this permit, the State Engineer will cancel permit no. 65290-F.
- 5) The use of ground water from this well is limited to municipal purposes directly or after storage in the Cooley West Complex, as described in Paragraph 26 of case no. 04CW326.
- 6) The pumping rate of this well shall not exceed 9,874 GPM in combination with Cooley Well nos. 1, 2 and 4 through 11.
- 7) The average annual amount of ground water to be appropriated shall not exceed 8,823 acre-feet in combination with Cooley Well Nos. 1, 2 and 4 through 11, of which up to 4,411.37 acre-feet may be stored in the Cooley West Complex.
- 8) Production is limited to the alluvium of the South Platte River.
- 9) The owner shall mark the well in a conspicuous place with well permit number(s), name of the aquifer, and court case number(s) as appropriate. The owner shall take necessary means and precautions to preserve these markings.
- 10) A totalizing flow meter must be installed on this well and maintained in good working order. Permanent records of all diversions must be maintained by the well owner (recorded daily and submitted to the Division Engineer monthly or upon request).
- 11) This well shall be constructed at least 600 feet from any existing well, completed in the same aquifer, that is not owned by the applicant.
- 12) This well shall be constructed not more than 200 feet from the location specified on this permit and not more than 200 feet from the location decreed for Cooley West Well No. 3 in case no. 04CW326 (decreed location is 1,507 from the south section line and 2,738 from the west section line).
- 13) This well is subject to administration by the Division Engineer in accordance with applicable decrees, statutes, rules, and regulations.

KAA
1-22-15

APPROVED
KAA


State Engineer


By

Receipt No. 3667639C

DATE ISSUED 01-22-2015

EXPIRATION DATE

N/A

ORDER OF THE STATE ENGINEER

IN THE MATTER OF WELL PERMIT NO. 65290-F

RECEIPT NO. 3611985C

LOCATION: NW¼ SE¼ SECTION 17, TOWNSHIP 2 S, RANGE 67 W, 6th P.M.

APPLICANT: CITY OF THORNTON

THE STATE ENGINEER FINDS:

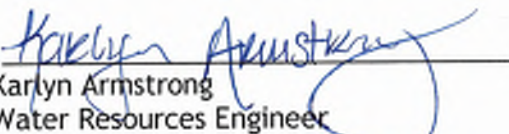
Well permit no. 65290-F was issued on April 2, 2007 for the use of an existing well constructed under permit no. 56813-F (canceled). On December 12, 2014, the well owner submitted an application to the SEO for the reapplication of an existing well, referencing well permit no. 652890-F. Well permit no. 78776-F was issued pursuant to that application.

Well permit no. 65290-F is hereby canceled and is of no further force or effect.

Dated this 22nd day of January, 2015.



Dick Wolfe, P.E.
Director/State Engineer

By: 
Karlyn Armstrong
Water Resources Engineer

Prepared by: KAA

Form No.
GWS-25

**OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES**

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER		78777		-F	
DIV. 1	WD 2	DES. BASIN	MD		

APPLICANT

CITY OF THORNTON
C/O WATER RESOURCES DIVISION
12450 WASHINGTON STREET
THORNTON, CO 80241-

(720) 977-6500

APPROVED WELL LOCATION

ADAMS COUNTY
NW 1/4 SE 1/4 Section 17
Township 2 S Range 67 W Sixth P.M.

DISTANCES FROM SECTION LINES

1500 Ft. from South Section Line
2990 Ft. from West Section Line

UTM COORDINATES (Meters Zone: 13,NAD83)

Easting: Northing:

CHANGE/EXPANSION OF USE OF AN EXISTING WELL

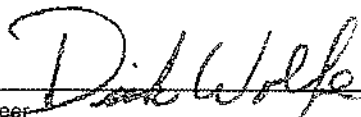
ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

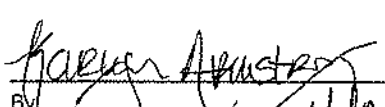
CONDITIONS OF APPROVAL

- 1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
- 2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
- 3) Approved pursuant to CRS 37-90-137(2) for the well constructed under permit no. 58226-F and subsequently re-permitted under permit no. 65291-F on the condition that this well is operated in accordance with the City of Thornton Augmentation Plan approved by the Division 1 Water Court in case no. 04CW326. If this well is not operated in accordance with the terms of said decree, it will be subject to administration including orders to cease diverting water. This well shall be known as Cooley West Well No. 4.
- 4) Upon issuance of this permit, the State Engineer will cancel permit no. 65291-F.
- 5) The use of ground water from this well is limited to municipal purposes directly or after storage in the Cooley West Complex, as described in Paragraph 26 of case no. 04CW326.
- 6) The pumping rate of this well shall not exceed 9,874 GPM in combination with Cooley Well nos. 1, 2, 3 and 5 through 11.
- 7) The average annual amount of ground water to be appropriated shall not exceed 8,823 acre-feet in combination with Cooley Well Nos. 1, 2, 3 and 5 through 11, of which up to 4,411.37 acre-feet may be stored in the Cooley West Complex.
- 8) Production is limited to the alluvium of the South Platte River.
- 9) The owner shall mark the well in a conspicuous place with well permit number(s), name of the aquifer, and court case number(s) as appropriate. The owner shall take necessary means and precautions to preserve these markings.
- 10) A totalizing flow meter must be installed on this well and maintained in good working order. Permanent records of all diversions must be maintained by the well owner (recorded daily and submitted to the Division Engineer monthly or upon request).
- 11) This well shall be constructed at least 600 feet from any existing well, completed in the same aquifer, that is not owned by the applicant.
- 12) This well shall be constructed not more than 200 feet from the location specified on this permit and not more than 200 feet from the location decreed for Cooley West Well No. 4 in case no. 04CW326 (decreed location is 1,500 from the south section line and 2,990 from the west section line).
- 13) This well is subject to administration by the Division Engineer in accordance with applicable decrees, statutes, rules, and regulations.

KAA
1-22-15

APPROVED
KAA


State Engineer


By

Receipt No. 3667639D

DATE ISSUED 01-22-2015

EXPIRATION DATE N/A

ORDER OF THE STATE ENGINEER

IN THE MATTER OF WELL PERMIT NO. 65291-F

RECEIPT NO. 3611985D

LOCATION: NW¼ SE¼ SECTION 17, TOWNSHIP 2 S, RANGE 67 W, 6th P.M.

APPLICANT: CITY OF THORNTON

THE STATE ENGINEER FINDS:

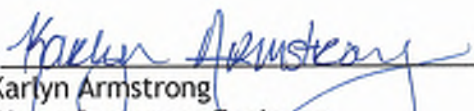
Well permit no. 65291-F was issued on April 2, 2007 for the use of an existing well constructed under permit no. 58226-F (canceled). On December 12, 2014, the well owner submitted an application to the SEO for the reapplication of an existing well, referencing well permit no. 652891-F. Well permit no. 78777-F was issued pursuant to that application.

Well permit no. 65291-F is hereby canceled and is of no further force or effect.

Dated this 22nd day of January, 2015.



Dick Wolfe, P.E.
Director/State Engineer

By: 

Karlyn Armstrong
Water Resources Engineer

Prepared by: KAA

- 14) This well is subject to administration by the Division Engineer in accordance with applicable decrees, statutes, rules, and regulations.
- 15) Pursuant to Construction Rule 6.2.2.1 (2 CCR 402-2), licensed or private drillers and pump installers must provide advanced notification (at least 24 hours) to the State Engineer prior to each of the following for this well: well construction, the initial installation of the pump, and initial installation of a cistern connected to the water well supply system. Any change in the anticipated date of construction/installation must be re-noticed (at least 24 hours prior to revised anticipated date). Information regarding the notification process and a link to the electronic notification form can be found on the following webpage: <http://water.state.co.us/groundwater/BOE/Pages/VariancesWaivers.aspx>

NOTE: This permit will expire on the expiration date unless the well is constructed and a pump is installed by that date. A Well Construction and Yield Estimate Report (GWS-31) and Pump Installation and Production Equipment Test Report (GWS-32) must be submitted to the Division of Water Resources to verify the well has been constructed and the pump has been installed. A one-time extension of the expiration date may be available. Contact the DWR for additional information or refer to the extension request form (GWS-64) available at: <http://www.water.state.co.us>

NOTE: A hydrogeologic aquifer evaluation has been completed for this permit and the details of the evaluation can be viewed in the original permit file.

NOTE: Permit no. 78778-FR (first replacement) not constructed was expired by the Order of the State Engineer.



Issued By IOANA COMANICIU

Date Issued: 3/7/2019

Expiration Date: 3/7/2020

PERMIT HISTORY

03-07-2019 WELL CONSTRUCTION VARIANCE ISSUED

ORDER OF THE STATE ENGINEER

IN THE MATTER OF WELL PERMIT NO. 65292-F

RECEIPT NO. 3611985E

LOCATION: NW¼ SE¼ SECTION 17, TOWNSHIP 2 S, RANGE 67 W, 6th P.M.

APPLICANT: CITY OF THORNTON

THE STATE ENGINEER FINDS:

Well permit no. 65292-F was issued on April 2, 2007 for the use of an existing well constructed under permit no. 58227-F (canceled). On December 12, 2014, the well owner submitted an application to the SEO for the reapplication of an existing well, referencing well permit no. 652892-F. Well permit no. 78778-F was issued pursuant to that application.


Well permit no. 65292-F is hereby canceled and is of no further force or effect.

Dated this 22nd day of January, 2015.



Dick Wolfe, P.E.
Director/State Engineer

By:



Karlyn Armstrong,
Water Resources Engineer

Prepared by: KAA

APPENDIX B

COLORADO DIVISION OF WATER RESOURCES POLICY MEMORANDUM 2015-01



POLICY MEMORANDUM 2015-01

(Policy effective February 1, 2015)

DATE: February 1, 2015

TO: Approved Well Testers and **Tributary** Well Users within the South Platte River Basin

FROM: Division of Water Resources, South Platte River Basin, Division 1

SUBJECT: Measurement Rule Policy for **RULES AND REGULATIONS GOVERNING THE MEASUREMENT OF GROUND WATER DIVERSIONS LOCATED IN THE SOUTH PLATTE RIVER BASIN WITHIN WATER DIVISION NO. 1, Court Case 11CW292 (Rules)**

EFFECTIVE DATE: February 1, 2015

NOTE: A Rule provision does not apply where application of the provision would be inconsistent with or conflict with a specific term or condition of a water court decree that existed prior to the Rules (December 31, 2013), in which case the term or condition of said existing decree shall control. In the event the water court decree is silent, the Measurement Rules shall control. Further, any stipulations entered into with Opposers to the Rules will be recognized and followed in administration of the Rules.

Rule 2.1.22 of the Rules defines “Well User” to mean any person diverting ground water from a Well. This may include, but is not necessarily limited to, the owner of a water right or well permit which allows the diversion of ground water and any person having the right to use such a water right or well permit owned by another, including all agents, employees, lessees, assigns or successors of the same.



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I. General

Rule 3.1.1 of Rules Governing the Measurement of Ground Water Diversions by Wells Located in the South Platte River Basin within Water Division No. 1 (Rules), states that “the State Engineer may adopt written standards and specifications for the installation, calibration, testing, repair, and maintenance of Totalizing Flow Meters (TFM).” This Measurement Rule Policy document is intended to provide such written standards, clarifications and guidance. In particular, this policy is intended to clarify items discussed in **Rule 3.1 – Measurement Devices, Rule 3.2 – Power Conversion Coefficient Alternate Measurement Method, Rule 6 – Data Submission, and Rule 11 – Variances.**

II. Totalizing Flow Meter Policies (Rule 3.1)

The following items are intended to clarify items discussed in Rule 3.1 of the Rules in accordance with Rule 3.1.1 of the Rules.

- A. TFM and Installation Requirements (Rules 3.1.1, 3.1.2, 3.1.2.3, 3.1.4, & 3.1.5.3)
 1. New TFMs purchased or installed after December 1, 2014 must prohibit the totalizer of the TFM from moving backward or reducing the total amount registered on the TFM (this would include anti-reverse gears in mechanical TFMs). Existing TFM’s purchased or installed prior to December 1, 2014 do not require anti-reverse mechanism until future replacement.
 2. Installations of an electrically powered TFM dependent upon batteries as their principal source of power are not allowed.
 - a) Batteries may serve as a backup power source only.
 3. TFM dependent upon electricity for operation must be hardwired to the same electric panel box as the well that the TFM measures.
 - a) There can be no splices, disconnects or switches between the TFM and the electric box that would allow water to be diverted without simultaneous recording on TFM totalizer (due to power disconnect).
 - b) It is recommended that the wire between the electric box and the TFM be encased in conduit or otherwise routed and attached in such a manner as to prevent breakage from livestock, wildlife and the elements. This may be required in the event that damage to unprotected wiring occurs.
 4. Any wire between a TFM and a remote register:
 - a) Must be a continuous wire with neither splices or disconnects.
 - b) It is recommended that the wire be encased in conduit or otherwise routed and attached in such a manner as to prevent breakage from livestock, wildlife and the elements. This may be required in the event that damage to unprotected wiring occurs.



DIVISION OF WATER RESOURCES

South Platte River Basin Well Measurement Rules Policy

5. All mechanical TFMs must be equipped with a totalizing feature on the TFM and attached to the direct drive of the impeller. This includes TFMs utilizing a remote readout sensor installation.
 6. If a previously verified TFM is used to measure a different well due to relocation of a TFM assembly, the TFM is required to be re-certified in the new installation/configuration to assure meter accuracy in its modified location and configuration.
 7. If a previously verified TFM is used to measure the well for which it was verified but the plumbing configuration has been modified, the TFM is required to be re-certified to assure the meter accuracy in its final installed configuration. For example if the previously verified TFM has been placed in new piping such as a new center pivot riser pipe, a new verification test is required.
- B. TFM Maintenance, Replacement, and Repair Requirements (Rules 3.1.4, 3.1.5.3, 3.5.1)
1. All TFM replacement, repair and maintenance must be in accordance with the manufacturer's recommendations and with the Rules and Measurement Rules Policies regarding accuracy.
 2. TFM Component replacement, repair or general maintenance of a TFM requires that a new Meter Verification Test¹ be performed and submitted (Form 3.1 - Notice of Totalizing Flow Meter Verification, Re-Verification, or Replacement) unless a Variance is approved by the Division Engineer prior to such maintenance event in accordance with Item II.B.5. below. General Maintenance and repair that does not require a new Meter Verification Test to be conducted, or a Variance (see item II.B.5 below), is limited only to those instances that do not require the removal or replacement of any component(s) of the TFM or breakage of the Register Seal or TFM Seal. This may include but not be limited to the following:
 - a) Removal and replacement of register weather cover;
 - b) Removal and replacement of TFM canopy lid or lid spring;
 - c) Inspection of TFM propeller (mechanical propeller meters) without removal of any components of meter or propeller (requires a variance);
 - d) Inspection of TFM magnetic or ultrasonic sensors without removal of any components of meter or sensor (requires a variance);
 - e) Temporary removal of TFM with prior DWR approval (outlined in paragraph II.B.6) requires a variance.

¹ Meter Verification Test is defined as an independent field test performed by a Qualified Well Tester to determine the accuracy of the installed Totalizing Flow Meter. Reporting and submittal of all required information for the Meter Verification Test is accomplished on a Form or format as required by the Division Engineer (currently Form 3.1 - Notice of Totalizing Flow Meter Verification, Re-Verification, or Replacement)



DIVISION OF WATER RESOURCES

South Platte River Basin Well Measurement Rules Policy

3. When performing TFM component replacement, repair or general maintenance a Meter Verification Test must be performed before any water is diverted by the well/pump, other than to accomplish the TFM Verification test. Additionally, form 3.1 – Notice of Totalizing Flow Meter Verification, Re-Verification, or Replacement must be submitted to Division of Water Resources, Division 1 before any water is diverted.

a) In addition to Form 3.1, the Qualified Well Tester² or the Well User³ must supply the following information to DWR by verbal or written communication:

(1) Notification of intent to remove the factory seal prior to commencement of work.

b) In the event that water will be diverted for purposes other than, and prior to, a Meter Verification Test the above notification shall also include the following:

(1) The name of the person performing the replacement or repair, along with a brief statement of that person's qualifications if not a Qualified Well Tester;

(2) Reading from the TFM register being replaced or repaired (if possible) and the beginning reading of the new or repaired register on the submitted Form 3.1.

4. Under certain circumstances, a TFM may be temporarily removed and reinstalled without requiring a new Meter Verification Test if no maintenance and/or alteration is done to the TFM in accordance with Rule 3.1.5.3. Temporary removal and reinstallation of the TFM must be documented on Form 3.1 Meter Verification Test (new test not required) and submitted by a Qualified Well Tester and the policy addressing Tamper-Resistant Seals (outlined in paragraph II.D.) must be followed. The Well User must submit and have an approved Variance Request for such circumstances prior to removal. Failure to obtain a Variance Request approval may require that the Well User perform a new TFM Verification and submit Form 3.1 for approval.

5. Variance allowing TFM Maintenance, Component Replacement, and Repair Requirements, without a Meter Verification Test requirement:

a) A Variance may be granted by the Division Engineer to allow specific Maintenance and Repair actions to occur without the requirement for a new TFM Verification Test to be performed. Following are the conditions that such a Variance may be considered:

² Qualified Well Tester as defined by the Rules: "a person who is currently certified by the State Engineer as qualified to determine the accuracy of a TFM and perform a Power Conversion Coefficient test on a well," or as specifically defined in a court decree prior to entry of Rules.

³ Well User as defined by the Rules: "any person diverting ground water from a Well. This may include, but is not necessarily limited to, the owner of a water right or well permit which allows the diversion of ground water and any person having the right to use such a water right or well permit owned by another, including all agents, employees, lessees, assigns or successors of the same."



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- (1) The current Meter Verification Test must have a Correction Factor⁴ within $\pm 5\%$ to allow Maintenance and Repair actions to occur without the need for a new TFM Verification Test to be performed.
- (2) Proposed TFM Maintenance, Component Replacement or Repair will not *significantly* modify the TFM accuracy (Correction Factor).
- (3) Person performing the TFM Maintenance, Component Replacement or Repair must be certified by the TFM Manufacturer to perform such action.
- (4) An approved Maintenance, Component Replacement or Repair Form must be approved as part of the Variance approval. Upon completion of any Maintenance, Component Replacement or Repair, the approved form must be submitted to the Division Engineer within 30 days of completion of such action. The Form shall contain at a minimum the following information:
 - (i) Variance approval number, as assigned by DWR
 - (ii) Name of Person or Entity performing action
 - (iii) TFM Serial Number
 - (iv) Well WDID and Permit Number
 - (v) Date of action performed
 - (vi) Description of action performed
 - (vii) Qualification of person performing action (Decree, Qualified Well Tester, Manufacturer's Certification, etc.)
 - (viii) Verification that TFM is operable upon completion of action. Ideally this would be a quick verification of actual water through the meter compared to the register. However, if water cannot be diverted a simple visual/audio verification that the flow meter operates quietly and rotates freely (no binding).
- (5) Under certain circumstances a Variance may be granted on a continuous ongoing basis with or without an expiration or review date.

- C. TFM Register (Readout) Replacement and Repair Requirements (Rules 3.1.5.3, 3.5.1)
Any time a register is changed or repaired on a previously verified TFM, the following procedure must be followed:

⁴ "Correction Factor" is a ratio representing the flow as measured by a test meter compared to the flow as measured by an installed TFM. A correction factor must be verified and submitted to the Division Engineer by a Qualified Well Tester in accordance with the Rules.



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1. All TFM register replacement and repairs must be in accordance with the manufacturer's recommendations and with the Rules and Measurement Rules Policy regarding accuracy.
2. A Meter Verification Test of the TFM with the new register in place must be performed before any water is diverted by the well/pump, except to perform the TFM Verification test. Additionally, form 3.1 – Notice of Totalizing Flow Meter Verification, Re-Verification, or Replacement must be submitted to Division of Water Resources, Division 1 before any water is diverted.
3. TFM registers must at all times be secured with a tamper-resistant cover. The tamper-resistant cover shall be "sealed" in place by means of a factory seal or a wire cable secured in place by a clamp or other mechanism. If a factory seal is replaced with a wire and seal clamp, the seal clamp shall be in accordance with item II.D below.
4. In addition to Form 3.1, the Qualified Well Tester or the Well User must supply the following information to DWR:
 - a) Verbal or written notification of intent to remove the factory seal prior to commencement of work;
 - b) In the event that water will be diverted for purposes other than, and prior to, a Meter Verification Test the above notification shall also include the following:
 - (1) The name of the person performing the replacement or repair, along with a brief statement of that person's qualifications if not a Qualified Well Tester;
 - (2) Reading from the TFM register being replaced or repaired (if possible) and the beginning reading of the new or repaired register on the submitted Form 3.1

D. Tamper Resistant Seals (Rules 3.1.2.3, 3.1.2.4)

1. Typically, a Qualified Well Tester or APA will install or replace broken tamper resistant seals on behalf of the Well User during a Meter Verification Test or approved maintenance program. It is the Well User's responsibility to ensure that tamper resistant seals are installed and maintained at all times.
2. Register (Readout or Canopy) Seals



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a) All programmable TFM registers must at all times be secured with a tamper resistant cover. The tamper resistant cover shall be “sealed” in place by means of a wire cable that is threaded through cross-drilled holes in at least four cover bolts and secured in place by a clamp or other approved mechanism. The seal clamp shall be appropriate for outdoor use and be preprinted with a five to seven digit numeric identifier to be recorded on Form 3.1. In order for the cover and seal to be considered tamper resistant by the Division of Water Resources, it must not allow any modifications to the programmable functions of the flow meter without the breakage of the seal.

b) All mechanical TFM registers must at all times be secured with a tamper resistant cover. The tamper resistant cover shall be “sealed” in place by means of a factory seal or a wire cable secured in place by a clamp of other approved mechanism. If a factory seal is replaced with a wire and seal clamp, the seal clamp shall be appropriate for outdoor use and be preprinted with a five to seven digit numeric identifier to be recorded on Form 3.1. *Other seal identifiers may be allowed if approved prior to use by the Division of Water Resources.* In order for the cover and seal to be considered tamper resistant by the Division of Water Resources, it must not allow any modifications to the flow meter without the breakage of the seal.

3. Saddle or Insert Type Meter/Sensor Seals

a) All saddle or insert type mechanical meters and magnetic/ultrasonic sensors must at all times be secured in place with a tamper resistant seal around the pipe including a numeric identifier as described above. *Other seal identifiers may be allowed if approved prior to use by the Division of Water Resources.* The seal must be secured such that removal or movement of the TFM will break the seal.

b) Meters that are temporarily removed and replaced in the same pipe and pipe configuration in accordance with II.B.2, II.B.4, & II.B.5 contained herein can be sealed with a new seal without re-testing the meter. Form 3.1 shall be completed and submitted by a Qualified Well Tester indicating the type of meter for which seal was replaced, new seal number, old seal number, and the TFM reading. No water shall be diverted while the meter is removed.

4. Broken register seals can be replaced by a Qualified Well Tester without re-testing the well by submitting Form 3.1. This will be allowed with the seal breaks due to environmental conditions (i.e. wire fatigue associated with the weather) and the Qualified Well Tester is able to accurately attest to no modifications being made to the installed TFM.

5. For programmable register seal replacement, submittal of the meter k factor will be required as part of the 3.1 submittal. Meter verification (Form 3.1) will not be considered complete by DWR unless all new and removed seal numbers and k factor (when applicable) are provided on Page 1 of Form 3.1.



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6. Any seal that is replaced for any reason (meter replacement, meter verification, etc.) should be documented as described above on Form 3.1 by checking all boxes that apply. For example, for a re-verification of a previously verified TFM that requires removal of the register seal, check the box for “Re-verify Previously Verified TFM” and also the box for “Register seal replaced due to:” and include new and old seal number.
- E. Remote Readouts or Registers (Rule 3.1.2.2, 3.1.2.3, 3.6)
1. Remote registers must be accessible and readable at any reasonable time.
 2. In the event that a TFM is connected to a remote register, and the remote register is a secondary reading device to the TFM register, the remote register reading must display a direct numeral duplication of the TFM register, in accordance with ANSI/AWWA C706-10 Standard, Effective October 1, 2010 or as modified. The Well User shall verify that the TFM register and the remote register readouts are duplicative OR report the register reading from the actual TFM register but NOT the remote readout.
 - a) During a meter certification test, the remote register reading must be duplicative of the TFM’s totalizing reading, and the information must be reported on form 3.1.
 - b) Note that a TFM’s accuracy is being tested during a meter certification test, not the remote register’s accuracy.

III. Test Procedures (Rule 3.1.5)

- A. General Test Procedures
1. All test meters should be located and operated in accordance with the manufacturer’s recommendations and specifications. If the existing piping configuration does not allow for this, the Qualified Well Tester should clearly note this on Form 3.1.
 2. Measurement Device tests being performed on wells not in compliance with the Rules must be accomplished in accordance with Rule 5 – Water Not to be Withdrawn. Any water withdrawn pursuant to Rule 5 from a Well with no legal means to operate, such as an approved augmentation or substitute water supply plan, must be immediately returned to the same stream system without application to beneficial use.
 3. All wells shall be pumped continuously a minimum of 15 minutes before any TFM verification measurement readings are recorded (start-up time).
 4. A minimum of three separate volume readings, each spanning a minimum of 5 minutes or a single volume reading spanning a minimum of 15 minutes from both the installed and test meters totalizing feature (excluding Collins Meter) must be obtained for a test to be considered valid.
 5. All time increments, including start-up time, must be documented on Form 3.1 for test to be considered valid.



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6. The smallest allowable increment for the readings from the totalizing feature is at least one revolution of the smallest moveable digit. (For example: if the smallest digit recorded by the totalizing feature is 0.1 acre-feet, the smallest allowable volume reading is the time for 0.1 acre-feet to be recorded (i.e. moves from 0.1 to 0.2))

7. The calculated flow rate (volume/time) shall not change more than 2.5% between any readings.

8. All calculations should be adequately documented on Form 3.1 including, but not limited to, beginning and ending totalizer reading on both installed and test meters with corresponding start and finish times.

9. Instantaneous readings are not allowed for the test meter (except for Collins type testing equipment)

B. Mechanical TFM Test Procedures

1. For field verification of a mechanical TFM, instantaneous readings are not allowed on either the installed TFM or a mechanical test meter.

2. For field verification of a mechanical TFM, the totalizing feature of both the installed and test meters must be used. The only exception to this would be for a Collins-tube type test meter that measures the velocity directly.

C. Magnetic- or Ultrasonic-Type TFM Test Procedures

1. For field verification of a magnetic- or ultrasonic-type TFM, the totalizing feature of both the installed and test meters must be used unless the time for the totalizing feature on the installed flow meter to advance the smallest increment exceeds 15 minutes. In such case, instantaneous readings of the installed TFM may be allowed in-lieu of the totalizing feature readings. The TFM instantaneous flow readings must consist of a minimum of 10 separate instantaneous readings taken at documented even intervals over a minimum time period of 15 minutes not including the start-up time. The instantaneous flow rates taken shall not vary by more than 2.5% between any readings. The Totalizing feature of the test meter must be used (no instantaneous observations will be allowed).

2. For tests utilizing instantaneous readings, the test meter reading shall span the concurrent time interval as the installed meter test.

D. Collins-Type Meter Test Procedures

1. Use of any Collins or other types of manometers shall follow manufacturer recommendations and specifications in completing TFM certifications. Deviations from manufacturer recommendations and specifications shall be noted and submitted on the prescribed test forms.



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2. For a Collins tube, a Two-Point Test shall be accomplished by taking a front and back reading on both sides of the pipe at a distance equal to $0.354 * I.D$ (inside diameter) from the center of the pipe. The readings from each side of the pipe shall be averaged separately. If the difference between the average velocities from each side of the pipe is greater than one foot per second (1 fps), a Ten-Point Test must be performed. A Two-Point Test will not be accepted.
3. With a Collins Meter test, every effort shall be made so that the test is performed a minimum of three pipe diameters upstream or one pipe diameter downstream of the existing installed flow meter. Written documentation on Form 3.1 of flow rate recorded by the installed TFM should be made after the removal of the Collins Tube to confirm that the Collins Tube obstruction during the test does not cause inaccuracies to the installed flow meter.
4. If the Collins Meter is located less than 3 pipe diameters from any obstruction (i.e. flow meter, bend, valve, reduction, etc.) a Ten-Point Test is required.
5. For Flow Constants (gallons/minute/foot/seconds) not listed on the Collins Meter chart the appropriate equation below should be used. (Note: The following equations can always be used):
 6. Pipe sizes up to 10-inch NPS (Nominal Pipe Size): $(2.55 * D^2) - D$
 7. Pipe sizes over 10-inch NPS: $(D^2 * 2.45)$
 8. Where D = Inside Diameter (inches)

E. Volumetric Test Procedures

1. Use of volumetric test will be considered on a case by case basis. Any Tester that proposes to utilize a volumetric test must contact the Division of Water Resources prior to commencement of the test to propose measurement technique. Failure to obtain preliminary approval may result in denial of test and require re-testing. The following guidelines are recommended:
 - a) A minimum test time of one minute is required for a single volumetric measurement. This means that the minimum volume allowable in gallons is equal to the well flow rate in gallons per minute (gpm). For example, a 50 gpm well would require a minimum single vessel volume of 50 gallons for a one minute test.
 - b) Three separate tests shall be performed in using a volumetric test method, and the results of the three separate tests shall be averaged together and entered on Form 3.1.
 - c) The volumetric vessel shall be calibrated by weight using the value of 8.34 lbs per gallon for cool water or dimensionally using the value of 7.48 gallons per cubic foot.



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d) The scale used for vessel calibration shall be accurate for the calibrated weight of water and shall be documented on Form 3.1. Any available scale certification documentation such as scale tickets should be submitted with Form 3.1.

IV. Totalizing flow meter accuracy and variances (Rule 3.1.3)

A. Totalizing flow meters shall be deemed to be in accurate operating condition when the flow measured by the meter is within plus or minus 5% of an independent field measurement made using calibrated test equipment, by a Qualified Well Tester as defined by the Rules.

B. TFMs that fail to meet the accuracy standard of paragraph 3.1.3.1 of the Rules will use a Correction Factor pursuant to Rules 3.1.3.2 and 3.1.3.3 as summarized on the table below.

% of Field Measurement	Correction Factor	Requirements
±5%	0.950 to 1.050	No Request for Variance is required, no Correction Factor applied
±5 to 8%	0.949 to 1.051 OR 0.920 to 1.080	No Request for Variance is required, Correction Factor applied, good for four years
±8 to 10%	0.919 to 1.081 OR 0.900 to 1.100	No Request for Variance is required, Correction Factor applied TEST WILL BE VALID FOR ONE YEAR ONLY ⁵ . No later than one year from the date of this test, a new measurement test must be conducted and the accuracy of the new Test must be within at least ±8.0% or better.
Above ±10%	<0.900 OR >1.100	UNACCEPTABLE; Meter/System must be repaired/replaced unless a variance is approved by the Division Engineer ⁵ .

⁵TFMs installed prior to the effective date of the Rules (December 31, 2013) providing evidence of stable and accurate measurements that are greater than ±8% but no more that ±15% of an independent field measurement(s) made by a Qualified Well Tester using calibrated test equipment may be granted a variance by the Division Engineer. See Paragraph IV.E. below for conditions.



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C. The Correction Factor must be calculated by a Qualified Well Tester as defined by the Rules

D. If the flow measured by the TFM is within 5% - 10% of an independent field measurement made with calibrated test equipment, a Correction Factor will be applied to calculate all well diversions through the TFM until a new 3.1 form is submitted and approved by the Division of Water Resources.

1. TFMs that are verified to measure within $\pm 5\%$ of the actual flow by calibrated test equipment DO NOT apply a Correction Factor in the computation of the diversions by a well.

2. TFMs that are verified to measure $\pm 5\text{-}10\%$ of the actual flow by calibrated test equipment WILL apply a Correction Factor in the computations of the diversions by a well.

a) The Correction Factor for a TFM will be applied in the computation of diversions by a well by applying the Correction Factor from the date of the test forward until the date of a subsequent test.

$$\text{Correction Factor} = (Q_{\text{test meter}}) / (Q_{\text{installed meter}})$$

$$\text{Diversion} = \text{Meter Reading} * \text{Correction Factor}$$

E. TFMs installed prior to the effective date of the Rules (December 31, 2013) showing stable measurements that are greater than $\pm 8\%$ but no more than $\pm 15\%$ of an independent field measurement(s) made by a Qualified Well Tester using calibrated test equipment may be granted a variance by the Division Engineer provided the following:

1. The TFM must be installed in a plumbing configuration existing prior to the effective date of the Rules, as evidenced by documentation (i.e. affidavit) submitted by applicant supporting the variance request and approved by Division Engineer

2. A Qualified Well Tester or other person authorized to perform a certification test must perform an initial certification test demonstrating that the flow measured by such TFM is more than plus or minus 8% but no more than plus or minus 15% of an independent field measurement using calibrated test equipment. The Qualified Well Tester or other person authorized to perform a certification test must also calculate a Correction Factor based upon this initial test.

3. A Qualified Well Tester must perform a second certification test of the TFM at a date more than one year but less than two years subsequent to the date of the initial certification test for the TFM. This second certification test must demonstrate that the flow measured by such TFM is no more than plus or minus 15% of an independent field measurement using calibrated test equipment. In addition, the Correction Factor calculated based upon this second certification test must be within 4% of the Correction Factor calculated based upon the initial certification test.



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4. Subsequent certification tests for the TFM shall be performed within four years of the date of the initial certification test and each subsequent certification test (other than the second certification test), as provided for in the Rules. These subsequent certification tests must demonstrate that the flow measured by such TFM is no more than plus or minus 15% of an independent field measurement using calibrated test equipment, and the Correction Factors calculated based upon such subsequent certification tests must remain within 4% of the Correction Factor for the initial test. If these conditions are not met, the Division Engineer may cancel the variance, and the TFM may not be used until certified to be within Accurate or Acceptable Operating Condition under the Rules or until a subsequent variance is granted.
5. An alteration to the plumbing configuration, including relocation of the TFM, may result in the Division Engineer cancelling the variance, and the TFM may not be used until certified to be within Accurate or Acceptable Operating Condition under the Rules or until a subsequent variance is granted.
6. The Division Engineer may, at his discretion and in accordance with 37-92-502 (6) C.R.S. and Rule 3.6, field inspect the plumbing configuration for the TFM or test equipment to confirm that the discrepancy between the flow as measured by the TFM and as measured using calibrated test equipment may fairly be attributed to the plumbing configuration, and that the error introduced by the plumbing configuration cannot be remedied by a simple relocation of the TFM to a more suitable location within the plumbing configuration.

V. Power Conversion Coefficient Alternate Measurement Method Policies (Rule 3.2)

The following items are intended to clarify items discussed in Rule 3.2 of the Rules.

A. General Test Procedures (Rule 3.2.1)

1. At least five measurements of both pumping level and operating pressure taken at the beginning and end of at least four consecutive 15 minute periods showing both operating pressure and drawdown have not changed by more than 10% per hour when operated at a constant discharge rate.
2. In situations where the pumping level cannot be obtained:
 - a) The reason is provided on Form 3.2: no access hole, well is pumping air, non-vertical well bore, and permission not granted by Well User, etc.
 - b) The pump has run a minimum of two hours prior to the beginning of the test, and
 - c) Neither the operating pressure nor discharge rate change by more than 2.5% over a 1 hour period, determined by at least five measurements of both operating pressure and discharge taken at the beginning and end of at least four consecutive 15 minute periods.
3. Must maintain a full pipe of water during testing and be performed during normal operating conditions.



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- a) If the system does not have a full pipe of water and has to be adjusted with a valve or temporarily modified to achieve a full pipe (squeezed down) at any point during the year (irrigation year) and/or in order to perform a PCC, a TFM will be required. Any required modification during the testing to obtain a full-pipe MUST be noted on the test form submitted.
 - b) If the system has been re-nozzled, a new PCC is required.
4. Any system in which a well is physically commingled with another well(s), will exclude the Well User from using PCC as an alternate method of measurement in that system.
 5. At least one single volume reading spanning a cumulative elapsed time of no less than 15 minutes must be obtained by the Qualified Well Tester if using calibrated flow measurement testing equipment (excluding Collins Meter) after the system has been proven to be stabilized.
 6. If the qualified well tester uses a Collins test meter, three separate instantaneous readings spaced across a 15 minute interval must be determined. The tester will then average the three separate readings. The flow rate shall not change more than 2.5% during the well test.
 7. When determining the Average Rate of the Power Demand for the well system, a minimum of 5 readings with the elapsed time of each reading equaling no less than 1 minute must be taken. The average of the five readings will then be used in the Power Demand calculations.
 8. In regard to Rule 3.2.3, if the difference between any two congruent PCC ratings is greater than 5%, both ratings shall be considered invalid and a PCC will not be considered an accurate method of measurement from the date of the second test forward, unless the well user or APA submits and obtains approval of a variance providing adequate detail and documentation to explain the differences in ratings. If the PCC is not considered to be an accurate method of measurement, the PCC method will not be allowed and the well must be equipped with a TFM.
 9. Instances that may qualify for a variance include but are not limited to the following:
 - a) Permanent modifications to the pumping and/or piping systems after the initial rating has been accomplished but before the second rating is completed.
 - b) In the event permanent modifications to the pumping and/or piping systems are made, a new PCC rating is due immediately after the modifications have been completed.
- B. Application of PCC Rating to Calculated Diversions from a Well (Rule 3.2.2)



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1. A PCC rating shall meet the requirements of Rule 3.2 of the Measurement Rules. Total Diversions shall be applied for the computation of rating and resulting diversions from a well based upon a PCC as follows:

- a) The first or initial rating shall be relied upon to calculate the total groundwater diversions from a well until the second PPC test is conducted.
- b) After the second PCC test is conducted, an average of the first and second PCC ratings will be relied upon to calculate the total groundwater diversion from a well for two years (until the date of a subsequent PCC) after the date of the second test so long as the two tests meet the standards of Rule 3.2.2.3.

VI. Data Submission (Rules 3.1.5.4, 3.2.2.5, and 6)

The following items are intended to clarify items discussed in Rules 3.1, 3.2, and 6 of the Rules regarding the submission of data.

A. Rule 3.1.5.4 and 3.2.2.5 requires written proof of meter certification to be submitted to the Division engineer on a form or in a format prescribed by the State Engineer. Certified well test data shall be submitted on prescribed Form 3.1 – Notice of Totalizing Flow Meter Re-Verification, Installation, or Replacement and Form 3.2 – Notice of Power Consumption Coefficient Rating or Re-Rating. Currently, submittal may be submitted to the Division Engineer by 1) hardcopy submittal through the mail; or 2) by digital email submittal as outlined below.

B. In accordance with Rule 6.1 and 6.2, monthly well diversions shall be submitted on Form 6 – Water Use Reporting Form, or using DWR’s online reporter or bulk upload tool. Other submittals of monthly well diversions may be accepted on a case-by-case basis if approved by the Division Engineer. A request must be made to the Division Engineer in writing either providing an example of such submittal or describe in detail how the submittal will be made. When possible it is preferable that augmentation plans submitting individual well diversions or meter readings as part of monthly or annual accounting submittals to the Division Engineer do not need to duplicate submittals under the Rules as the submittal is approved by the Division Engineer. However, at a minimum, the accounting submittals must meet certain standards which may include the following:

1. Meter Serial Number
2. Well WDID (unique Division of Water Resources Structure Identifier)
3. Meter Reading (entire meter reading, all digits, no decimals)
4. Meter multiplier
5. Date of Meter Reading
6. Type of Meter Reading (Actual, Estimated, Calculated, Corrected, Total Diversion, Other)



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- C. (Rule 3.1.5 – Meter Certification) An active well is considered out of compliance with the Rules if its meter certification has expired and until the Division of Water Resources has received and approved the TFM or PCC test.
1. An expired meter certification remains expired and may come under enforcement even if a meter certification test has been completed but has not been submitted to the Division Engineer
 2. Completed meter certification tests must be submitted to the Division Engineer within and no later than 30 days from the completion of the test. A certification test will be rejected if the test is received by the Division Engineer later than 30 days from the completion of the test.
- D. All tests not accepted will be returned to the Well User or APA, and the Qualified Well Tester with the address(s) provided on the forms.
- E. Only those forms found on the Colorado Division of Water Resources website under <http://water.state.co.us/groundwater/GWAdmin/UseAndMeasurement/Pages/SouthPlatteRBRules.aspx> or forms/formats already approved by the Division Engineer will be allowed.
- F. Electronic submittal of all measurement forms (email):
1. Submittal of a completed form may be sent to DWR by email at dnr_div1spgwm@state.co.us
 2. Submittals must be complete, including required signatures and completely legible. Submittals not complete or legible will be returned to the same email address as delivered.
 3. Emailed submittals shall meet the following criteria:
 - a) One test per email correspondence.
 - b) Subject line of email shall contain at a minimum the WDID or Permit Number of the Well.
 - c) The test documentation file must be included as an attachment to the email. The Well Test, Photos, Documentation, etc. shall be combined and attached to the email as ONE Document/Attachment. The attachment shall be formatted as a PDF file only.
 4. Submittals and their attachment should be reduced to the smallest file size while maintaining adequate quality. Typically the file should not exceed 10 MB when submitted by email.
- G. Forms other than DWR forms created by others must be pre-approved by DWR personnel prior to submittal. This includes but is not limited to: modified forms, spreadsheets, and digital submittals.



VII. Calibrated testing equipment (Rule 3.7)

- A. All Qualified Well Testers are required to provide evidence verifying their flow measurement testing equipment (excluding Collins Test Meters) have been semi-annually (every 2-years) calibrated, rated accurate within plus or minus 2%, in good working condition, all in accordance with the Rules.
- B. Qualified Well Testers are required to submit copies of their well meter testing equipment certification to the Division Engineer. All meter certification tests and PCCs conducted by calibrated equipment will be rejected if the calibration documentation is not submitted to the Division Engineer.
- C. A volumetric vessel (Bucket) that is used as testing equipment to verify installed flow meters shall be calibrated by weight, using the value of 8.34 lbs per gallon for cool water or dimensionally using the value of 7.48 gallons per cubic foot. The scale used for vessel calibration shall be accurate for the calibrated weight of water, and any available scale certification documentation, such as scale tickets, must be submitted upon request.

VIII. Variance Policies (Rule 11)

The following items are intended to clarify items discussed in Rule 11 of the Rules. Rule 11 of the Rules, allows the Division Engineer to grant variances when the strict application of any provisions of the Rules would cause undue hardship. The intent of this Policy Memorandum is to establish principles, guidelines, and requirements for variance requests.

- A. Variance requests shall be submitted on prescribed Form 11 – Variance Request for review by the Division Engineer. Failure to accurately or completely submit Form 11 may result in the rejection of the Variance Request.
- B. The Division Engineer shall make best efforts to issue a written order on any variance request within 14 calendar days of submission. Any variance not approved by the Division Engineer within 14 calendar days for submission may be deemed a denial of such request for purpose of appeal.
- C. Approval of a Variance Request by the Division Engineer should be obtained by the Well User prior to any proposed modifications or materials being ordered. This is to avoid any difficulty to the Well User in the event the Variance Request is denied.
- D. In interpreting Rule 11 the term “undue hardship” will be broadly construed to lessen the burdens of compliance with the Rules consistent with and not contrary to any term or condition of a water court decree regarding the operation of the Well for which a variance is sought, and is consistent with reliable measurement and reporting of groundwater withdrawals.
- E. Variances will not be granted in the following cases:
1. Where the measurement device measures water from separate sources including surface and groundwater, but provides only a total measurement of all flows;



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2. Where the measurement device and/or interim water measurement program is inoperable due to being intentionally damaged or destroyed by the Well User or at their direction.
- F. The granting of a variance under Rule 11 is solely a variance from certain requirements for the Rules, and is not a substitute for compliance with any other lawful requirements applicable to the withdrawal and use of groundwater, and a variance does not excuse any such non-compliance.
- G. A granted variance shall be identified by the WDID number and the date the variance is granted (mm/dd/yyyy).
- H. Rule 3.1.5.5 provides for a variance for “a well or wells within a decreed plan of augmentation that has or have not been used and has or have not been Operationally Disabled, where such plan adequately documents such non-use through operational TFMs.”
1. Monthly TFM readings shall be submitted annually in accordance to Rule 6 on Form 6 documenting such non-use.
 2. Further documentation shall be submitted showing that the TFM remains operable.



Dick Wolfe, P.E.

Director/State Engineer

February 1, 2015

Date

APPENDIX C

LIST OF CERTIFIED WELL TESTERS (SOUTH PLATTE RIVER GROUND WATER)

Certified Well Testers (Division 2 Ground Water)

AGRO ENGINEERING (LORENZ, JASON)	Address: 0210 ROAD 2 S ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 BUSINESS FAX (719) 852-5146 CELL (719) 850-4011	E-mail JASON@AGRO.COM
ALLENBAUGH, JEREMY	Address: 265 BELLOWS DRV. HARTSEL, CO 80449 Phone number(s): BUSINESS (303) 588-1732	E-mail SNOWMOUNTAINDESIGNSTUDIO@GMAIL.COM
ARCHULETA, CHRIS	Address: 530 N ILIFF DRIVE PUEBLO, CO 81007 Phone number(s): CELL (719) 423-9945	E-mail C.ARCHULETA18@GMAIL.COM
BATES WELL METERING (BATES, RITA)	Address: 6155 KINGDOM VIEW COLORADO SPRINGS, CO 80918 Phone number(s): BUSINESS (208) 515-6209	E-mail ADVENTUREROJO@GMAIL.COM
COLORADO WATER WELL (DEA, THOMAS)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 882-3749 BUSINESS (303) 892-9053	E-mail TOM@COLORADOWATERWELL.COM
COLORADO WATER WELL (HULL, DAVID)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 435-4530	E-mail DAVID@COLORADOWATERWELL.COM
CWPDA (MCELROY, LARRY)	Address: PO BOX 471 SWINK, CO 81077 Phone number(s): BUSINESS (719) 469-0042	E-mail FARMERMCELROY@GMAIL.COM
DANIEL, DEB	Address: 48575 COUNTY ROAD X BURLINGTON, CO 80807 Phone number(s): BUSINESS (719) 346-8269 CELL (719) 342-9492	E-mail DEBI.DANIEL57@GMAIL.COM
DODSWORTH FAMILY FARMS, INC. (DODSWORTH, DUAINE)	Address: 29034 COUNTY ROAD 30 WRAY, CO 80758 Phone number(s): BUSINESS (970) 630-1242	E-mail DODSWORTHX8@GMAIL.COM
GRIFFITH INC. (GRIFFITH, SHAWN R.)	Address: 3299 STATE HWY 91 LEADVILLE, CO 80461 Phone number(s): BUSINESS (719) 486-1517 BUSINESS FAX (719) 486-1517	E-mail griffithinc@hotmail.com
HARRY MARSHALL CONSULTANT (MARSHALL, HARRY)	Address: 220 W. HARGREAVES HOLYOKE, CO 80734 Phone number(s): BUSINESS (970) 854-3489 BUSINESS (970) 520-1814 BUSINESS FAX (970) 854-3489 CELL (970) 520-1814	E-mail HMARSHALL61242@GMAIL.COM
HELTON & WILLIAMSEN (OLSON, ANDERS)	Address: 384 INVERNESS PARKWAY SUITE 144 ENGLEWOOD, CO 8011 Phone number(s): BUSINESS (303) 792-2161 CELL (303) 870-7513	E-mail AOLSON@HELTON-WILLIAMSEN.COM
JEHN WATER CONSULTANTS, INC. (BANKS, HILLARY)	Address: 88 INVERNESS CIRCLE EAST, K-102 CENTENNIAL, CO 80112 Phone number(s): BUSINESS (303) 321-8335	E-mail HBANKS@JEHNWATER.COM
KARG, ROBERT A & ELISSA M	Address: 4405 CR 31 ATWOOD, CO 80722 Phone number(s): BUSINESS FAX (970) 522-0847 CELL (970) 520-1876	E-mail ELISSA_KARG@YAHOO.COM

Certified Well Testers (Division 2 Ground Water)

LAURITSEN, BRIAN	Address: 107 MILL ST. LAMAR, CO 81052 Phone number(s): HOME (719) 940-0730	E-mail VALLEYAGBRIAN@HOTMAIL.COM
MCKINLEY, KYLIE	Address: 88 INVERNESS CIRCLE EAST, K-102 CENTENNIAL, CO 80112 Phone number(s): BUSINESS (303) 321-8335	E-mail KYLIE.MCKINLEY33@GMAIL.COM
QUALITY IRRIGATION (BJORLIN, WESTON)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115 CELL (970) 630-2269	E-mail QUALITYWELLTESTER@YAHOO.COM
QUALITY IRRIGATION (HANSEN, JOSEPH)	Address: PO BOX 459 YUMA, CO 80759 Phone number(s): BUSINESS (970) 630-3303 HOME (970) 848-3846	E-mail JOSEPHKANEHANSEN@GMAIL.COM
QUALITY IRRIGATION (IRWIN, JANELLE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail JANELLE@QUALITYIRRIGATION.COM
QUALITY IRRIGATION (MOLINA, MELVIN)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail MRMOLINAM@YAHOO.COM
QUALITY IRRIGATION (WAGNER, EUGENE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail GENEW@QUALITYIRRIGATION.COM
QUALITY IRRIGATION (ZIMMERMAN, BRANDON)	Address: 40009 CR C YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS (940) 297-9436 BUSINESS FAX (970) 848-5115	E-mail BZIMMERMAN84@GMAIL.COM
RHOADS, SHAWNA	Address: 9963 N ROAD 4 WEST CENTER, CO 81125 Phone number(s): BUSINESS (719) 580-0202	E-mail RHOADSWEST@GMAIL.COM
RICHARDS' WELL CALIBRATIONS (RICHARDS, DAN)	Address: PO BOX 21 EADS, CO 81036 Phone number(s): BUSINESS (719) 688-5451 BUSINESS FAX (719) 438-5842	E-mail RICHWATER7@GMAIL.COM
WATER WELL WIZARDS, LLC (DASH, RUSSELL)	Address: 2411 N GREENWOOD PUEBLO, CO 81003 Phone number(s): BUSINESS (719) 562-9801	E-mail RGDASH@MSN.COM

Certified Well Testers (Division 3 Ground Water)

AGRO ENGINEERING (BATEY, COLTEN)	Address: 0210 ROAD 2 SOUTH ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 CELL (719) 588-8087	E-mail COLTEN@AGRO.COM
AGRO ENGINEERING (CROWDER, BILL)	Address: 0210 ROAD 2 SOUTH ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 BUSINESS FAX (719) 852-5146 CELL (719) 850-3312	E-mail AGROIDBILL@GMAIL.COM
AGRO ENGINEERING (LORENZ, JASON)	Address: 0210 ROAD 2 S ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 BUSINESS FAX (719) 852-5146 CELL (719) 850-4011	E-mail JASON@AGRO.COM
AGRO ENGINEERING (MCKECHNIE, STEVEN)	Address: 0210 ROAD 2S ALAMOSA, CO 81101 Phone number(s): CELL (719) 588-7188	E-mail STEVEN@AGRO.COM
AGRO ENGINEERING (ROGERS, KERI)	Address: 0210 ROAD 2 S ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957	E-mail KERI@AGRO.COM
AGRO ENGINEERING (THOMPSON, KIRK)	Address: 0210 ROAD 2 SOUTH ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 CELL (719) 850-4010	E-mail KIRKAGRO@GMAIL.COM
ALLENBAUGH, JEREMY	Address: 265 BELLOWS DRV. HARTSEL, CO 80449 Phone number(s): BUSINESS (303) 588-1732	E-mail SNOWMOUNTAINDESIGNSTUDIO@GMAIL.COM
ARCHULETA, CHRIS	Address: 530 N ILIFF DRIVE PUEBLO, CO 81007 Phone number(s): CELL (719) 423-9945	E-mail C.ARCHULETA18@GMAIL.COM
BATES WELL METERING (BATES, RITA)	Address: 6155 KINGDOM VIEW COLORADO SPRINGS, CO 80918 Phone number(s): BUSINESS (208) 515-6209	E-mail ADVENTUREROJO@GMAIL.COM
CACTUS HILL AG CONSULTING LLC (PORCO, RANDY)	Address: 11150 FDR 255 LA JARA, CO 81140 Phone number(s): BUSINESS (719) 274-4078	E-mail RANDYPORCO@GMAIL.COM
CACTUS HILL AG CONSULTING LLC (TER KUILE-MILLER, MAYA)	Address: 20758 CR 10 LA JARA, CO 81140 Phone number(s): HOME (719) 580-1976	E-mail MAYATK30@GMAIL.COM
CACTUS HILL AG CONSULTING, LLC (MILLER-TER KUILE, DIANA)	Address: 20758 COUNTY ROAD 10 LA JARA, CO 81140 Phone number(s): BUSINESS2 (719) 298-6232 CELL (719) 298-6232 HOME (719) 274-5430	E-mail DMILLERTERKUILE@GMAIL.COM
CENTRAL PUMP COMPANY (GEIMAN, JOE)	Address: 570 EAST HIGHWAY 112 CENTER, CO 81125 Phone number(s): BUSINESS (719) 588-8252 HOME (719) 754-3936	E-mail JOE@CPCPUMP.COM
CENTRAL PUMP COMPANY (LUTHER, LUCAS)	Address: 0570 E HIGHWAY 112 CENTER, CO 81125 Phone number(s): BUSINESS (719) 754-3936 HOME (719) 588-9565	E-mail LUCAS@CPCPUMP.COM

Certified Well Testers (Division 3 Ground Water)

CENTRAL PUMP COMPANY (RAMEY, ROBERT)	Address: 0570 E HIGHWAY 112 CENTER, CO 81125 Phone number(s): BUSINESS (719) 754-3936	E-mail ROBBY@CPCPUMP.COM
COLORADO WATER WELL (DEA, THOMAS)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 882-3749 BUSINESS (303) 892-9053	E-mail TOM@COLORADOWATERWELL.COM
COLORADO WATER WELL (HULL, DAVID)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 435-4530	E-mail DAVID@COLORADOWATERWELL.COM
COOMBS, JASON	Address: 23725 COUNTY ROAD 15 LA JARA, CO 81140 Phone number(s): BUSINESS (719) 588-4442 HOME (719) 274-0224	E-mail FARMERCOOMBS@HOTMAIL.COM
COOMBS, NATHAN	Address: 13245 CR 16 LA JARA, CO 81140 Phone number(s): BUSINESS (719) 588-3090 HOME (719) 843-0722	E-mail CWCD1971@HOTMAIL.COM
DANIEL, DEB	Address: 48575 COUNTY ROAD X BURLINGTON, CO 80807 Phone number(s): BUSINESS (719) 346-8269 CELL (719) 342-9492	E-mail DEBI.DANIEL57@GMAIL.COM
DODSWORTH FAMILY FARMS, INC. (DODSWORTH, DUAINÉ)	Address: 29034 COUNTY ROAD 30 WRAY, CO 80758 Phone number(s): BUSINESS (970) 630-1242	E-mail DODSWORTHX8@GMAIL.COM
GRIFFITH INC. (GRIFFITH, SHAWN R.)	Address: 3299 STATE HWY 91 LEADVILLE, CO 80461 Phone number(s): BUSINESS (719) 486-1517 BUSINESS FAX (719) 486-1517	E-mail griffithinc@hotmail.com
HARRY MARSHALL CONSULTANT (MARSHALL, HARRY)	Address: 220 W. HARGREAVES HOLYOKE, CO 80734 Phone number(s): BUSINESS (970) 854-3489 BUSINESS (970) 520-1814 BUSINESS FAX (970) 854-3489 CELL (970) 520-1814	E-mail HMARSHALL61242@GMAIL.COM
J & A WELDING AND REPAIR (KURYS, JOHN)	Address: 3099 SHERMAN AVENUE MONTE VISTA, CO 81144 Phone number(s): BUSINESS (719) 852-5390 CELL (719) 849-8543	E-mail JAKURYS7418@OUTLOOK.COM
KARG, ROBERT A & ELISSA M	Address: 4405 CR 31 ATWOOD, CO 80722 Phone number(s): BUSINESS FAX (970) 522-0847 CELL (970) 520-1876	E-mail ELISSA_KARG@YAHOO.COM
QUALITY IRRIGATION (BJORLIN, WESTON)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115 CELL (970) 630-2269	E-mail QUALITYWELLTESTER@YAHOO.COM
QUALITY IRRIGATION (HANSEN, JOSEPH)	Address: PO BOX 459 YUMA, CO 80759 Phone number(s): BUSINESS (970) 630-3303 HOME (970) 848-3846	E-mail JOSEPHKANEHANSEN@GMAIL.COM
QUALITY IRRIGATION (IRWIN, JANELLE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail JANELLE@QUALITYIRRIGATION.COM

Certified Well Testers (Division 3 Ground Water)

QUALITY IRRIGATION (MOLINA, MELVIN)	Address: PO BOX 420 YUMA, CO 80759	E-mail MRMOLINAM@YAHOO.COM
	Phone number(s): BUSINESS (970) 848-3846	
	BUSINESS FAX (970) 848-5115	
<hr/>		
QUALITY IRRIGATION (WAGNER, EUGENE)	Address: PO BOX 420 YUMA, CO 80759	E-mail GENEW@QUALITYIRRIGATION.COM
	Phone number(s): BUSINESS (970) 848-3846	
	BUSINESS FAX (970) 848-5115	
<hr/>		
QUALITY IRRIGATION (ZIMMERMAN, BRANDON)	Address: 40009 CR C YUMA, CO 80759	E-mail BZIMMERMAN84@GMAIL.COM
	Phone number(s): BUSINESS (970) 848-3846	
	BUSINESS (940) 297-9436	
	BUSINESS FAX (970) 848-5115	
<hr/>		
RHOADS, SHAWNA	Address: 9963 N ROAD 4 WEST CENTER, CO 81125	E-mail RROADSWEST@GMAIL.COM
	Phone number(s): BUSINESS (719) 580-0202	
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RICHARDS' WELL CALIBRATIONS (RICHARDS, DAN)	Address: PO BOX 21 EADS, CO 81036	E-mail RICHWATER7@GMAIL.COM
	Phone number(s): BUSINESS (719) 688-5451	
	BUSINESS FAX (719) 438-5842	
<hr/>		
WATER WELL WIZARDS, LLC (DASH, RUSSELL)	Address: 2411 N GREENWOOD PUEBLO, CO 81003	E-mail RGDASH@MSN.COM
	Phone number(s): BUSINESS (719) 562-9801	

Certified Well Testers (Republican River Ground Water)

AGRO ENGINEERING (LORENZ, JASON)	Address: 0210 ROAD 2 S ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 BUSINESS FAX (719) 852-5146 CELL (719) 850-4011	E-mail JASON@AGRO.COM
ALLENBAUGH, JEREMY	Address: 265 BELLOWS DRV. HARTSEL, CO 80449 Phone number(s): BUSINESS (303) 588-1732	E-mail SNOWMOUNTAINDESIGNSTUDIO@GMAIL.COM
ARCHULETA, CHRIS	Address: 530 N ILIFF DRIVE PUEBLO, CO 81007 Phone number(s): CELL (719) 423-9945	E-mail C.ARCHULETA18@GMAIL.COM
COLORADO WATER WELL (DEA, THOMAS)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 882-3749 BUSINESS (303) 892-9053	E-mail TOM@COLORADOWATERWELL.COM
COLORADO WATER WELL (HULL, DAVID)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 435-4530	E-mail DAVID@COLORADOWATERWELL.COM
DANIEL, DEB	Address: 48575 COUNTY ROAD X BURLINGTON, CO 80807 Phone number(s): BUSINESS (719) 346-8269 CELL (719) 342-9492	E-mail DEBI.DANIEL57@GMAIL.COM
DODSWORTH FAMILY FARMS, INC. (DODSWORTH, DUAINE)	Address: 29034 COUNTY ROAD 30 WRAY, CO 80758 Phone number(s): BUSINESS (970) 630-1242	E-mail DODSWORTHX8@GMAIL.COM
DUERST MACHINE WORKS (ERKER, GREG)	Address: PO BOX 99 BURLINGTON, CO 80807 Phone number(s): BUSINESS (719) 346-5348 BUSINESS FAX (719) 346-7029 CELL (719) 342-1734	E-mail DWDUERST@HOTMAIL.COM
DUERST MACHINE WORKS (HUDNELL, JERRY)	Address: PO BOX 99 BURLINGTON, CO 80807 Phone number(s): BUSINESS (719) 346-5348 BUSINESS FAX (719) 346-7029 CELL (719) 349-5231	E-mail
EAST CHEYENNE GROUND WATER MANGEMENT DISTRICT (TALBER	Address: PO BOX 193 CHEYENNE WELLS, CO 80810 Phone number(s): CELL (719) 343-3129	E-mail ECGWMD@OUTLOOK.COM
FIELD WELL TESTING (SCHOLEFIELD, SHANNON)	Address: 621 SOUTH COLUMBUS STREET YUMA, CO 80759 Phone number(s): BUSINESS (970) 630-1740	E-mail FIELDWELLTESTING@YAHOO.COM
G & L SERVICES (FRAME, LARRY)	Address: 14256 CR 9 SEDGWICK, CO 80749 Phone number(s): CELL (970) 520-3347	E-mail LARRYFRAME1@YAHOO.COM
GRIFFITH INC. (GRIFFITH, SHAWN R.)	Address: 3299 STATE HWY 91 LEADVILLE, CO 80461 Phone number(s): BUSINESS (719) 486-1517 BUSINESS FAX (719) 486-1517	E-mail griffithinc@hotmail.com
HARRY MARSHALL CONSULTANT (MARSHALL, HARRY)	Address: 220 W. HARGREAVES HOLYOKE, CO 80734 Phone number(s): BUSINESS (970) 854-3489 BUSINESS (970) 520-1814 BUSINESS FAX (970) 854-3489 CELL (970) 520-1814	E-mail HMARSHALL61242@GMAIL.COM

Certified Well Testers (Republican River Ground Water)

HARRY MARSHALL CONSULTING (MOORHEAD, DENISE)	Address: PO BOX 173 BRULE, NE 69127 Phone number(s): BUSINESS (308) 287-2528 BUSINESS FAX (970) 854-3489 CELL (308) 289-6928	E-mail FPRAIRIE@ATCJET.NET
HARRY MARSHALL CONSULTING (MOORHEAD, KEN)	Address: PO BOX 173 BRULE, NE 69127 Phone number(s): BUSINESS (308) 287-2528 BUSINESS FAX (970) 854-3489	E-mail KMOORHEAD@HOTMAIL.COM
J&J IRRIGATION (WILLIAMS, JAMES)	Address: 36330 US HIGHWAY 385 WRAY, CO 80758 Phone number(s): BUSINESS (970) 332-3303 BUSINESS FAX (970) 332-5173 CELL (970) 630-3680	E-mail
J&J IRRIGATION INC (BUSTER, MITCHEL)	Address: 36330 US HIGHWAY 385 WRAY, CO 80758 Phone number(s): BUSINESS (970) 332-3303	E-mail
J&J IRRIGATION INC (SMITH, JUSTIN)	Address: PO BOX 394 WRAY, CO 80758 Phone number(s): HOME (970) 332-3303	E-mail JUSTINRSMITH88.JS@GMAIL.COM
JEHN WATER CONSULTANTS, INC. (BANKS, HILLARY)	Address: 88 INVERNESS CIRCLE EAST, K-102 CENTENNIAL, CO 80112 Phone number(s): BUSINESS (303) 321-8335	E-mail HBANKS@JEHNWATER.COM
KARG, ROBERT A & ELISSA M	Address: 4405 CR 31 ATWOOD, CO 80722 Phone number(s): BUSINESS FAX (970) 522-0847 CELL (970) 520-1876	E-mail ELISSA_KARG@YAHOO.COM
MCKINLEY, KYLIE	Address: 88 INVERNESS CIRCLE EAST, K-102 CENTENNIAL, CO 80112 Phone number(s): BUSINESS (303) 321-8335	E-mail KYLIE.MCKINLEY33@GMAIL.COM
MIDCAP METER CERT (MIDCAP, NATE)	Address: PO BOX 402 WRAY, CO 80758 Phone number(s): BUSINESS (970) 467-7625 HOME (970) 774-6114	E-mail MIDCAPMETERCERT@YAHOO.COM
QUALITY IRRIGATION (BJORLIN, WESTON)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115 CELL (970) 630-2269	E-mail QUALITYWELLTESTER@YAHOO.COM
QUALITY IRRIGATION (HANSEN, JOSEPH)	Address: PO BOX 459 YUMA, CO 80759 Phone number(s): BUSINESS (970) 630-3303 HOME (970) 848-3846	E-mail JOSEPHKANEHANSEN@GMAIL.COM
QUALITY IRRIGATION (IRWIN, JANELLE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail JANELLE@QUALITYIRRIGATION.COM
QUALITY IRRIGATION (MOLINA, MELVIN)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail MRMOLINAM@YAHOO.COM
QUALITY IRRIGATION (WAGNER, EUGENE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail GENEW@QUALITYIRRIGATION.COM

Certified Well Testers (Republican River Ground Water)

QUALITY IRRIGATION (ZIMMERMAN, BRANDON)	Address: 40009 CR C YUMA, CO 80759	E-mail BZIMMERMAN84@GMAIL.COM
	Phone number(s): BUSINESS (970) 848-3846	
	BUSINESS (940) 297-9436	
	BUSINESS FAX (970) 848-5115	
<hr/>		
RICHARDS' WELL CALIBRATIONS (RICHARDS, DAN)	Address: PO BOX 21 EADS, CO 81036	E-mail RICHWATER7@GMAIL.COM
	Phone number(s): BUSINESS (719) 688-5451	
	BUSINESS FAX (719) 438-5842	
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RIDNOUR, DEVIN J.	Address: 29550 COUNTY ROAD 35 WRAY, CO 80758	E-mail RIDNOURDT@GMAIL.COM
	Phone number(s): BUSINESS (970) 630-1120	
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WATER WELL WIZARDS, LLC (DASH, RUSSELL)	Address: 2411 N GREENWOOD PUEBLO, CO 81003	E-mail RGDASH@MSN.COM
	Phone number(s): BUSINESS (719) 562-9801	
<hr/>		
YW WELL TESTING (SPOUSE, KYLE)	Address: 121 S MAIN YUMA, CO 80759	E-mail YWWELLTESTING@HOTMAIL.COM
	Phone number(s): CELL (970) 630-3662	
	HOME (970) 848-0353	

Certified Well Testers (South Platte River Ground Water)

AGRO ENGINEERING (LORENZ, JASON)	Address: 0210 ROAD 2 S ALAMOSA, CO 81101 Phone number(s): BUSINESS (719) 852-4957 BUSINESS FAX (719) 852-5146 CELL (719) 850-4011	E-mail JASON@AGRO.COM
ALLENBAUGH, JEREMY	Address: 265 BELLOWS DRV. HARTSEL, CO 80449 Phone number(s): BUSINESS (303) 588-1732	E-mail SNOWMOUNTAINDESIGNSTUDIO@GMAIL.COM
ARCHULETA, CHRIS	Address: 530 N ILIFF DRIVE PUEBLO, CO 81007 Phone number(s): CELL (719) 423-9945	E-mail C.ARCHULETA18@GMAIL.COM
CCI, LLC (RUSCH, JOHN R.)	Address: 14267 MORGAN COUNTY ROAD 17 FT MORGAN, CO 80701 Phone number(s): HOME (970) 768-4032	E-mail JRRUSCHLT@FLCI.NET
CHAPMAN, DON	Address: 34272 COUNTY ROAD X HILLROSE, CO 80733 Phone number(s): BUSINESS (970) 768-4228 HOME (970) 847-3417	E-mail DC@RIVID.ORG
CITY OF BRIGHTON (LOWE, PERRY)	Address: 4350 BROMEY LANE BRIGHTON, CO 80601 Phone number(s): BUSINESS (303) 655-2100	E-mail PLOWE@BRIGHTONCO.GOV
COLORADO WATER WELL (DEA, THOMAS)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 882-3749 BUSINESS (303) 892-9053	E-mail TOM@COLORADOWATERWELL.COM
COLORADO WATER WELL (HULL, DAVID)	Address: 2001 EAST 58TH AVENUE DENVER, CO 80216 Phone number(s): BUSINESS (303) 435-4530	E-mail DAVID@COLORADOWATERWELL.COM
CURE, TONY	Address: 1466 PLAINS DRIVE EATON, CO 80615 Phone number(s): BUSINESS (970) 353-3118 CELL (970) 889-0112	E-mail TONYWCURE@GMAIL.COM
DANIEL, DEB	Address: 48575 COUNTY ROAD X BURLINGTON, CO 80807 Phone number(s): BUSINESS (719) 346-8269 CELL (719) 342-9492	E-mail DEBI.DANIEL57@GMAIL.COM
DODSWORTH FAMILY FARMS, INC. (DODSWORTH, DUAINÉ)	Address: 29034 COUNTY ROAD 30 WRAY, CO 80758 Phone number(s): BUSINESS (970) 630-1242	E-mail DODSWORTHX8@GMAIL.COM
FIELD WELL TESTING (SCHOLEFIELD, SHANNON)	Address: 621 SOUTH COLUMBUS STREET YUMA, CO 80759 Phone number(s): BUSINESS (970) 630-1740	E-mail FIELDWELLTESTING@YAHOO.COM
G & L SERVICES (FRAME, LARRY)	Address: 14256 CR 9 SEDGWICK, CO 80749 Phone number(s): CELL (970) 520-3347	E-mail LARRYFRAME1@YAHOO.COM
G AND L SERVICES (BOMAN, GAYLENE)	Address: 14256 CR 9 SEDGWICK, CO 80749 Phone number(s): BUSINESS (970) 466-0357	E-mail GAYLENEMAIL@GMAIL.COM
GRIFFITH INC. (GRIFFITH, SHAWN R.)	Address: 3299 STATE HWY 91 LEADVILLE, CO 80461 Phone number(s): BUSINESS (719) 486-1517 BUSINESS FAX (719) 486-1517	E-mail griffithinc@hotmail.com

Certified Well Testers (South Platte River Ground Water)

HARRY MARSHALL CONSULTANT (MARSHALL, HARRY)	Address: 220 W. HARGREAVES HOLYOKE, CO 80734 Phone number(s): BUSINESS (970) 854-3489 BUSINESS (970) 520-1814 BUSINESS FAX (970) 854-3489 CELL (970) 520-1814	E-mail HMARSHALL61242@GMAIL.COM
HELTON & WILLIAMSEN (OLSON, ANDERS)	Address: 384 INVERNESS PARKWAY SUITE 144 ENGLEWOOD, CO 8011 Phone number(s): BUSINESS (303) 792-2161 CELL (303) 870-7513	E-mail AOLSON@HELTON-WILLIAMSEN.COM
HRS WATER CONSULTANTS (POLMANTEER, REID)	Address: 8885 WEST 14TH AVENUE LAKEWOOD, CO 80215 Phone number(s): HOME (303) 462-1111	E-mail RPOLMANTEER@HRSWATER.COM
JEHN WATER CONSULTANTS, INC. (BANKS, HILLARY)	Address: 88 INVERNESS CIRCLE EAST, K-102 CENTENNIAL, CO 80112 Phone number(s): BUSINESS (303) 321-8335	E-mail HBANKS@JEHNWATER.COM
KARG, ROBERT A & ELISSA M	Address: 4405 CR 31 ATWOOD, CO 80722 Phone number(s): BUSINESS FAX (970) 522-0847 CELL (970) 520-1876	E-mail ELISSA_KARG@YAHOO.COM
LOWER LATHAM RESERVOIR CO. (YAGO, KEITH)	Address: 1508 4TH AVENUE GREELEY, CO 80631 Phone number(s): BUSINESS (970) 353-6611 BUSINESS FAX (970) 352-8866 CELL (970) 396-9651	E-mail KEITH.YAGO@GMAIL.COM
MCKINLEY, KYLIE	Address: 88 INVERNESS CIRCLE EAST, K-102 CENTENNIAL, CO 80112 Phone number(s): BUSINESS (303) 321-8335	E-mail KYLIE.MCKINLEY33@GMAIL.COM
MIDCAP METER CERT (MIDCAP, NATE)	Address: PO BOX 402 WRAY, CO 80758 Phone number(s): BUSINESS (970) 467-7625 HOME (970) 774-6114	E-mail MIDCAPMETERCERT@YAHOO.COM
QUALITY IRRIGATION (BJORLIN, WESTON)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115 CELL (970) 630-2269	E-mail QUALITYWELLTESTER@YAHOO.COM
QUALITY IRRIGATION (HANSEN, JOSEPH)	Address: PO BOX 459 YUMA, CO 80759 Phone number(s): BUSINESS (970) 630-3303 HOME (970) 848-3846	E-mail JOSEPHKANEHANSEN@GMAIL.COM
QUALITY IRRIGATION (IRWIN, JANELLE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail JANELLE@QUALITYIRRIGATION.COM
QUALITY IRRIGATION (MOLINA, MELVIN)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail MRMOLINAM@YAHOO.COM
QUALITY IRRIGATION (WAGNER, EUGENE)	Address: PO BOX 420 YUMA, CO 80759 Phone number(s): BUSINESS (970) 848-3846 BUSINESS FAX (970) 848-5115	E-mail GENEW@QUALITYIRRIGATION.COM

Certified Well Testers (South Platte River Ground Water)

QUALITY IRRIGATION (ZIMMERMAN, BRANDON)	Address: 40009 CR C YUMA, CO 80759	E-mail BZIMMERMAN84@GMAIL.COM
	Phone number(s): BUSINESS (970) 848-3846	
	BUSINESS (940) 297-9436	
	BUSINESS FAX (970) 848-5115	
<hr/>		
QUALITY WELL & PUMP (CERRILLO, FIDEL)	Address: 39525 HIGHWAY 85 AULT, CO 80610	E-mail TURBINE@QUALITYWELLANDPUMP.COM
	Phone number(s): HOME (970) 353-3118	
<hr/>		
RICHARDS' WELL CALIBRATIONS (RICHARDS, DAN)	Address: PO BOX 21 EADS, CO 81036	E-mail RICHWATER7@GMAIL.COM
	Phone number(s): BUSINESS (719) 688-5451	
	BUSINESS FAX (719) 438-5842	
<hr/>		
RIDNOUR, DEVIN J.	Address: 29550 COUNTY ROAD 35 WRAY, CO 80758	E-mail RIDNOURDT@GMAIL.COM
	Phone number(s): BUSINESS (970) 630-1120	
<hr/>		
WATER WELL WIZARDS, LLC (DASH, RUSSELL)	Address: 2411 N GREENWOOD PUEBLO, CO 81003	E-mail RGDASH@MSN.COM
	Phone number(s): BUSINESS (719) 562-9801	

APPENDIX D

FLOODPLAIN USE PERMIT



City Development

9500 Civic Center Drive, Thornton, CO 80229

Phone: (303) 538-7295

developmentsubmittals@cityofthornton.net

PERMIT #:
CV #:

Floodplain Development Permit

All shaded areas to be completed by the City of Thornton

PROJECT NAME (SUBDIVISION, FILING, LOT, BLOCK, and PHASE As Applicable):

PARCEL #(S):

PROJECT LOCATION (ADDRESS/INTERSECTION):

PROJECT OWNER

PROPERTY OWNER NAME:

TITLE:

PHONE:

EMERGENCY PHONE:

ADDRESS, CITY, STATE, ZIP:

CONSULTING ENGINEER

CONTACT NAME (Responsible P.E.):

COMPANY:

PHONE:

EMERGENCY PHONE:

COMPANY ADDRESS, CITY, STATE, ZIP:

CONTRACTOR

NAME:

COMPANY:

PHONE:

EMERGENCY PHONE:

ADDRESS, CITY, STATE, ZIP:

ADDITIONAL LICENSED SUBCONTRACTORS:

FLOODPLAIN / FLOOD HAZARD INFORMATION

FLOODPLAIN NAME:

PROJECT LOCATION: FLOOD FRINGE FLOODWAY (If floodway, submit Engineer's report addressing standards set forth in CFR 60.3(d)(3))

FLOODPLAIN (If no floodway is established, submit Engineer's report certifying no rise greater than 0.50-feet and no impact to existing structures)

FLOODPLAIN DESIGNATION: FEMA FHAD OTHER (Specify):

FEMA ZONES (If applicable): A AE AH AO X X (Shaded)

BASE (100-YR) FLOOD ELEVATION: (TYPICAL - Elevations to be based on NAVD 1988) _____

FREEBOARD REQUIRED: (If no BFE is established, see 18-642(d)) _____

SOURCE (FIRM MAP #, UDFCD OSP/MASTERPLAN, OTHER - Specify):

LOWEST FLOOR ELEVATION: (Including basements) _____

ELEVATION REQUIRED FOR FLOODPROOFING: _____

TYPE OF WORK

- Temporary
- Permanent
- Rehabilitation
- Maintenance
- Emergency Repair
- Other

DISCRPTION OF WORK* *(Check & complete all that apply)*

All work shall be in accordance within the most current City of Thornton Municipal Code and Standards and Specifications for Public and Private Improvements

- | | | |
|--|--|---|
| <input type="checkbox"/> RESIDENTIAL - DEVELOPMENT/IMPROVMENTS | <input type="checkbox"/> DRAINAGEWAY STABILIZATION/IMPROVMENTS | <input type="checkbox"/> CHANGE IN USE |
| <input type="checkbox"/> NON-RESIDENTIAL - DEVELOPMENT/IMPORVEMENTS | <input type="checkbox"/> CHANNEL MAINTENANCE | <input type="checkbox"/> PARKS / OPEN SPACE |
| <input type="checkbox"/> GOVERNMENT AGENCY - CAPITAL IMPROVEMENTS | <input type="checkbox"/> SEDIMENT REMOVAL | <input type="checkbox"/> PLAYGROUND |
| <input type="checkbox"/> GRADING | <input type="checkbox"/> BRIDGE/UNDERPASS/CULVERT | <input type="checkbox"/> SHELTER/ENCLOSURE |
| <input type="checkbox"/> CUT <input type="checkbox"/> FILL | <input type="checkbox"/> TRAIL CONSTRUCTION | <input type="checkbox"/> NEW STRUCTURE |
| <input type="checkbox"/> UTILITY/PIPE INSTALL | <input type="checkbox"/> LOW WATER CROSSING | <input type="checkbox"/> STRUCTURE ADDITION |
| <input type="checkbox"/> BORE <input type="checkbox"/> TRENCH <input type="checkbox"/> OUTFALL | <input type="checkbox"/> PEDESTRIAN BRIDGE | <input type="checkbox"/> STRUCTURE REMODEL |
| <input type="checkbox"/> OTHER: _____ | | |

APPLICATION SUBMITTALS *(Include with permit application)*

ALL APPLICATIONS:

- | | |
|--|---|
| <input type="checkbox"/> VICINITY MAP | <input type="checkbox"/> FLOODPLAIN IMPACT LETTER <i>(Narrative w/ description of work, impacts, mitigation, & other)</i> |
| <input type="checkbox"/> PLAN SHEETS <i>(Applicable sheets ONLY)</i> | <input type="checkbox"/> PE CERTIFICATION |
| <input type="checkbox"/> CONSTRUCTION DRAWINGS "CDs" | <input type="checkbox"/> FINAL DRAINAGE REPORT/LETTER |
| <input type="checkbox"/> SITE PLAN/SKETCH <i>(Only if CDs N/A)</i> | <input type="checkbox"/> FLOODPLAIN MAP(S) <i>(Appropriate project limits identified)</i> |

AS APPLICABLE:

- | | | |
|---|--|--|
| <input type="checkbox"/> CERTIFICATION OF NO IMPACT | <input type="checkbox"/> FLOODPLAIN ANALYSIS | <input type="checkbox"/> EASEMENTS/AGREEMENT(S) <i>(w/ legal descriptions)</i> |
| <input type="checkbox"/> NO RISE CERTIFICATION | <input type="checkbox"/> FLOODPLAIN MODIFICATION STUDY | <input type="checkbox"/> URBAN DRAINAGE APPROVAL LETTER |
| <input type="checkbox"/> FILL CERTIFICATE | <input type="checkbox"/> CLOMR/LOMR | <input type="checkbox"/> APPROVED 404 PERMIT |
| <input type="checkbox"/> FLOODPLAIN/ELEVATION CERTIFICATE | <input type="checkbox"/> X-SECTIONS | <input type="checkbox"/> ADDITIONAL PERMITS <i>(CDOT, other)</i> |
| <input type="checkbox"/> CONSTRUCTION STAGING AREAS | <input type="checkbox"/> MATERIAL STORAGE AREAS | |
| <input type="checkbox"/> OTHER: _____ | | |

COMMENTS / SPECIAL CONDITIONS

COMPLIANCE PRE-CONSTRUCTION POST-CONSTRUCTION

GENERAL PROVISIONS

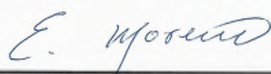
The Floodplain Development Permit (FDP) is the mechanism the City of Thornton utilizes to evaluate any and all impacts of activities proposed in the City's floodplains. A FDP is required for any development proposed in the floodplain. All activities must be in compliance with the FEMA National Flood Insurance Program (NFIP) regulations, the City of Thornton Municipal Code, and the City of Thornton Standards & Specifications for Public and Private Improvements (Standards & Specifications). The following constitute the instructions for completion, and the terms and conditions that must be met. The applicant acknowledges receipt of these General Provisions and the availability of the Standards & Specifications as the standard for engineering plans and source documentation.

1. Most of the City's floodplains have been delineated on the NFIP Flood Insurance Rate Maps (FIRMs) or on Flood Hazard Area Delineation (FHAD) reports produced with the Urban Drainage and Flood Control District (UDFCD). Where a FHAD has been adopted by the CWCB subsequent to the effective FIRM date, the more restrictive shall be used.
2. For areas where floodplain delineations have not been documented, it's the applicant's responsibility to delineate the floodplain. The Floodplain Administrator will be responsible for approving the delineation.
3. In general, all activities in the floodplain, regardless of impact need to be permitted. FDPs are required for any proposed activity within the above defined floodplains.
4. The FDP must be approved by the Floodplain Administrator prior to any activity occurring.
 - Land Development Cases. When the floodplain activity is associated with a land development proposal, approval of the FDP shall be required along with approval of the Construction Permit.
 - Stand-Alone Cases. All other activities that require a FDP and are not related to other City reviewed development cases will be submitted directly to the Floodplain Administrator prior to any proposed activity occurring.
5. Any activities being performed in the floodplain without an approved permit shall cease immediately and will not recommence until an approved permit is obtained. City inspectors will utilize the approved floodplain permit and associated plans during all inspection activities.
6. Owner assumes responsibility for engineering, design, construction, and maintenance associated with the permit and represents that any and all local, state, and federal permits required for the project covered by the permit have been acquired.
7. Permits are issued subject to the approval of the city, state, or other governmental agencies having either joint supervision over the property, or authority to regulate land use by means of zoning and/or building regulations.
8. Either contractor or owner must pay any required permit fees. No refunds shall be made on any permit fee.
9. The FDP is valid for a period of 550 calendar days from the date of approval. The permit can also be revoked for cause (including non-compliance with the approved application, City Code, etc.) at any time whereby all work shall cease immediately until a permit is re-issued. Any work not commenced within this time frame, or any cessation of work for more than 20-calendar days following this time frame will require a new FDP based on regulations and mapping in effect at the time of the new application.
10. Contractor or owner shall notify City at least 72 hours prior to construction so that City can inspect any and all activities.
11. The owner shall be responsible for owner's contractor performing all permitted work in strict compliance with all documents submitted to the City. Failure to do so will result in the City issuing a Stop Work Order.
12. If owner or owner's contractor abandons the permitted work prior to its scheduled completion or fails or refuses to properly complete the same, the City of Thornton may, in its discretion, issue a summons and complaint requiring the owner to appear in Thornton Municipal Court. A conviction could include fines and/or jail.
13. In addition to the remedies set forth above for failure to complete the permitted work, the City of Thornton may seek a court order directing the owner to promptly complete the permitted work or restore the affected property to its condition prior to the work beginning, failing that, the City of Thornton may seek a money judgment for the cost of one of them completing the permitted work or restoring the affected property to its condition prior to the work beginning.

APPLICANT'S ACCEPTANCE OF TERM & CONDITIONS


To the best of my/our knowledge, the information provided herein is correct. Further, I have read this permit and I accept the terms and conditions listed. I understand that this permit is granted under the terms and conditions listed therein, the special terms and conditions, and the General Provisions listed below. I understand that this approval is based on the adherence to the approved construction plans, the current City of Thornton Municipal Code, the Standard and Specifications for Public and Private Improvements, and State and Federal laws and regulations. Any approval obtained from the City does not alleviate my/our need to fully comply with the requirements any other applicable federal, state, or local laws or regulations.

OWNER (Printed Name):
Eduardo Moreno

SIGNATURE: 

DATE:
06/08/2020

ENGINEER OF RECORD (Printed Name):


SIGNATURE: 

DATE:
5/20/20

CONTRACTOR (Printed Name):

SIGNATURE:

DATE:

PERMIT FEE \$600.00

PAYMENT RECEIVED

NA CIP #20-062

DATE: 6/8/2020

PERMIT APPROVED - *The information submitted for the proposed project was reviewed and is in compliance with approved floodplain management standards.*

PERMIT DENIED - *The proposed project does not meet approved flood plain management standards (explanation is attached).*

CLOMR/LOMR FILE #: _____ N/A

FLOODPLAIN ADMINISTRATOR SIGNATURE:

DATE: 06/10/2020

May 19, 2020

Mr. Eduardo Moreno
City of Thornton
9500 Civic Center Drive
Thornton, CO 80299

Subject: City of Thornton Project CIP #20-062 West Cooley Alluvial Wells – Rehabilitation Project, No Rise Certification, Thornton, Colorado

Dear Mr. Moreno,

DEERE & AULT, A SCHNABEL ENGINEERING COMPANY has evaluated the potential impact to the floodway that could result from the proposed alluvial well rehabilitation project. This project lies within the floodway of the South Platte River as mapped on FIRM panels 08001C0318H and 08001C0606H dated 03/05/2007 (see attached FIRMette).

The above grade obstruction consists of four flowmeter vaults that extend above existing grade. Vaults for wells 1, 3, 4, and 5 extend above grade an average of 0.56', 0.36', 0.35', and 0.17', respectively. Three of these meter vaults (for wells 1, 3, and 4) have an obstruction footprint of 8'x7' and one vault (for well 5) has a footprint of 9'x9.25'. In the direction of overbank flood flows, the flow obstructions caused by these vaults are 4.48 ft², 2.88 ft², and 2.80 ft² (8' width times heights of 0.56', 0.36', and 0.35') for the three 8'x7' vaults and 1.53 ft² (9' width times 0.17' height) for the 9'x9.25' vault.

The additional flow obstruction at a meter vault caused by bollards and Unistrut electrical pedestals¹ is a maximum of 1.95 ft². This is a very conservative blockage assumption because the bollards and Unistrut pedestals do not extend for the full length of the vaults. The meter vault, bollard, and Unistrut dimensions are shown on select pages from the plan set as an attachment.

Based on the April 2005 Flood Hazard Area Delineation (FHAD)² for this reach of the South Platte River, the 0.5' floodway for cross sections in the vicinity of the meter vaults has an average velocity ranging from

¹ Each bollard has a diameter of 5.5" and the Unistrut has a width of 3.125". Considering two bollards and the Unistrut totaling 1.18' and a maximum flow depth of 1.66' at the vault for well 5, the maximum additional flow obstruction is 1.95 ft².

² Select pages from the FHAD are provided as an attachment.

Mr. Eduardo Moreno
West Cooley Alluvial Wells – Rehabilitation Project

3.2 to 4.3 feet per second. At a 100-year flow rate of 36,400 cfs, this velocity range equates to a conveyance area ranging from 8,500 to 11,400 ft². The flow obstruction caused by the largest of the vaults plus the bollards and Unistrut pedestal totals 6.43 ft² which is approximately 0.06 to 0.08 percent of the floodway conveyance area in this reach and occurs over a combined vault length of 30.25 feet along the river orientation.

An additional factor of note is that a bi-directional spillway between the West Cooley Reservoir South Cell and the South Platte River has recently been completed immediately downstream of this well rehabilitation site. The construction of this spillway removed approximately 3 feet of soil for a length of approximately 150 feet which adds 450 ft² of conveyance to the floodway. The 0.5' floodway for cross sections in the vicinity of the spillway has an average velocity ranging from 3.4 to 3.7 feet per second. At a 100-year flow rate of 36,400 cfs, this velocity range equates to a conveyance area ranging from 9,800 to 10,700 ft². This added conveyance due to the spillway excavation is approximately 4 percent of the floodway conveyance area and occurs over a river distance of approximately 300 feet.

The four vaults will cause a minor flow obstruction on the order of 0.06 to 0.08 percent of the floodway conveyance area for 30 feet along the river. This alone should be justification for a No-Rise Certification. However, paired with the fact that the recent spillway construction immediately downstream of the vaults has increased the floodway conveyance area on the order of 4 percent for 300 feet along the river, the effect of these offsetting modifications should result in a net decrease in the floodway elevations throughout the subject reach. Therefore, a No-Rise Certification for the meter vaults is justified.

We appreciate the opportunity to be of service for this project. Please contact me if you have any questions or comments regarding this No-Rise Certification.

Sincerely,

DEERE & AULT, A SCHNABEL ENGINEERING COMPANY

Mark A. Severin, P.E.
Principal

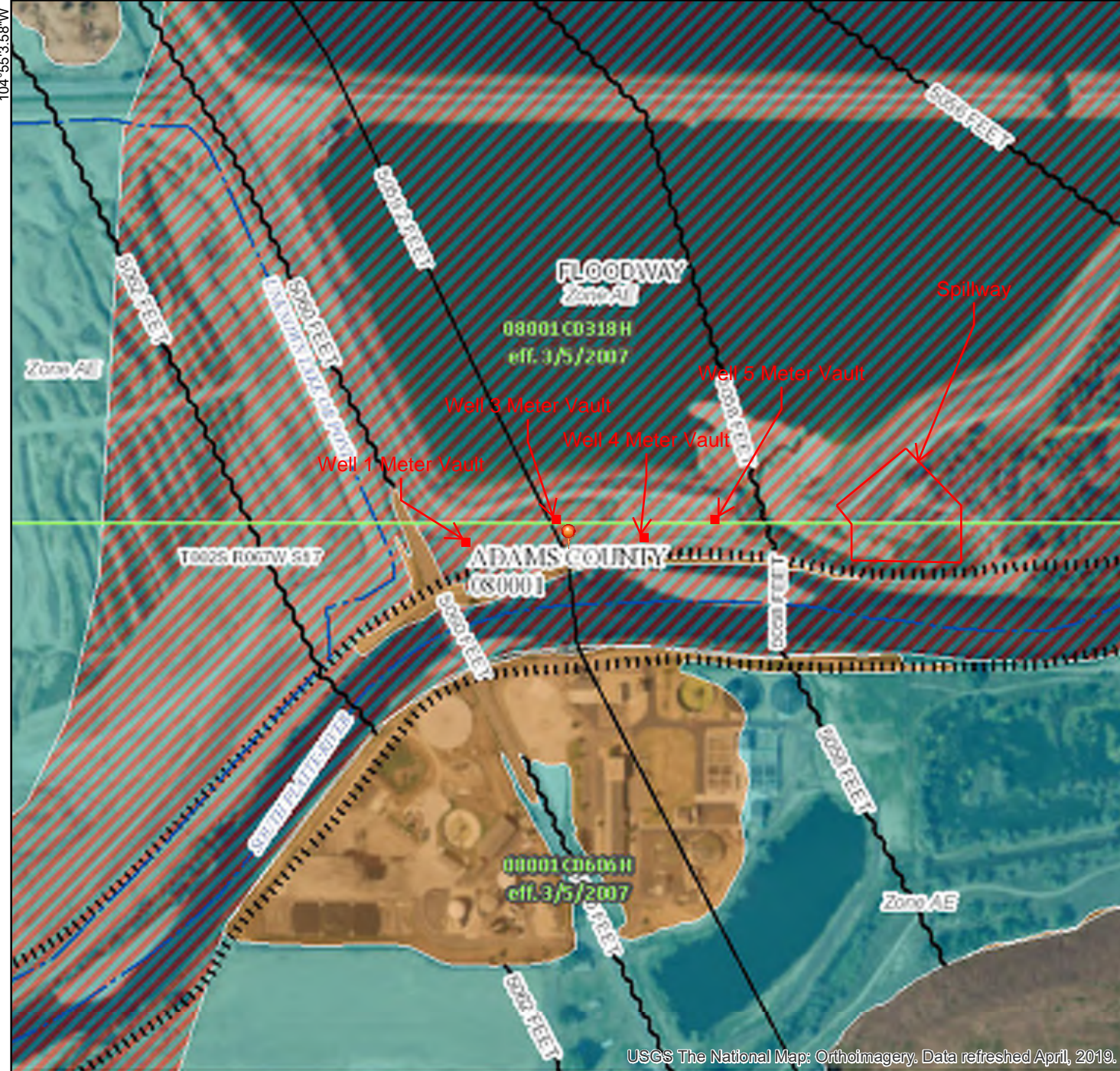
Attachments

MAS

National Flood Hazard Layer FIRMMette



39°52'43.45"N



104°55'3.58"W

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- | | | |
|-----------------------------|--|--|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE)
<i>Zone A, V, A99</i> |
| | | With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i> |
| | | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i> |
| | | Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i> |
| | | Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i> |
| | | Area with Flood Risk due to Levee <i>Zone D</i> |
| OTHER AREAS | | NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i> |
| | | Effective LOMRs |
| GENERAL STRUCTURES | | Area of Undetermined Flood Hazard <i>Zone D</i> |
| | | Channel, Culvert, or Storm Sewer |
| OTHER FEATURES | | Levee, Dike, or Floodwall |
| | | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation |
| MAP PANELS | | 17.5 Coastal Transect |
| | | Base Flood Elevation Line (BFE) |
| | | Limit of Study |
| | | Jurisdiction Boundary |
| | | Coastal Transect Baseline |
| | | Profile Baseline |
| | | Hydrographic Feature |
| | | Digital Data Available |
| | | No Digital Data Available |
| | | Unmapped |



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/15/2020 at 5:05:19 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

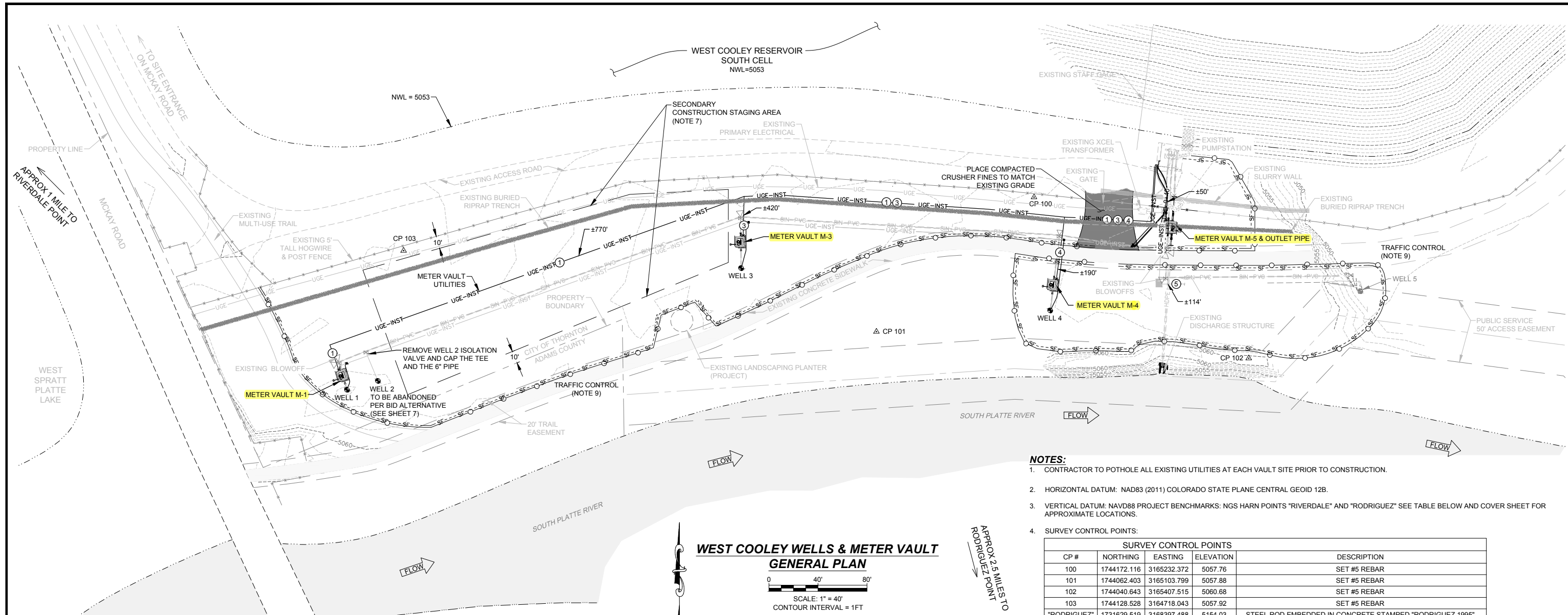
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

USGS The National Map: Orthoimagery. Data refreshed April, 2019.



39°52'15.84"N

104°54'26.13"W

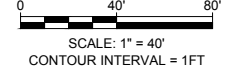


- NOTES:**
- CONTRACTOR TO POT HOLE ALL EXISTING UTILITIES AT EACH VAULT SITE PRIOR TO CONSTRUCTION.
 - HORIZONTAL DATUM: NAD83 (2011) COLORADO STATE PLANE CENTRAL GEOID 12B.
 - VERTICAL DATUM: NAVD88 PROJECT BENCHMARKS: NGS HARN POINTS "RIVERDALE" AND "RODRIGUEZ" SEE TABLE BELOW AND COVER SHEET FOR APPROXIMATE LOCATIONS.
 - SURVEY CONTROL POINTS:

SURVEY CONTROL POINTS				
CP #	NORTHING	EASTING	ELEVATION	DESCRIPTION
100	1744172.116	3165232.372	5057.76	SET #5 REBAR
101	1744062.403	3165103.799	5057.88	SET #5 REBAR
102	1744040.643	3165407.515	5060.68	SET #5 REBAR
103	1744128.528	3164718.043	5057.92	SET #5 REBAR
"RODRIGUEZ"	1731629.519	3168397.488	5154.03	STEEL ROD EMBEDDED IN CONCRETE STAMPED "RODRIGUEZ 1995"
"RIVERDALE"	1747766.622	3160875.032	5100.29	STEEL ROD EMBEDDED IN CONCRETE STAMPED "RIVERDALE 1995"

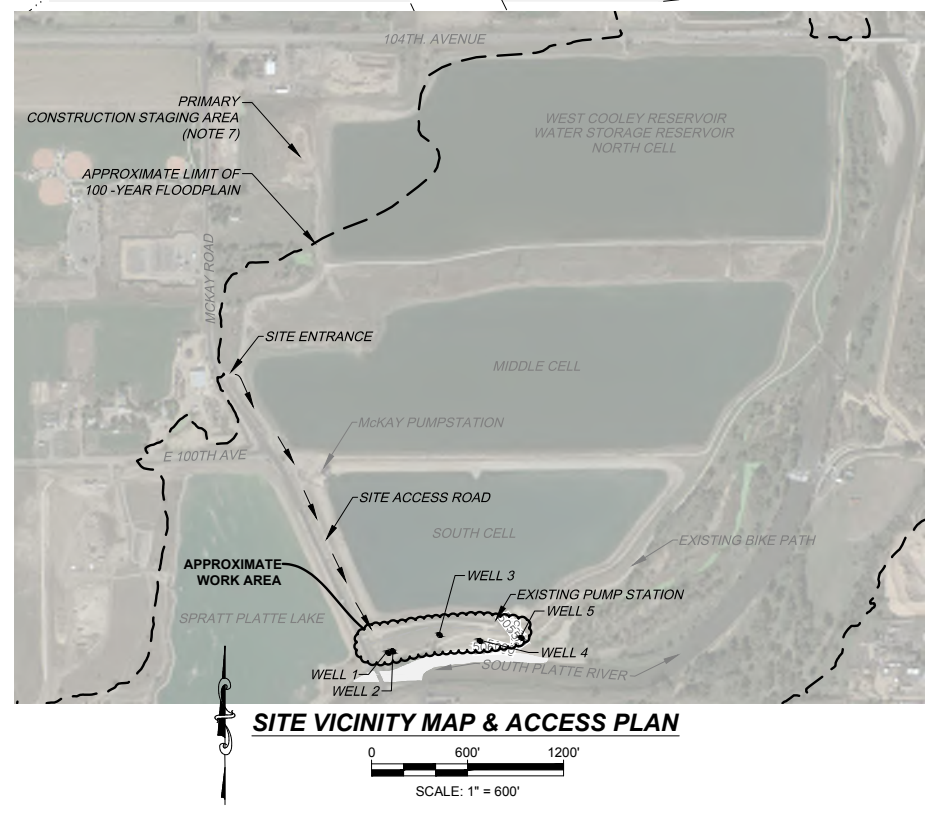
- FIELD SURVEY WORK COMPLETED BY SURVEY SYSTEMS INC, IN MARCH 2014.
- ALL DISTANCES AND COORDINATES SHOWN IN NAD83 (2011) COLORADO STATE PLANE CENTRAL GEOID 12B.
- THE PROJECT AREA IS LOCATED DIRECTLY ALONG AND WITHIN THE FLOODWAY AND FLOODPLAIN LIMITS OF THE SOUTH PLATTE RIVER. THE PROJECT AREA IS SUBJECT TO FLOODING RESULTING FROM AREA PRECIPITATION OR SNOW MELT RUNOFF. THE CONTRACTOR SHOULD BE AWARE OF POTENTIAL FLOODING EVENTS ALONG THE SOUTH PLATTE RIVER, PARTICULARLY WHEN LEAVING EQUIPMENT UNATTENDED. CONTRACTOR SHALL COMPLY WITH THE PROJECT FLOODPLAIN DEVELOPMENT PERMIT. THIS INCLUDES STAGING CONSTRUCTION OFFICE TRAILERS AND PARKED EQUIPMENT OUTSIDE OF THE FLOODPLAIN IN THE PRIMARY CONSTRUCTION STAGING AREA SHOWN ON THE SITE VICINITY MAP (THIS SHEET). THE SECONDARY CONSTRUCTION STAGING AREA MAY BE USED TO STAGE CONSTRUCTION ACTIVITIES AND TO STORE INERT MATERIALS THAT HAVE NO POTENTIAL TO CONTAMINATE SURFACE WATER DURING FLOODING.
- CONTRACTOR SHALL MINIMIZE AREAS OF DISTURBANCE AND SHALL NOT UNNECESSARILY DISTURB ESTABLISHED VEGETATION, ROADS, OR OTHER SITE INFRASTRUCTURE. CONTRACTOR SHALL EMPLOY BEST MANAGEMENT PRACTICES FOR EROSION CONTROL IN DISTURBED AREAS AND ACROSS THE SITE. SEE SHEET 8 FOR EROSION CONTROL PLAN.
- CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN FOR THE EXISTING TRAIL THROUGH THE CONSTRUCTION SITE. SEE SHEET 8.
- EXISTING PROPERTY LINE AND EASEMENT BOUNDARIES TAKEN FROM OCT 27, 2006 ALTA/ACSM LAND TITLE SURVEY. PROPERTY LINES AND EASEMENTS SHOWN ARE APPROXIMATE.
- EXCESS SOIL MATERIAL FROM SITE WORK SHALL BE DISPOSED OF OFFSITE.
- CONTRACTOR IS NOT ALLOWED TO STORE ANY FUEL, PAINT, OR ANY OTHER MATERIAL THAT CAN BE CONSIDERED A POLLUTANT OR MAY CAUSE CONTAMINATION TO GROUND WATER OR TO THE ADJACENT WATER RESERVOIR. NO EXCEPTIONS WILL BE GRANTED.
- CONSTRUCTION ACCESS TO SITE SHALL BE FROM CITY OF THORNTON ACCESS ROAD ENTRANCE FROM MCKAY ROAD.
- LOCATIONS OF SOME EXISTING FEATURES (SUCH AS PUMP STATION, SIDEWALK, FENCING AND UTILITY LINES BETWEEN WELLS) APPROXIMATED FROM OCT. 2003 CONSTRUCTION DRAWINGS TITLED "SOUTH PLATTE RESERVOIR PROJECT"

**WEST COOLEY WELLS & METER VAULT
GENERAL PLAN**

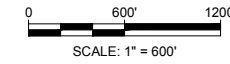


LEGEND:

- WELL 1
- ⊗ EXISTING WEST COOLEY ALLUVIAL WELLS. INSTALL NEW PUMP ASSEMBLIES PER SHEET 7.
- ⊗ EXISTING 6" DIA. ISOLATION VALVES
- ⊗ EXISTING 2" BLOWOFF VALVE
- △ EXISTING THRUST BLOCK
- △ CONTROL POINT
- EXISTING MINOR CONTOURS
- EXISTING MAJOR CONTOURS
- EXISTING PROPERTY LINE
- EXISTING EASEMENTS
- EXISTING FENCE
- UGE-INST EXISTING UNDERGROUND ELECTRICAL AND INSTRUMENTATION WIRE FOR WELL TRANSDUCER. EACH ARE IN A SEPARATE 1" DIA. PVC CONDUIT
- ①③ UGE-INST PROPOSED UNDERGROUND ELECTRICAL AND INSTRUMENTATION WIRE FOR WELL TRANSDUCER WELL IDS ARE CIRCLED.
- UGE EXISTING UNDERGROUND ELECTRIC
- EXISTING WATERLINE
- EXISTING ROADS
- EXISTING BUILDINGS
- BIN-PVC EXISTING GROUNDWATER COLLECTION SYSTEM PVC CLASS 200 CONFORMING TO AWWA C-900 STANDARDS
- HDPE EXISTING RIVER DISCHARGE SYSTEM HDPE PE 3408 IN ACCORDANCE WITH ASTM D3350. PIPE SIZE INCREASES FROM 12IN TO 18IN APPROXIMATELY 64 FEET SOUTH OF EXISTING PUMP STATION
- EXISTING BURIED RIPRAP
- SF- - SF- - SF- - LOCATION OF SILT FENCE
- ○ LOCATION OF ORANGE CONSTRUCTION FENCE.

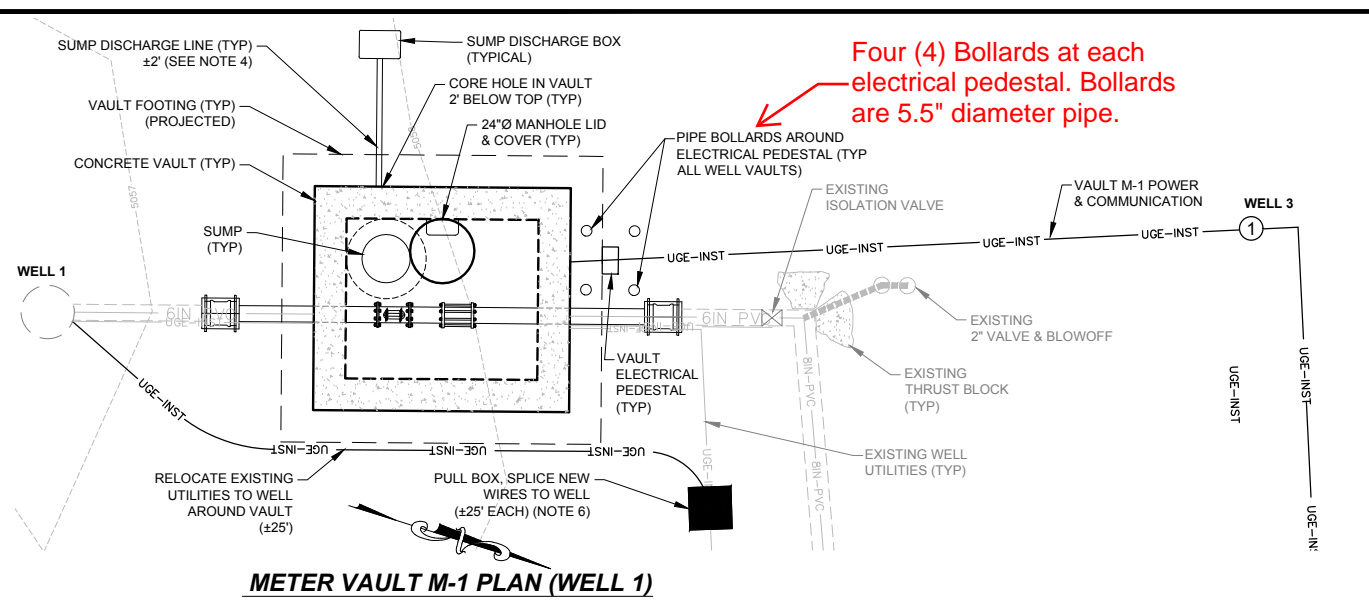


SITE VICINITY MAP & ACCESS PLAN



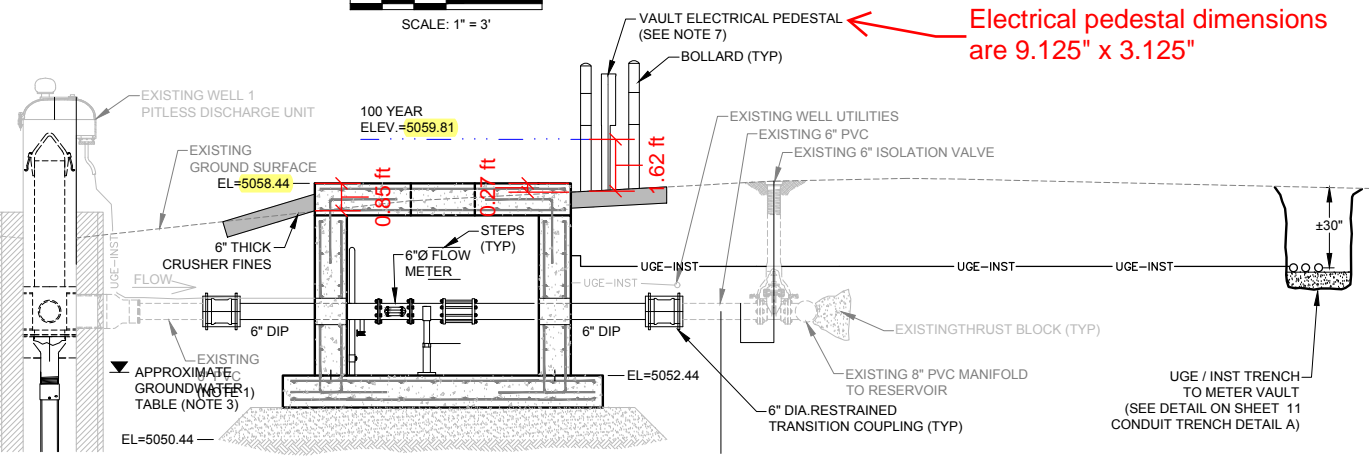
REVISIONS				WEST COOLEY ALLUVIAL WELLS		
NO.	DESCRIPTION	DATE	BY	GENERAL PLAN & SURVEY CONTROL		
1	50% CONSTRUCTION DWGS.	9-17-14	GGC	DEERE & AULT <small>ENGINEERING COMPANY</small> 600 S. AIRPORT RD., BLDG. A, SUITE 205 LONGMONT, CO 80503 TEL. 303.651.1468 FAX 303.651.1469		
2	90% CONSTRUCTION DWGS.	4-1-15	VDW			
3	100% CONSTRUCTION DWGS.	5-29-15	VDW			
4	100% CONSTR. DWGS. WIADCO REV.	6-26-15	VDW			
5	100% CONSTR. DWGS. 2020 REV.	3-3-20	VDW			
DESIGNED BY: VDW				APPROVED BY: GGC	JOB NO.	SHEET:
DRAWN BY: HOG				DATE: 6-26-15	0158.039.03	2
CHECKED BY: VDW				SCALE: AS NOTED		

Monday, May 18, 2020 2:05:53 PM DRAWING: C:\0158 thornton\0158_039_ancs\alluvial wells\CAD\doc drawings\ancs\wells-SURVEY.DWG



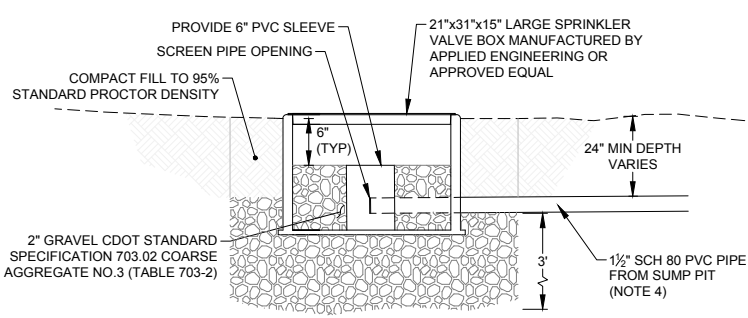
METER VAULT M-1 PLAN (WELL 1)

SCALE: 1" = 3'



METER VAULT M-1 PROFILE (WELL 1)

SCALE: 1" = 3'



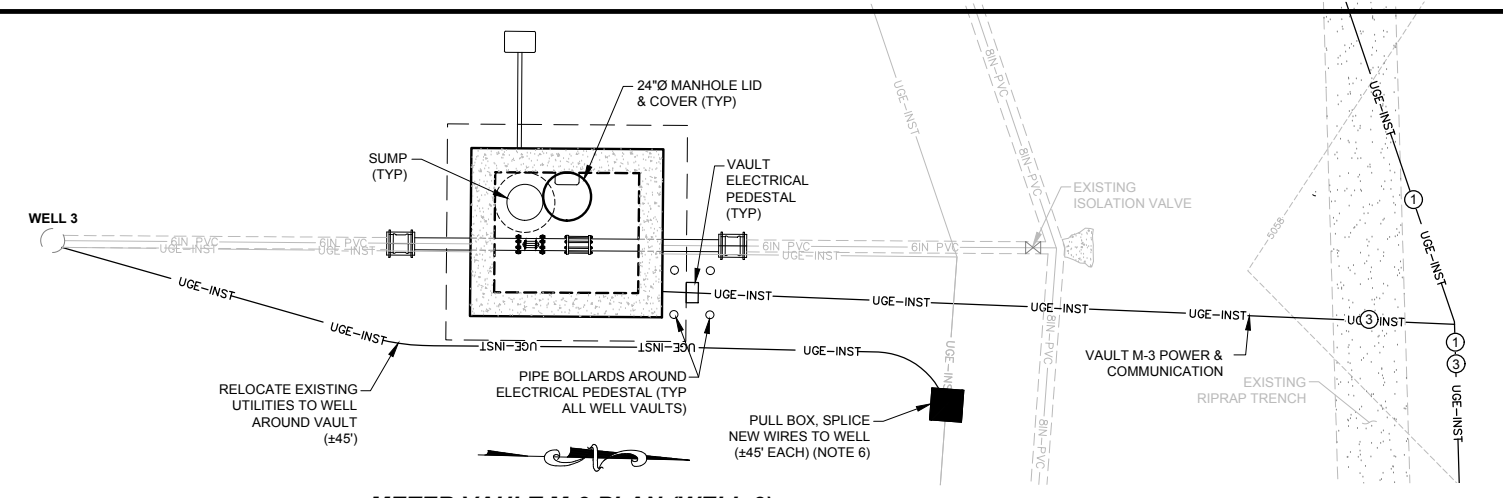
VAULT SUMP PUMP DISCHARGE BOX

SCALE: 1" = 1'

- NOTES:**
- EXISTING WATER LINES WERE LOCATED USING 2013 WELL VIDEO LOGS AND DEPTH MEASUREMENTS TO VALVE NUTS. CONTRACTOR TO CONFIRM DEPTHS OF PIPELINES AT EACH PROPOSED VAULT LOCATION BEFORE CONSTRUCTION OR ORDERING METER VAULTS, AND ASSOCIATED PIPING.
 - METER VAULT DETAILS ARE SHOWN ON SHEET 6.
 - GROUNDWATER LEVELS ARE APPROXIMATE AND MAY FLUCTUATE SEASONALLY. PRE-CONSTRUCTION DEWATERING REQUIRED TO DROP THE WATER TABLE 2' BELOW EXCAVATION LIMIT. EXISTING WELLS EQUIPPED WITH TEMPORARY PUMPS MAY BE USED.
 - SLOPE SUMP DISCHARGE LINES DOWN TO DISCHARGE BOX LOCATE BOX 4FT MIN AWAY FROM VAULT.
 - VAULTS TO BE PRECAST OR CAST-IN-PLACE.
 - ALL SPLICES IN NEW PULL BOXES SHALL BE WATERPROOF.
 - VAULT ELECTRIC PEDISTALS SHALL BE INSTALLED ABOVE THE 100 YEAR FLOOD ELEVATION.

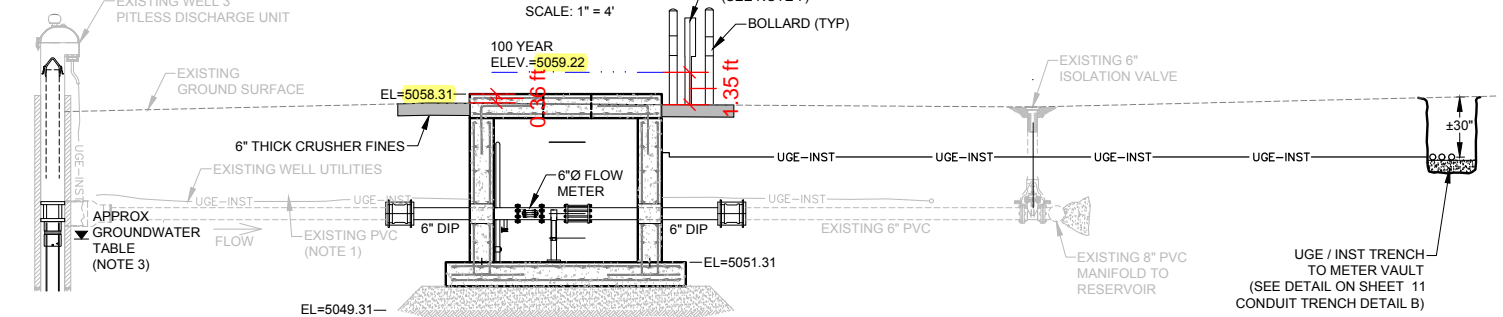
Four (4) Bollards at each electrical pedestal. Bollards are 5.5" diameter pipe.

Electrical pedestal dimensions are 9.125" x 3.125"



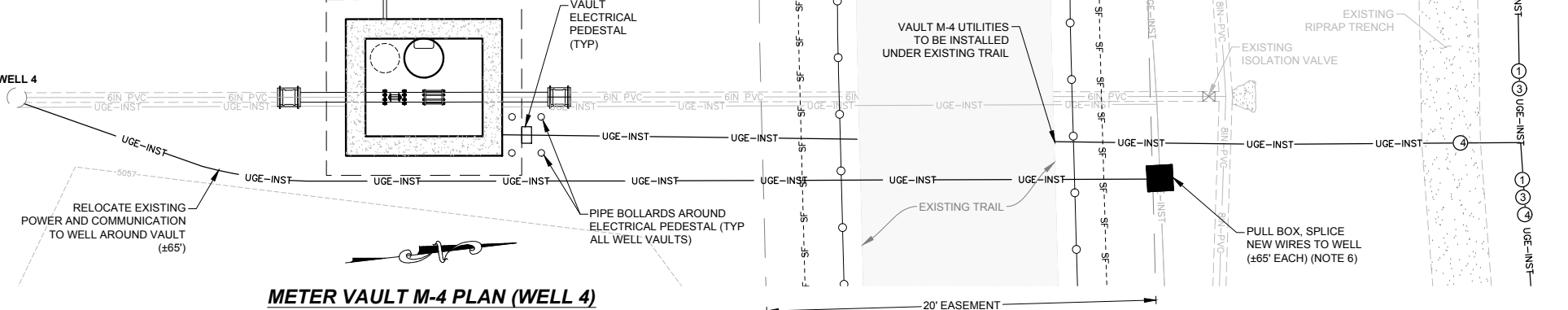
METER VAULT M-3 PLAN (WELL 3)

SCALE: 1" = 4'



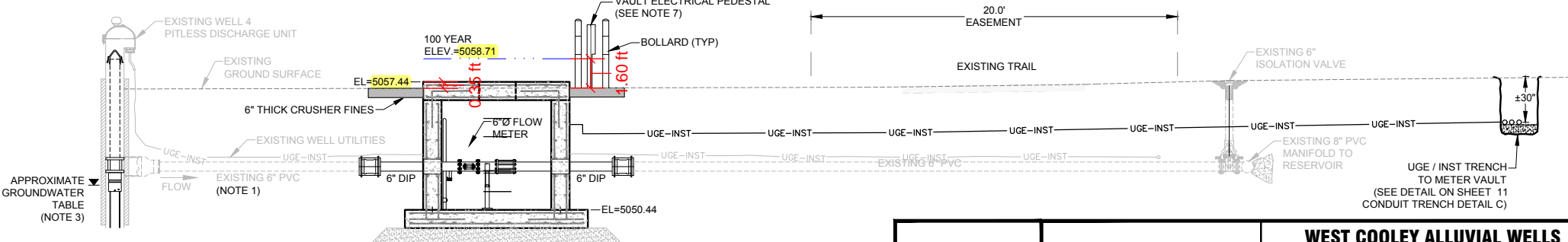
METER VAULT M-3 PROFILE (WELL 3)

SCALE: 1" = 4'



METER VAULT M-4 PLAN (WELL 4)

SCALE: 1" = 4'



METER VAULT M-4 PROFILE (WELL 4)

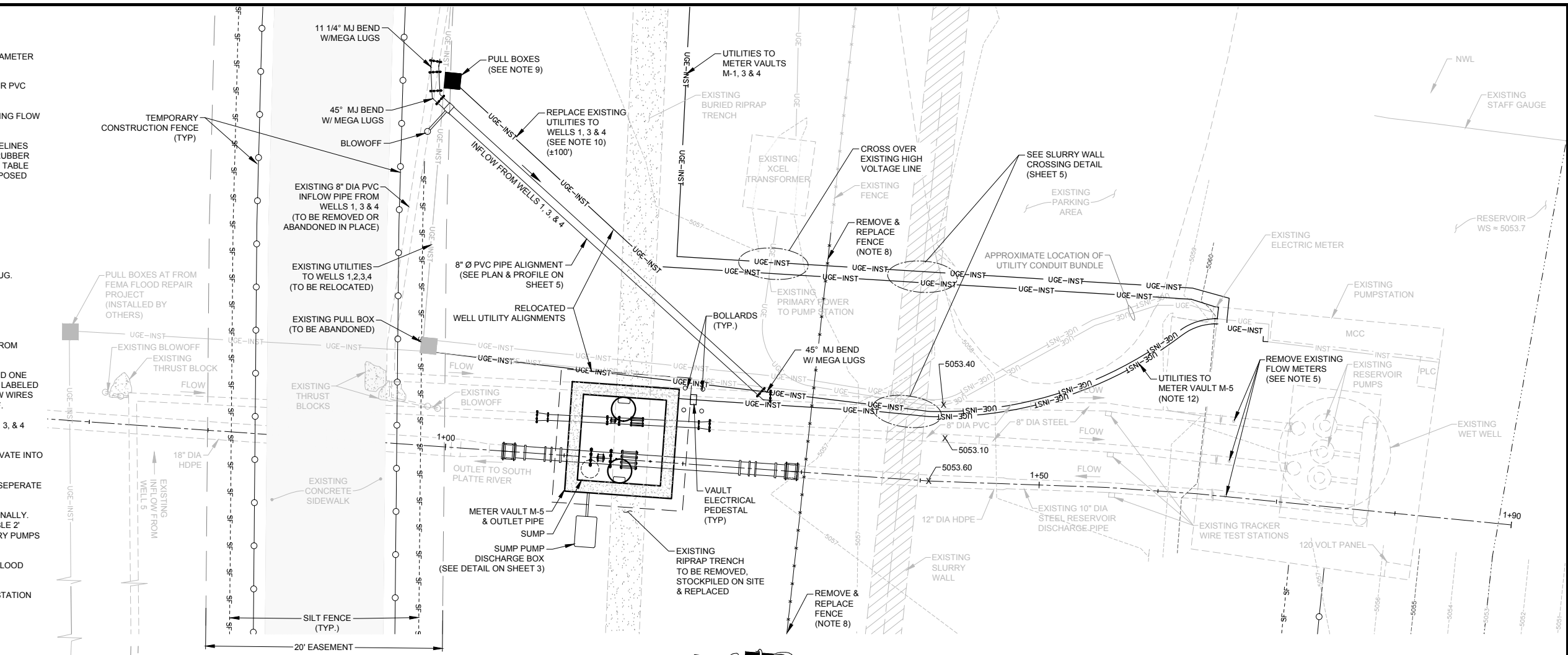
SCALE: 1" = 4'

REVISIONS				WEST COOLEY ALLUVIAL WELLS	
NO.	DESCRIPTION	DATE	BY	METER VAULTS M-1, M-3 & M-4 PLANS & PROFILES	
1	50% CONSTRUCTION DWGS.	9-17-14	GGC	 600 S. AIRPORT RD., BLDG. A, SUITE 205 LONGMONT, CO 80503 TEL 303.651.1468 FAX 303.651.1469	
2	90% CONSTRUCTION DWGS.	4-1-15	VDW		
3	100% CONSTRUCTION DWGS.	5-29-15	VDW		
4	100% CONSTR. DWGS. WIADCO REV.	6-26-15	VDW		
5	100% CONSTR. DWGS. 2020 REV.	3-3-20	VDW		
DESIGNED BY: VDW			APPROVED BY: GGC	JOB NO.	SHEET:
DRAWN BY: HOG			DATE: 6-26-15	0158.039.03	3
CHECKED BY: VDW			SCALE: AS NOTED		

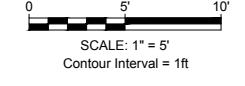
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GENERAL NOTES:

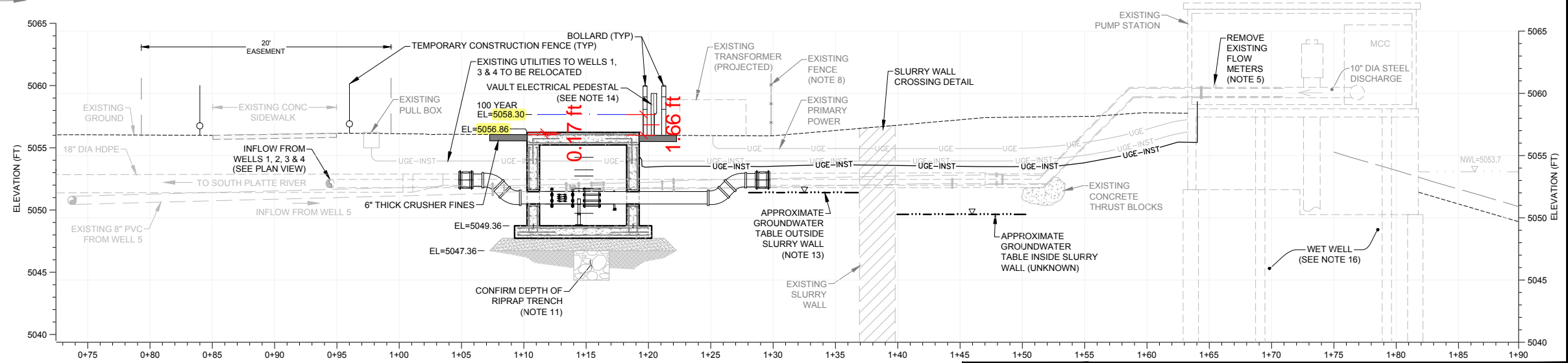
- PRIMARY POWER FROM EXISTING ELECTRIC TRANSFORMER ARE IN 1 1/2" DIAMETER PVC CONDUIT.
 - WELL ELECTRIC AND TRANSDUCER CABLES ARE IN SEPARATE 1" DIAMETER PVC CONDUITS. THERE ARE A TOTAL OF 8 CONDUITS, OR 2 PER WELL.
 - EXISTING 12" DIAMETER HDPE DISCHARGE PIPE SHALL BE BACKFILLED USING FLOW FILL TYPE MATERIAL.
 - EXISTING UTILITY BUNDLE, 8" DIAMETER PVC AND 12" DIAMETER HDPE PIPELINES WERE EXPOSED IN MARCH 2014. EXCAVATION WAS COMPLETED WITH A RUBBER TIRE BACKHOE. TOP OF PIPE ELEVATIONS ARE MARKED WITH AN 'X' (SEE TABLE BELOW). CONTRACTOR TO CONFIRM DEPTHS OF PIPELINES AT EACH PROPOSED VAULT LOCATION PRIOR TO CONSTRUCTION.
- | ITEM | X | Y | Z |
|-----------------------------------|--------------|--------------|---------|
| WELLS 1, 3 & 4 INFLOW PIPE (C900) | 3165340.4214 | 1744174.6534 | 5053.40 |
| WELL 5 INFLOW PIPE (C900) | 3165343.2412 | 1744174.7964 | 5053.10 |
| OUTLET PIPE (HDPE) | 3165346.8368 | 1744173.4089 | 5053.60 |
- REMOVE EXISTING FLOW METERS AND REPLACE WITH A WATER TIGHT PLUG.
 - NEW ELECTRICAL / COMMUNICATION LINES WILL BE REWIRED IN EXISTING CONDUITS FOR WELL 5.
 - FOLLOW OSHA STANDARDS FOR ALL EXCAVATION SLOPES & SHORING.
 - REMOVE AND REPLACE ±40 FEET OF EXISTING HOGWIRE & POST FENCE FROM EXISTING TRANSFORMER TO EAST.
 - INSTALL 2 PULL BOXES, ONE PULL BOX FOR THE ELECTRICAL UTILITIES AND ONE PULL BOX FOR THE INSTRUMENTATION UTILITIES. PULL BOXES ARE TO BE LABELED ACCORDINGLY AND SET AS CLOSE TOGETHER AS PRACTICAL. SPLICE NEW WIRES TO EXISTING WIRES IN PULL BOXES. ALL SPLICES SHALL BE WATERPROOF.
 - REPLACE EXISTING ELECTRICAL AND COMMUNICATION LINES TO WELLS 1, 3, & 4 BETWEEN PUMP STATION AND PULL BOXES.
 - IF RIPRAP TRENCH IS PRESENT IN FOUNDATION EXCAVATION, OVER EXCAVATE INTO TRENCH 1 FOOT AND BACKFILL WITH 3/4" GRAVEL.
 - METER VAULT M-5 UTILITIES AND WELL 5 UTILITIES TO BE INSTALLED IN A SEPARATE TRENCH FROM PRIMARY HIGH VOLTAGE POWER.
 - GROUNDWATER LEVELS ARE APPROXIMATE AND MAY FLUCTUATE SEASONALLY. PRE-CONSTRUCTION DEWATERING REQUIRED TO LOWER THE WATER TABLE 2' BELOW EXCAVATION LIMITS. EXISTING WELLS EQUIPPED WITH TEMPORARY PUMPS MAY BE USED.
 - VAULT ELECTRIC PEDISTALS SHALL BE INSTALLED ABOVE THE 100 YEAR FLOOD ELEVATION.
 - UNDERGROUND ELECTRIC FOR WELLS AND INSTRUMENTATION TO PUMPSTATION AND PRIMARY POWER IS PROJECTED TO PROFILE.
 - REPLACE EXISTING PRESSURE TRANSDUCER IN THE WET WELL.



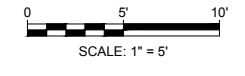
METER VAULT M-5 PLAN (OUTLET PIPE AND WELL 5)



Four (4) bollards around the electrical pedestal, 5.5 inch diameter pipe
 Electrical pedestal is 9.125 inches by 3.125 inches



**METER VAULT M-5 PROFILE (OUTLET PIPE AND WELL 5)
 (ALONG OUTLET PIPE)**



REVISIONS				WEST COOLEY ALLUVIAL WELLS	
NO.	DESCRIPTION	DATE	BY	METER VAULT M-5 PLAN & PROFILE	
1	50% CONSTRUCTION DWGS.	9-17-14	GGC	DEERE & AULT 600 S. AIRPORT RD., BLDG. A, SUITE 205 LONGMONT, CO 80503 TEL. 303.651.1468 FAX 303.651.1469	
2	90% CONSTRUCTION DWGS.	4-1-15	VDW		
3	100% CONSTRUCTION DWGS.	5-29-15	VDW		
4	100% CONSTR. DWGS. WIADCO REV.	6-26-15	VDW		
5	100% CONSTR. DWGS. 2020 REV.	3-3-20	VDW		
DESIGNED BY: VDW APPROVED BY: GGC				JOB NO.:	SHEET:
DRAWN BY: HOG DATE: 6-26-15				0158.039.03	4
CHECKED BY: VDW SCALE: AS NOTED					

Monday, May 18, 2020, 3:03:42 PM DRAWING: C:\0158\thornton\0158_039_039\dwg\alluvial_wells\CAD\dwg_drawings\wells-gen_PLAN.DWG

Flood Hazard Area Delineation

South Platte River Adams County, Colorado

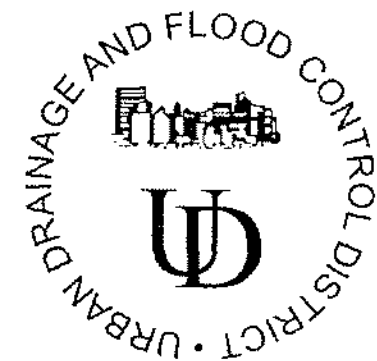
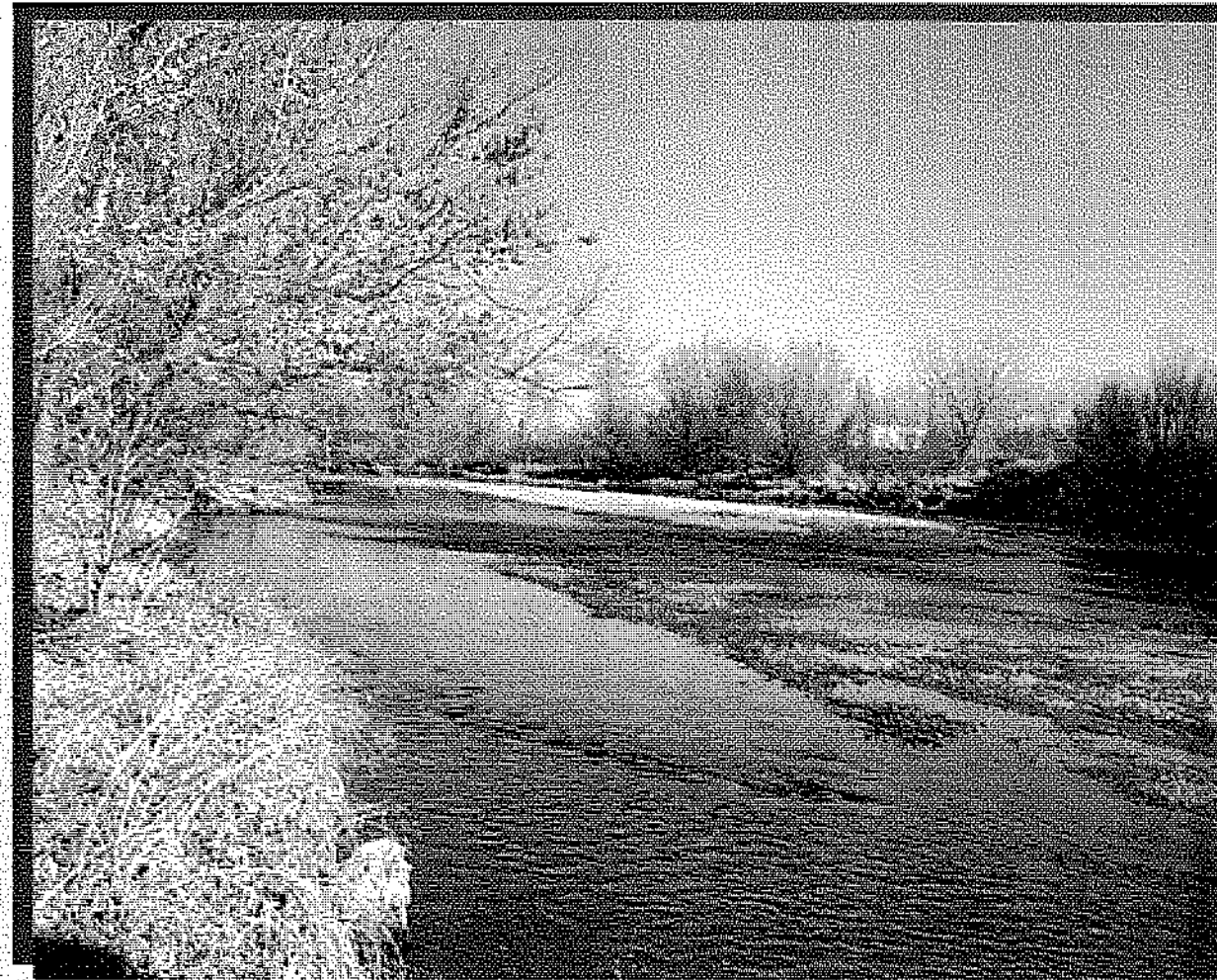
Prepared for

Urban Drainage and Flood
Control District
Adams County
City of Brighton
City of Commerce City
City of Thornton
Metro Wastewater
Reclamation District
Denver Water
South Adams County Water
and Sanitation District

Prepared by

CDM
Denver, Colorado

April 2005

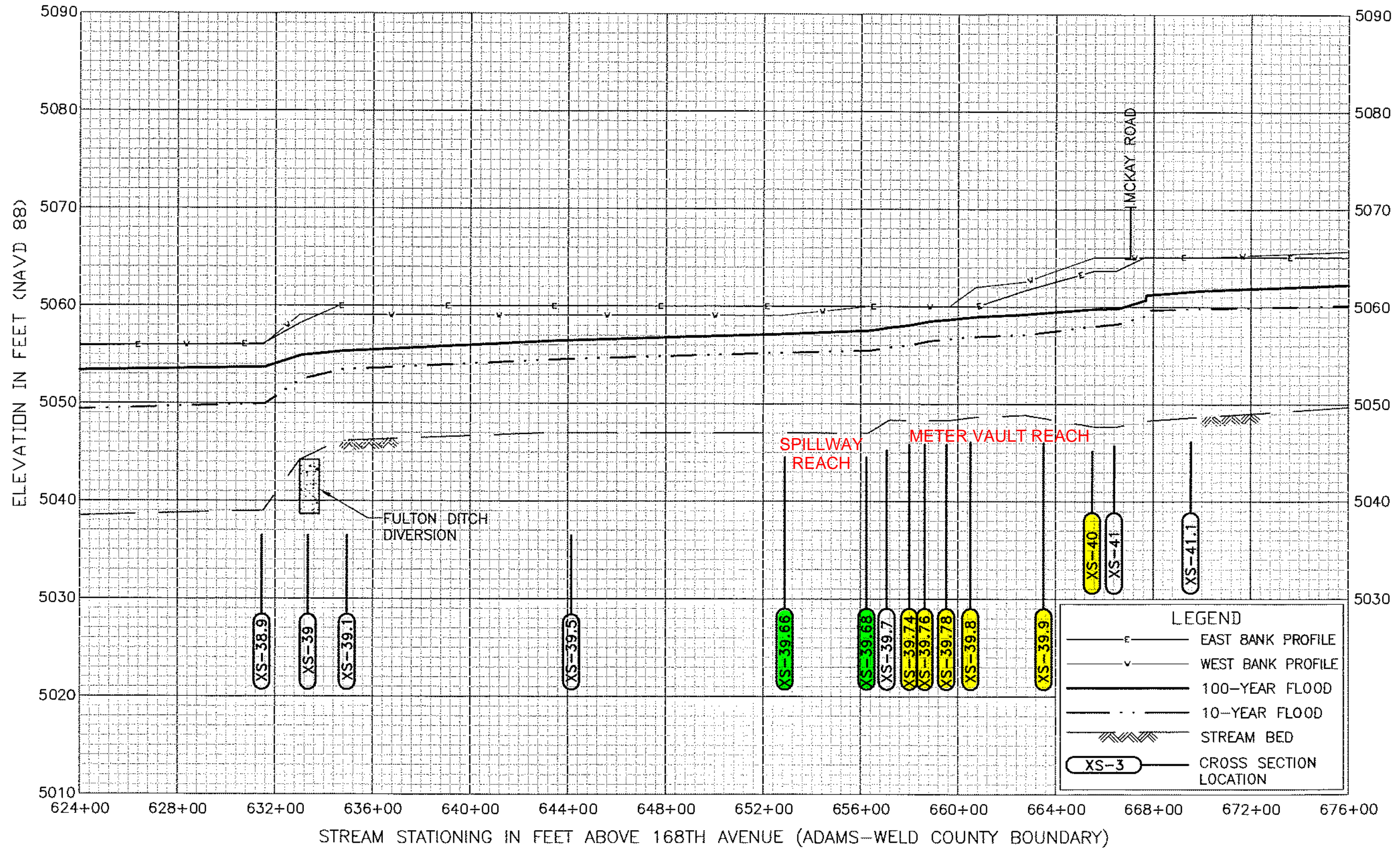


Section	Thalweg Elev. (ft)	Peak Discharge Data				Water Surface Elevation Data				100-Yr Floodplain		100-Yr Floodway (FW) Data (0.5 ft rise in WSEL)					100-Yr Floodway (FW) Data (1.0 ft rise in WSEL)				
		10-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)	500-Yr (cfs)	10-Yr (ft)	50-Yr (ft)	100-Yr (ft)	500-Yr (ft)	Width (ft)	Avg. Vel. (fps)	FW Width Left ⁽¹⁾ (ft)	FW Width Right ⁽¹⁾ (ft)	FW Width Total (ft)	Avg. Vel. (fps)	Floodway Elev. (ft)	FW Width Left ⁽¹⁾ (ft)	FW Width Right ⁽¹⁾ (ft)	FW Width Total (ft)	Avg. Vel. (fps)	Floodway Elev. (ft)
21	4993.26	11400	25500	33800	59800	5003.38	5005.22	5006.13	5008.32	3227	7.3	395	202	597	5.2	5006.53	389	202	591	5.2	5007.12
22	4994.30	11400	25500	33800	59800	5004.18	5006.55	5007.68	5009.91	2962	7.2	142	443	585	4.3	5008.16	142	418	559	5.3	5008.62
23	4995.60	11400	25500	33800	59800	5006.37	5009.01	5009.92	5012.13	2572	6.4	165	277	441	4.5	5010.20	165	171	336	4.1	5010.72
24	4998.51	11400	25500	33800	59800	5007.04	5009.63	5010.59	5012.94	2700	2.0	168	141	309	2.4	5010.98	168	135	303	2.3	5011.37
25	4999.80	11400	25500	33800	59800	5006.41	5009.29	5013.04	5014.19	2171	9.9	120	96	216	7.3	5013.43	120	96	216	7.3	5013.43
26	5000.44	12300	27000	33800	59800	5011.07	5017.62	5015.81	5017.17	2945	10.3	127	92	220	5.1	5015.76	127	93	220	5.1	5015.76
26.4	5000.00	12300	27000	34200	60508	5011.87	5017.62	5016.58	5017.24	3845	8.0	127	111	238	3.9	5016.58	127	111	238	3.9	5016.58
26.5	5005.00	12300	27000	34200	60508	5011.31	5017.75	5017.06	5018.66	3895	7.8	534	200	734	3.7	5017.03	271	200	471	3.7	5017.03
27	5002.02	12300	27000	34200	60508	5014.16	5018.07	5017.87	5019.50	4399	4.4	1149	509	1658	2.4	5017.84	591	509	1100	2.7	5017.83
28	5003.40	12300	27000	34800	61569	5015.01	5018.43	5018.52	5020.30	4165	5.9	1460	772	2232	3.8	5018.52	653	772	1425	4.7	5018.64
29	5005.18	12700	27500	35400	62631	5018.06	5020.28	5021.21	5022.99	4036	9.0	2515	747	3262	6.2	5021.60	1636	402	2037	5.9	5022.02
30	5011.60	12700	27500	36000	63692	5024.15	5027.25	5027.93	5029.44	4120	6.3	709	1920	2629	4.2	5028.17	709	1631	2340	4.6	5028.25
30.9	5017.00	12700	27500	36000	63692	5029.36	5031.78	5032.40	5033.99	3972	8.1	259	3089	3348	4.0	5032.84	257	2702	2959	4.7	5033.38
31	5021.03	12700	27500	35600	62985	5030.86	5032.43	5033.00	5034.46	4299	5.5	134	3202	3336	5.5	5033.15	132	2806	2938	4.4	5033.98
31.1	5029.96	12700	27500	35600	62985	5031.83	5032.79	5033.30	5034.71	4358	3.8	114	3275	3389	4.3	5033.76	114	2869	2983	3.9	5034.30
33	5029.91	12700	27500	35600	62985	5034.19	5035.62	5036.24	5037.80	3974	2.3	190	3015	3205	2.9	5036.73	190	2565	2755	3.4	5037.20
34	5032.09	12700	27500	35600	62985	5039.49	5040.69	5040.97	5041.68	3150	10.0	170	2391	2561	7.1	5041.27	170	2007	2177	7.6	5041.69
34.305	5031.32	12700	27500	35600	62985	5040.95	5042.19	5042.64	5043.87	3224	6.0	138	2694	2832	3.5	5043.06	138	2150	2288	4.1	5043.63
34.335	5032.40	12700	27500	35600	62985	5041.45	5042.78	5043.25	5044.51	3336	6.4	113	2919	3031	3.9	5043.56	113	2461	2574	3.9	5044.23
34.36	5033.35	12700	27500	35600	62985	5042.30	5043.62	5044.09	5045.36	3404	6.4	95	2887	2982	4.3	5044.59	95	2405	2500	4.3	5045.08
35	5034.06	12700	27500	35600	62985	5044.63	5045.78	5046.29	5047.61	4203	7.4	95	2169	2264	4.6	5046.72	95	1898	1992	4.9	5047.09
35.9	5035.20	12700	27500	35600	62985	5045.47	5046.95	5047.56	5049.11	4145	6.1	218	1669	1887	4.5	5047.96	218	1448	1666	4.7	5048.38
36	5035.60	12700	27500	35600	62985	5045.73	5046.53	5049.22	5052.17	4022	12.6	117	1708	1826	10.3	5049.25	117	1463	1580	10.4	5049.21
37	5034.89	12700	27500	35600	62985	5046.82	5051.88	5050.70	5053.22	4024	9.9	90	1693	1783	7.1	5050.70	90	1400	1490	7.2	5050.70
37.1	5035.36	12700	27500	35600	62985	5048.12	5052.55	5052.69	5054.99	5033	3.9	1022	1156	2178	3.0	5052.69	568	1151	1719	3.5	5052.67
38	5037.65	12700	27500	36400	64400	5048.51	5052.70	5052.91	5055.19	4929	4.0	1767	984	2750	2.8	5053.04	1530	727	2257	3.5	5053.08
38.9	5038.99	12700	27500	36400	64400	5049.95	5052.97	5053.70	5056.17	4097	10.3	2258	790	3048	4.4	5054.19	1935	720	2655	3.8	5054.69
39	5044.20	12700	27500	36400	64400	5052.44	5054.34	5054.92	5056.68	4251	7.6	2395	759	3154	3.3	5055.33	2019	531	2550	4.1	5055.32
39.1	5046.16	12700	27500	36400	64400	5053.43	5054.78	5055.33	5056.98	4371	7.0	2616	657	3273	3.1	5055.72	2236	378	2614	3.6	5055.87
39.5	5047.01	12700	27500	36400	64400	5054.51	5055.88	5056.43	5057.94	4192	6.5	3001	151	3153	2.9	5056.81	2540	151	2692	3.1	5057.15
39.66	5047.01	12700	27500	36400	64400	5055.24	5056.58	5057.16	5058.64	4169	6.9	2833	83	2916	3.4	5057.48	2361	83	2443	3.9	5057.87
39.68	5047.01	12700	27500	36400	64400	5055.47	5056.95	5057.54	5059.02	4113	8.1	2655	124	2778	3.7	5057.96	2232	124	2355	3.8	5058.51
39.7	5048.33	12700	27500	36400	64400	5055.82	5057.33	5057.86	5059.26	4113	7.0	2631	123	2754	3.4	5058.31	2220	123	2343	3.6	5058.80
39.74	5048.33	12700	27500	36400	64400	5056.05	5057.56	5058.10	5059.54	4087	8.1	2559	151	2710	4.0	5058.52	2161	151	2312	4.4	5058.95
39.76	5048.33	12700	27500	36400	64400	5056.48	5057.92	5058.49	5059.89	4079	7.0	2527	142	2669	3.4	5058.98	2147	142	2289	3.6	5059.49
39.78	5048.33	12700	27500	36400	64400	5056.66	5058.11	5058.69	5060.11	4147	7.1	2549	132	2681	3.4	5059.17	2170	132	2302	3.6	5059.69
39.8	5048.68	12700	27500	36400	64400	5056.93	5058.40	5058.98	5060.43	4078	6.7	2503	119	2622	3.2	5059.49	2148	119	2267	3.5	5059.98
39.9	5048.88	12700	27500	36400	64400	5057.15	5058.64	5059.23	5060.71	4206	7.0	2432	109	2542	3.3	5059.71	2038	109	2148	3.5	5060.22
40	5047.70	12700	27500	36400	64400	5058.04	5059.15	5059.80	5061.37	3936	9.8	2065	105	2170	4.3	5060.22	1812	105	1917	4.5	5060.73
41	5048.30	12700	27500	36400	64400	5059.68	5060.73	5061.21	5062.32	3454	7.8	1836	109	1944	4.2	5061.24	1680	109	1788	4.5	5061.65
41.1	5048.70	12700	27500	36400	64400	5059.84	5061.12	5061.68	5063.06	3312	7.0	1738	104	1842	4.2	5061.88	1399	104	1503	3.8	5062.38

METER VAULT REACH
SPILLWAY REACH

Note: ⁽¹⁾ = Width from centerline looking downstream
 (LR) = Levee intact model run
 (FLR) = Levee failure model run
 (CH) = Split flow reach, main channel flow
 (FP) = Split flow reach, floodplain flow
 NC = Not calculated

S:\0611\40892\MAPPING\UDFCPP13 12/29/04 11:54 waltbr XREFS: UDFCD-tb-PRO, legend_prfl
 S:\0611\40892\MAPPING\UDFCPP13 03/08/05 11:41 reddincp XREFS: UDFCD-tb-PRO, legend_prfl



LEGEND	
	EAST BANK PROFILE
	WEST BANK PROFILE
	100-YEAR FLOOD
	10-YEAR FLOOD
	STREAM BED
	CROSS SECTION LOCATION

SEE SHEETS 16, 17 & 18 FOR PLAN

<p>Camp Dresser & McKee Inc. 1331 17TH STREET, SUITE 1200 DENVER, COLORADO 80202 TEL: (303) 298-1311</p>	DESIGNED <u>T. BOGAN</u> DATE <u>12/04</u> DRAWN <u>K. CAMERON</u> DATE <u>12/04</u> CHECKED <u>E. ANSELL</u> DATE <u>03/05</u> APPROVED <u>T. JOHNSON</u> DATE <u>04/05</u>	Urban Drainage and Flood Control District • Adams County • City of Brighton • City of Commerce City • Denver Water Department • City of Thornton • South Adams County Water and Sanitation District • Urban Drainage and Flood Control District • Metro Wastewater Reclamation District	FLOOD HAZARD AREA DELINEATION SOUTH PLATTE RIVER IN ADAMS COUNTY, CO	PROFILE STA. 624+00 TO 676+00	SHEET <u>40</u> OF <u>48</u>
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APPENDIX E

ARVADA PUMP STATION AS-BUILT DRAWINGS

CONSTRUCTION PLANS for CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT

located in
SECTION 17, TWP. 2S, RNG. 67W
ADAMS COUNTY, COLORADO
June 2003

BTC AS BOLTS #1
Don Meyer's CREW

Applegate Group, Inc.
Consultants for Land, Minerals, and Water
1499 West 120th Ave., Ste. 200 5411 Boering Dr., Ste. 200
Denver, CO 80234-2728 Loveland, CO 80538
(303) 452-6611 (970) 461-9824
Fax: (303) 452-6179

SOUTH PLATTE RESERVOIR PROJECT
COVER SHEET



SCOPE OF WORK

The Contractor is to install a pump station at the south side of the City of Arvada's Reservoir, which will pump up to 9.0 cfs of water from the reservoir to the South Platte River. This preassembled pump station will be complete with wet well, inlet pipe, screens, and building. The pumping system will be three vertical turbine pumps installed in an eight-foot diameter wet well. The inlet pipe will be steel 30-inch in diameter, and 125 feet long with self-cleaning screens on the inlet. The installation of the concrete wet well and inlet pipe is to be done by removing as little of the existing engineered reservoir liner as possible after dewatering the area to be excavated. The pump station will discharge water through a 10-inch pipe that is metered, then through larger pipes to an outlet structure at the South Platte River.

A Motor Control Center is to be installed inside the pump house. This MCC will power the wells, pump station, and pump house. The MCC will house a Programmable Logic Controller, which will control the operation of the wells, and pump station, as well as collect data for use through the City's SCADA system.

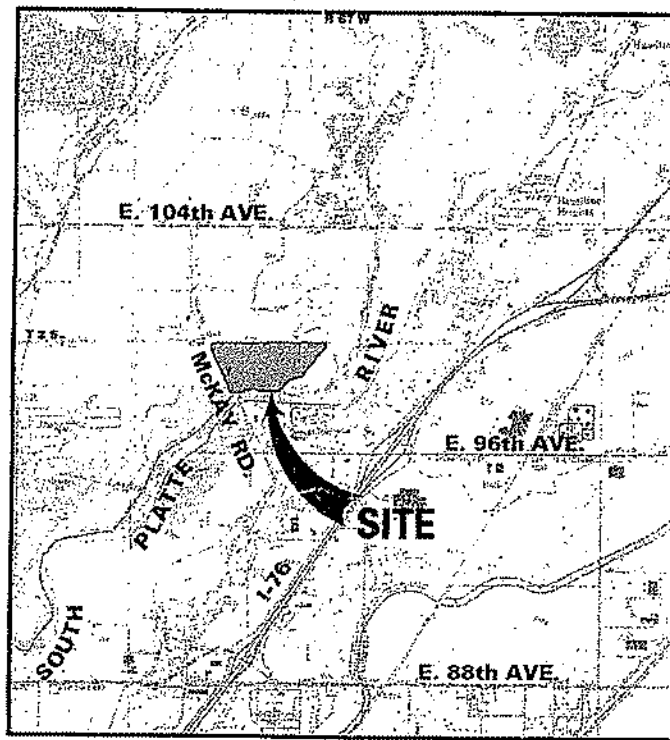
The Contractor is to install submersible pumps in each of the five wells existing on the north side of the South Platte River. Water is to be piped from each of these wells into the wet well at the pump station. Water flowing into this wet well is to be metered.

The wells are considered a diversion of ground water tributary to the South Platte River and administered as a headgate on the stream by the Office of the State Engineer, Colorado Division of Water Resources, for withdraw of City of Arvada's reusable effluent only.

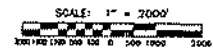
Water Commissioner: Bob Stahl
(303) 857-0742
(970) 381-0828 (cell)



IF YOU DIG COLORADO -- CALL US FIRST!
UTILITIES NOTIFICATION CENTER
1-800-922-1987 or
(303) 534-6700 (metro Denver)
CALL 2 BUSINESS DAYS PRIOR TO
EXCAVATION FOR UTILITY LOCATIONS



VICINITY MAP



SHEET INDEX

1. Cover Sheet
2. General Notes
3. Site Plan
4. Plan & Profile Well Water Piping
5. Foundation Plan and Details
6. Plan and Profile: Wet Well and Inlet Pipe
7. Pumping System
8. Pumphouse
9. Plan and Profile: Outlet Pipe
10. Outlet Details
11. Ground Water Wells
12. Details
13. Details; Piping Process Schematic
- E1. Electrical Site Plan and Legend
- E2. Electrical One-Line Diagram
- E3. Power and Lighting Plan
- E4. Control Panel

Owner:	City of Arvada South Platte Reservoir Project 9820 McKay Road Thornton, CO 80233 (720) 898-7766	Electrical Engineer:	Electrical Systems Consultants, Inc. 212 West Mulberry Fort Collins, CO 80521 (970) 224-9100
Consultant:	Applegate Group, Inc. 1499 West 120th Ave. Suite 200 Denver, CO 80234-2728 (303) 452-6611	Surveyor:	Epp & Associates P. O. Box 837 Craig, CO 81626 (970) 824-8236
Soils Report:	CTI/Thompson, Inc. 1971 West 12th Ave. Denver, CO 80204 (303) 825-0777		

Approved By:

James E. Root
City Engineer, City of Arvada

Date

REDUCED PRINTS ARE ISSUED FOR CONVENIENCE ONLY
CONSULT FULLSIZE DRAWINGS IN CASE OF CONFLICTS

NO.	DATE	BY	CHK'D	DESCRIPTION



OCT 23 2003

REDUCED PRINTS ARE ISSUED FOR CONVENIENCE ONLY
CONSULT FULL-SIZE DRAWINGS IN CASE OF CONFLICTS

GENERAL NOTES:

1. All work shall conform to the City of Arvada Requirements and Specifications, unless identified herein.
2. All work shall also conform to the Adams County Requirements and Specifications.
3. Contractor shall contact the Utility Notification Center of Colorado (UNCC) 1-800-922-1987 or 303-534-6700 at least 48 hours before beginning construction so all utility companies in the area can be notified, and all utility locates can be done.
4. No variance from the Specifications shall be accepted without prior written approval by the City of Arvada.
5. All phases of work shall be inspected and approved by the City of Arvada.
6. Water shall be used as a dust palliative.
7. All traffic control shall conform to the applicable regulations set forth on the Manual on Uniform Traffic Control Devices.
8. All operations shall conform to the applicable regulations set forth by the ICC and OSHA.
9. Upon completion of the work, the Contractor shall provide the Engineer with a complete set of "As-Built Plans" showing the "As-Built" locations of all pipes, valves, fittings, blow-off assemblies, and components. As-Built information shall be updated regularly on a "Record Set" of drawings as construction progresses.
10. These general notes are not all-inclusive. Refer to specifications for detailed information.

TRENCHING, EXCAVATING, and BACKFILLING:

1. Excavation and backfill for the groundwater supply pipes shall conform to the applicable standard detail shown within these drawings. Jetting or flooding of trench backfill is not allowed.
2. Backfill compaction for groundwater supply pipes shall be tested by a qualified soils engineer at 100-foot staggered intervals, every two (2) feet vertically, or as further directed by the City of Arvada.
3. Excavation and backfill for the wet well and inlet pipe shall conform to the applicable standard detail shown within these drawings.
4. Backfill compaction for the wet well and inlet pipe shall be tested by a qualified soils engineer at intervals every nine (9) inches vertically to 98% compaction with a water content of 1% below to 2% above the optimum moisture content as determined by ASTM D 698, or as further directed by the City of Arvada.
5. Alternate Bedding material shall be substituted in unstable conditions as designed by the soils engineer, and approved by the City of Arvada unless specified within these drawings where concrete, or low-fill are called out.
6. All bedrock under the wet well base shall be covered between shifts, or every 12 hours, to protect from air spiking.

WATER LINES:

1. Water lines for the Groundwater Collection System shall be installed to the lines and grades shown on the project drawings, and in accordance with applicable standard details, unless otherwise designated by the City of Arvada.
2. All water lines for the Groundwater Collection System shall be PVC Class 200 conforming to AWWA C-900 Standards.
3. All fittings for the Groundwater Collection System shall be made from gray-iron or ductile iron and furnished with mechanical joint ends. All fittings shall have a pressure rating of 250 psig and shall conform to AWWA C-110 or C-153 Standards.
4. All fittings for the Groundwater Collection System shall be wrapped with eight (8) mil polyethylene.
5. There shall be a minimum of 36 inches of cover over all Groundwater Collection System water supply lines at final grades.
6. All tees and gate valves shall be mechanically connected to the fitting. All gate valves shall open counter-clockwise. Gate valves shall conform to AWWA C-509 Standards.
7. Thrust blocks shall be cast-in-place concrete with sulfate-resistant modified Type II cement, having a minimum strength of 3,000 psi.
8. Thrust blocks shall be cast against undisturbed earth and shall bear on the wrapped fitting only, with no concrete interfering with the joint.
9. Tie rods or megalugs shall be installed at all bends, tees, fittings, etc.
10. PVC water line hydrostatic testing shall be conducted in accordance with AWWA C605-94 Standards. The City of Arvada pressure and duration acceptance criteria are 150 psig for two (2) hours.
11. Water line chlorination shall be conducted in accordance with AWWA C651-92, at a chlorine concentration of 100 ppm.
12. Where it is necessary to depress the water line at the River Discharge System, a minimum of two (2) feet shall be maintained between the outside of the pipes.
13. The water line for the River Discharge System shall be installed to the lines and grades shown on the project drawings, and in accordance with applicable standard details.
14. The water line for the River Discharge System shall be HDPE PE 3408 in accordance with ASTM D 3350.
15. The water line for the Reservoir Inlet System shall be installed horizontal to the lines and grades shown on the project drawings, and in accordance with applicable standard details.
16. Inlet pipe shall be cement-mortar lined and tape coated steel pipe; 30" diameter, 1/2" thick. Steel pipe shall conform to AWWA specification C200. Cement-mortar lining shall conform to AWWA specification C205. Tape coating shall conform to AWWA specification C214.

SEDIMENT AND EROSION CONTROL:

1. The Contractor shall be responsible for sediment and erosion control at the site throughout the construction.
2. Perimeter silt fencing shall be installed prior to any land disturbing activity (stockpiling, stripping, grading, etc.).

ACCESS ROAD:

1. All roadway construction within the public Rights-of-Way shall be performed in accordance with the Adams County Standards and Specifications (latest revision).
2. Concrete, aggregate base and asphaltic concrete mix designs shall be submitted by the supplier and approved in writing by the City of Arvada prior to any road construction. Materials shall be in conformance with City of Arvada and CDOT Standards where applicable.
3. All concrete shall be a minimum of Class A or B, and all asphalt shall be Grade S, or SX, in conformance with City of Arvada and CDOT Specifications.

WELLS:

1. All wells shall be completed with pumps, motors and accessories as per the "Water Well Construction Rules", 2CCR402-2, office of State Engineer, June 1, 2000.
2. Wells were drilled by others. See "Owner's Notice of Constructed Wells".
3. The City of Arvada will file "Completion of Pump Installation" reports with State Engineer's office after Contractor has completed required well work.

REVEGETATION:

1. Revegetate areas disturbed by trenching operation for well collection lines with vegetation native to this area or as directed by Owner.

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 Consultants for Land, Utilities, and Water
 1495 West 126th Ave., Suite 208 3441 Drexel Dr., Suite 2
 Denver, CO 80234-3128 Loveland, CO 80538
 (303) 452-5613 (970) 461-0884 Fax: (303) 452-2199

SOUTH PLATTE RESERVOIR PROJECT
GENERAL NOTES



NO.	DATE	BY	CHK'D	DESCRIPTION

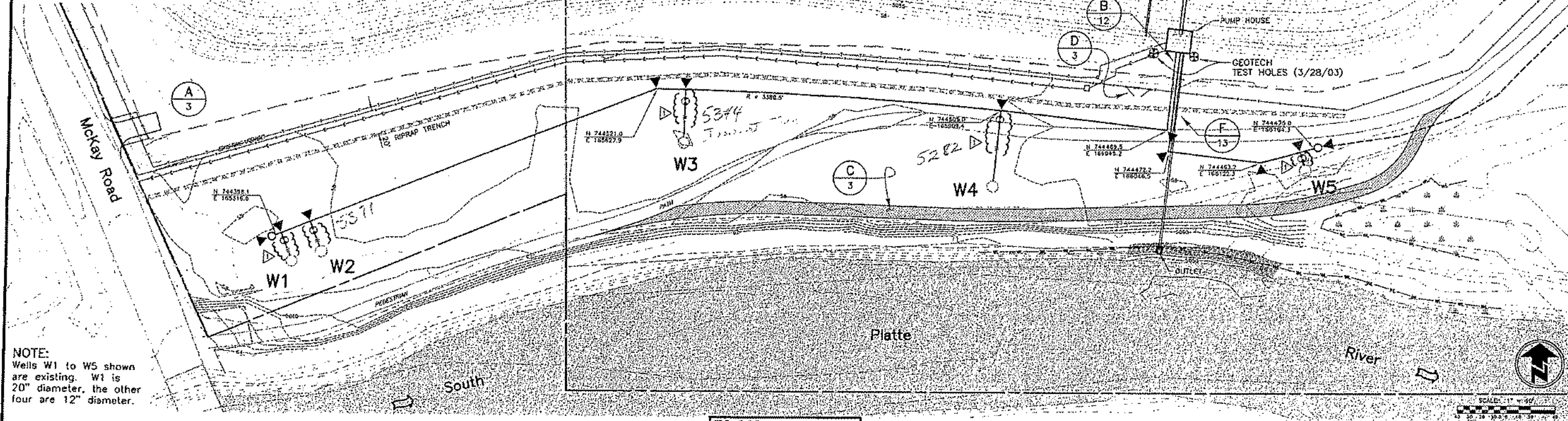


ARVADA RESERVOIR

- LEGEND**
- EXISTING CONTOURS, ADAMS COUNTY DATA, 1998
 - EXISTING CONTOURS, ARVADA RESERVOIR, AS-BUILT SURVEY
 - EXISTING CONTOURS, RIVERSIDE TOPOGRAPHIC SURVEY, 2003
 - EXISTING FENCE
 - EXISTING SLURRY WALL
 - PROPOSED ELECTRIC POWER
 - PROPOSED TELEPHONE CABLE
 - PROPERTY LINE
 - PROPOSED GROUNDWATER PIPING
 - FUTURE GROUNDWATER PIPING
 - GROUNDWATER WELL
 - BLOWOFF
 - THRUST BLOCK (DETAIL I-12)
 - RIPRAP TRENCH (EXISTING)
 - WETLAND DELINEATION (2/18/03)
 - WETLAND

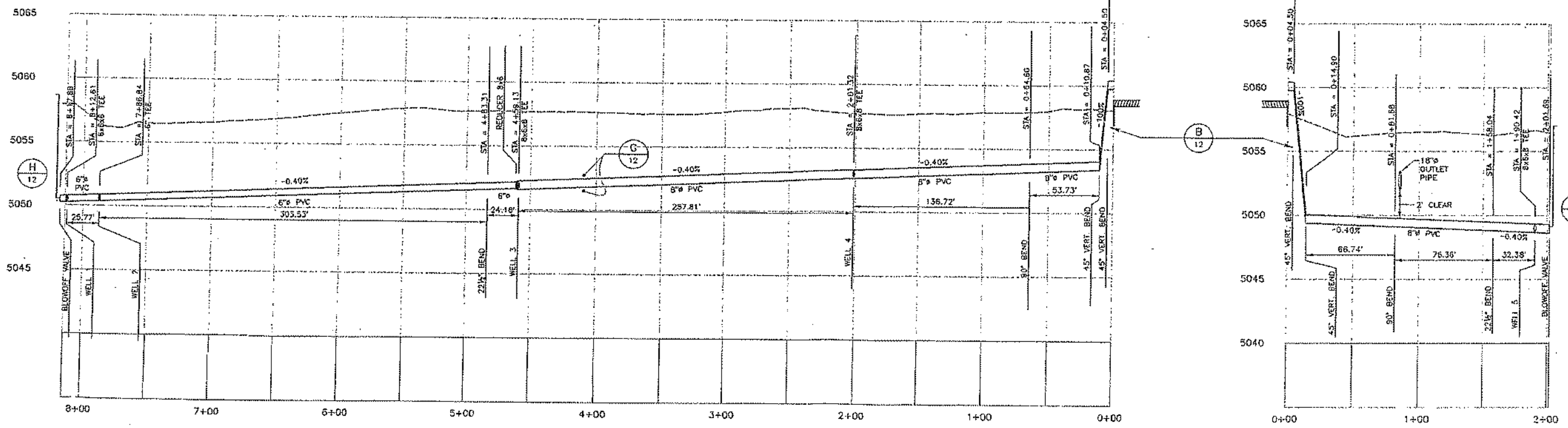
- ⊕ GATE VALVE 6-INCH RESILIENT SEAT, MECHANICAL JOINT AT TEE
- 6" PVC CLASS 200 FROM WELLS TO TEE

INCLINED STAFF GAUGE TO INDICATE RESERVOIR LEVEL IN FEET AND TENTHS OF FEET, MOUNTED ON BANK SEE DETAIL G-13



NOTE:
Wells W1 to W5 shown are existing. W1 is 20" diameter, the other four are 12" diameter.

PLAN SCALE: 1" = 40'
PROFILE 1" = 40' H, 1" = 4' V



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Denver, CO 80234-2728 Loveland, CO 80538
(303) 452-6611 (970) 461-9884

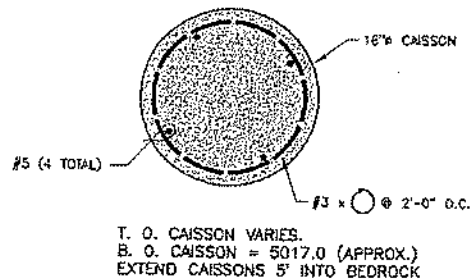
SOUTH PLATTE RESERVOIR PROJECT
PLAN & PROFILE
WELL WATER PIPING

CITY OF ARVADA

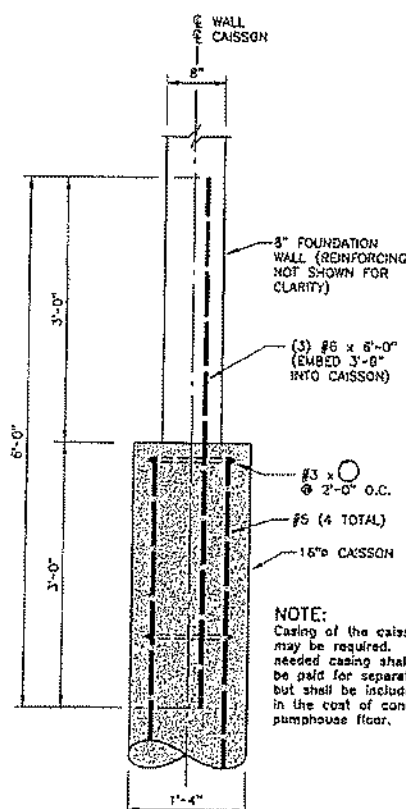
NO.	DATE	BY	CHK'D	DESCRIPTION
1	10/20/03	CJC	WBH	REVISED FOR AGREEMENT - 1-4-04

Date: 3/7/04
 Job No: 03-11
 Drawn: WJS
 Checked: WJS
 Scale: AS SHOWN

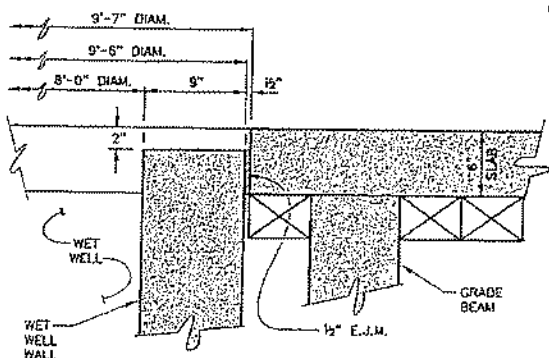




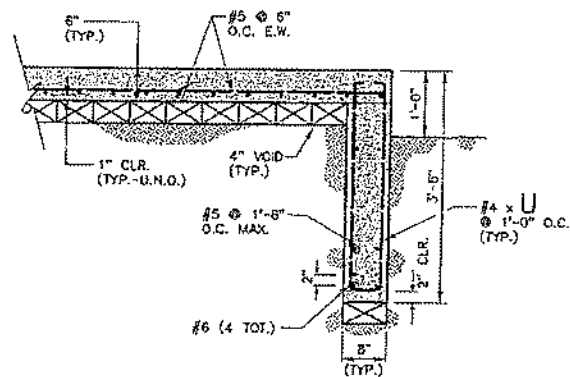
SECTION 'D' THROUGH CAISSON
Scale: 1 1/2" = 1'-0"



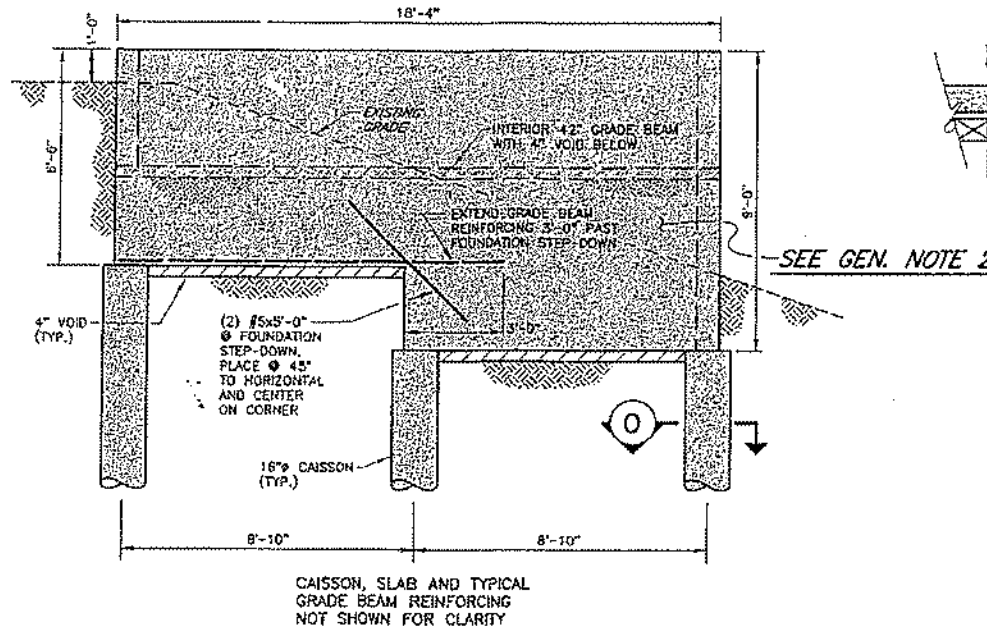
CAISSON/FOUNDATION WALL CONNECTION
Scale: 1" = 1'-0"



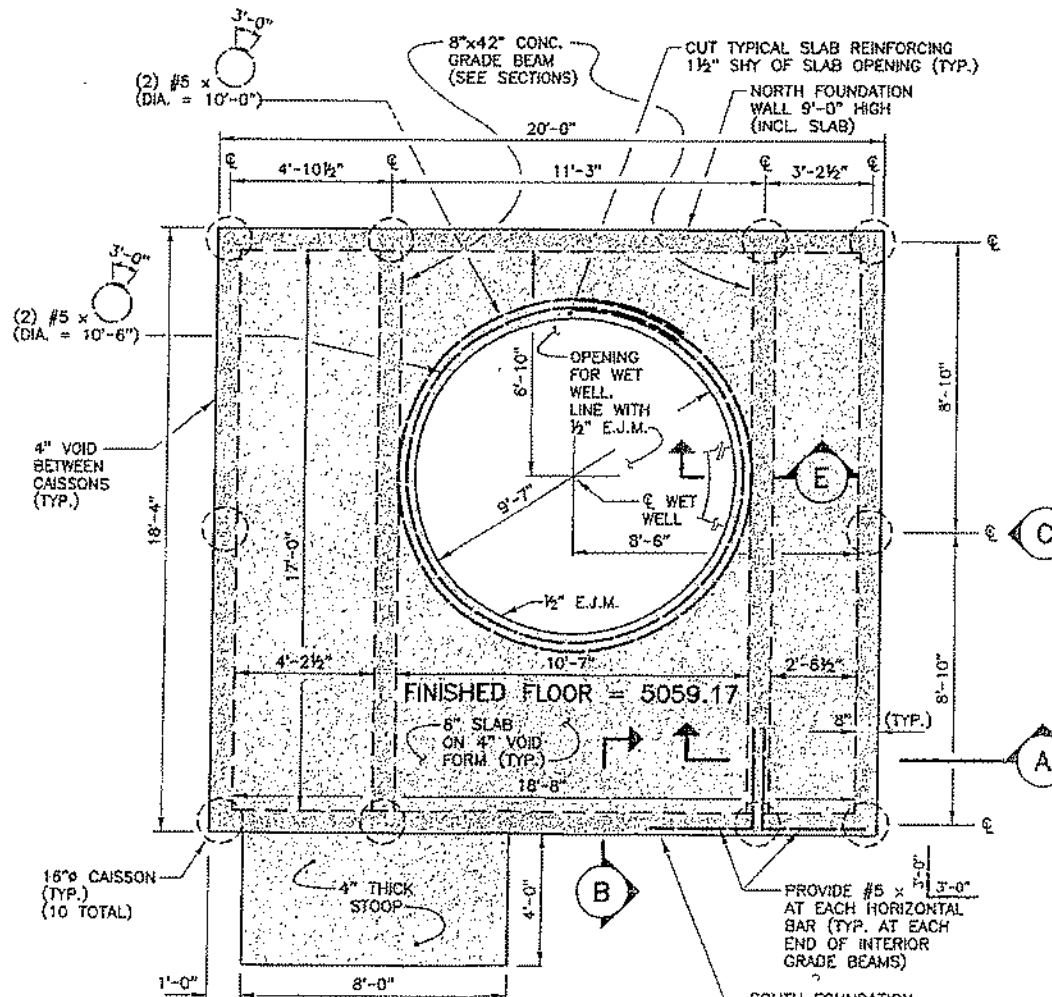
SECTION 'E'
Scale: 1 1/2" = 1'-0"



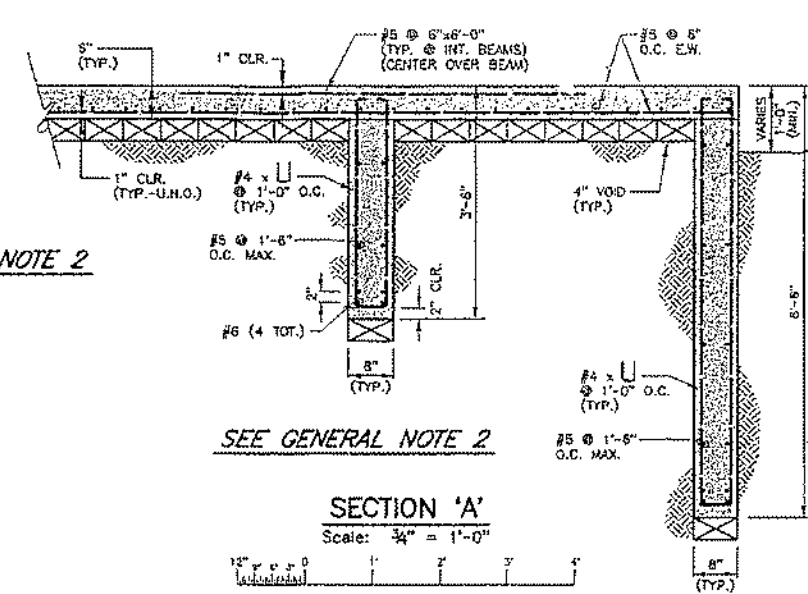
SECTION 'B'
Scale: 3/4" = 1'-0"



FOUNDATION ELEVATION 'C'
Scale: 3/8" = 1'-0"



FOUNDATION PLAN
Scale: 3/8" = 1'-0"



SECTION 'A'
Scale: 3/4" = 1'-0"

GENERAL NOTES:

1. The contractor shall field verify all dimensions prior to starting work and notify the engineer immediately of any discrepancies prior to proceeding.
2. Backfill inside of foundation to bottom of 4-inch void prior to pouring interior grade beams.

DESIGN CRITERIA:

1. Live Load = 50 psf
2. Snow Load = 30 psf
3. Pump(s) Load = 3 pumps @ 4,000# each, with 30% impact/vibration factor.
4. Wind Load: 85 MPH, Exposure C
5. Allowable soil bearing pressure = 30,000 psf end bearing.
6. Allowable skin friction = 3,000 psf.

CONCRETE:

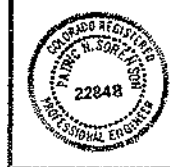
1. All concrete work shall conform to the requirements of ACI 318 "Building Code Requirements for Reinforced Concrete".
2. All concrete shall have a minimum compressive strength at 28 days of 4,000 psi.
3. Cement shall conform to ASTM C150, Type II; aggregates to ASTM C33.
4. Concrete shall contain 5% - 8% air entrainment.
5. The bottom of all concrete grade beams shall be a minimum of 2'-6" feet below finished grade.
6. Finish floor level with no slope.

REINFORCING STEEL:

1. Fabricate and place reinforcing bars in accordance with CRSI "Manual of Standard Practice" and CRSI "Recommended Practice for Placing Reinforcing Bars".
2. Reinforcing steel to comply with ASTM A615, Grade 60.
3. Lap reinforcing steel in concrete where spliced 48 bar diameters, but not less than 2'-0".
4. Lap wall steel in cast concrete around corners 48 bar diameters but not less than 2'-0" or provide corner bars which meet this criterion.

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NO.	DATE	BY	CHK'D	DESCRIPTION
1	8/22/0			
2	03-11			
3				
4				
5				
6				



Sheet: **5**

GENERAL NOTES:

1. Dewatering for construction activities is the sole responsibility of the Contractor.
2. Anchor wet well base to claystone bedrock (see detail F-12).

Applegate Group, Inc.
 Consultants for Land, Materials, and Water
 1499 West 126th Ave., Ste. 206
 Denver, CO 80234-2728
 (303) 535-6611
 Fax: (303) 535-6617

SOUTH PLATTE RESERVOIR PROJECT
PLAN AND PROFILE
WET WELL AND INTAKE PIPE

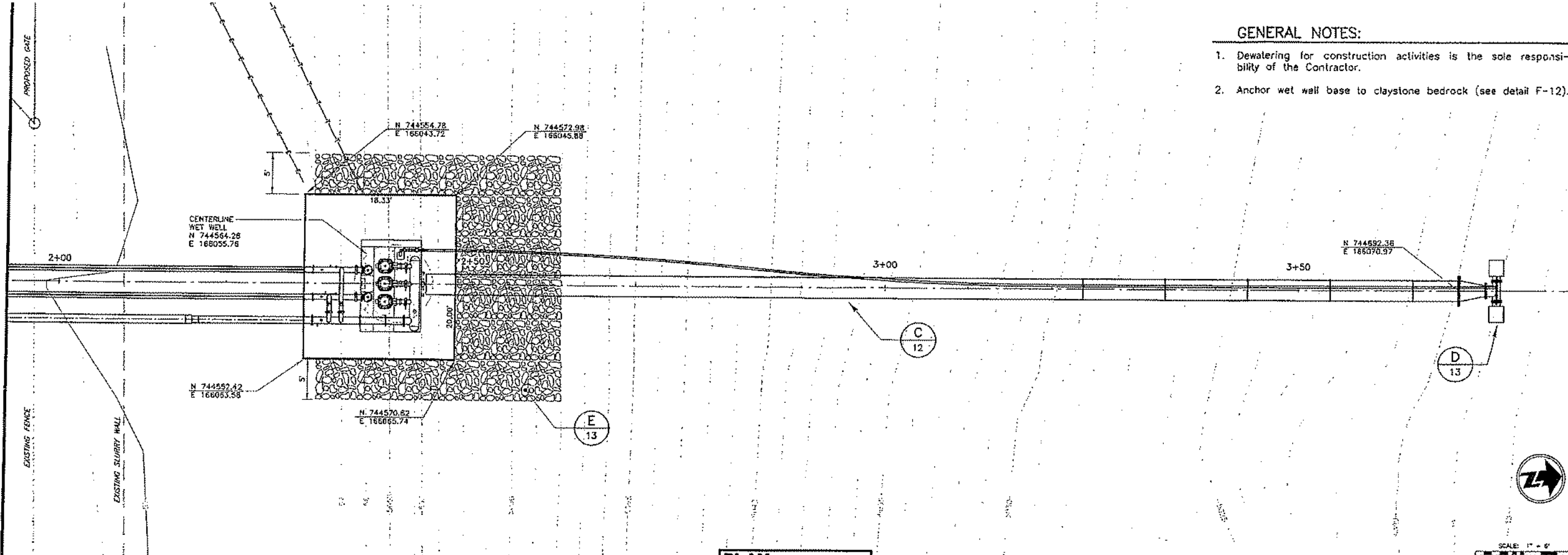
ARVADA
CITY OF

NO.	DATE	BY	CHKD.	DESCRIPTION

Date:	8/23/06
Job No.:	03-111
Drawn:	C/L
Design:	W/S
Checked:	PH
Scale:	1" = 6'

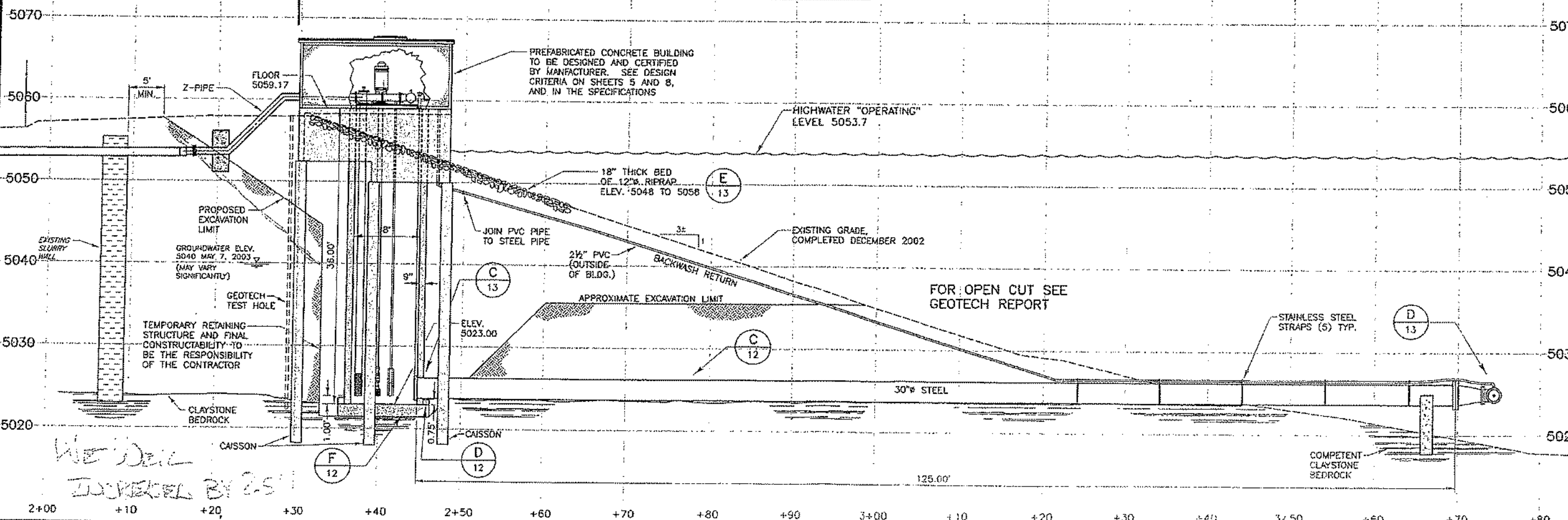


Sheet: **6**
 CR **12**



PLAN SCALE: 1" = 6'
PROFILE 1" = 6' H
 1" = 6' V

SEE SHEET 9



REDUCED PRINTS ARE ISSUED FOR CONVENIENCE ONLY CONSULT FULLSIZE DRAWINGS IN CASE OF CONFLICTS

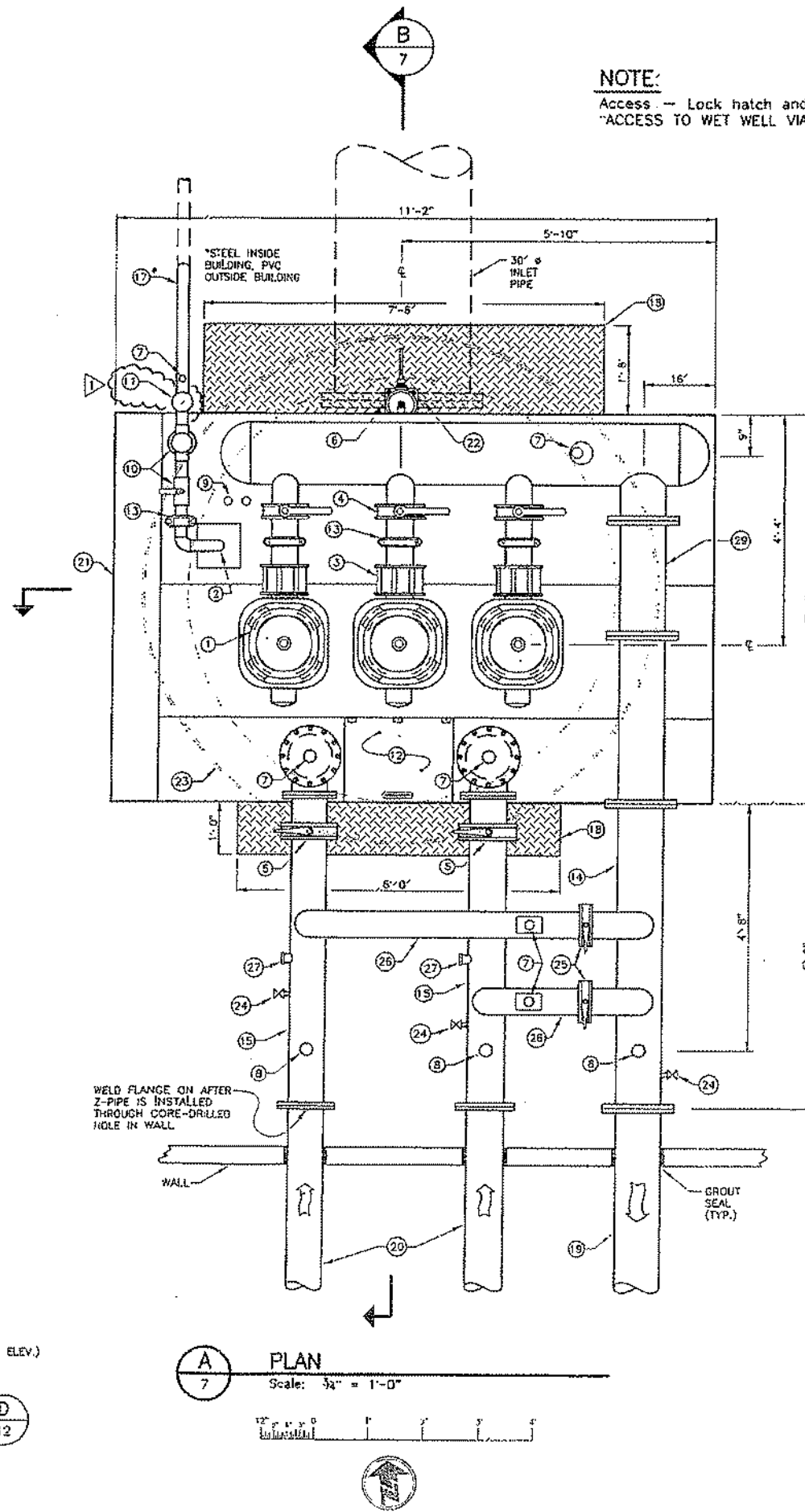
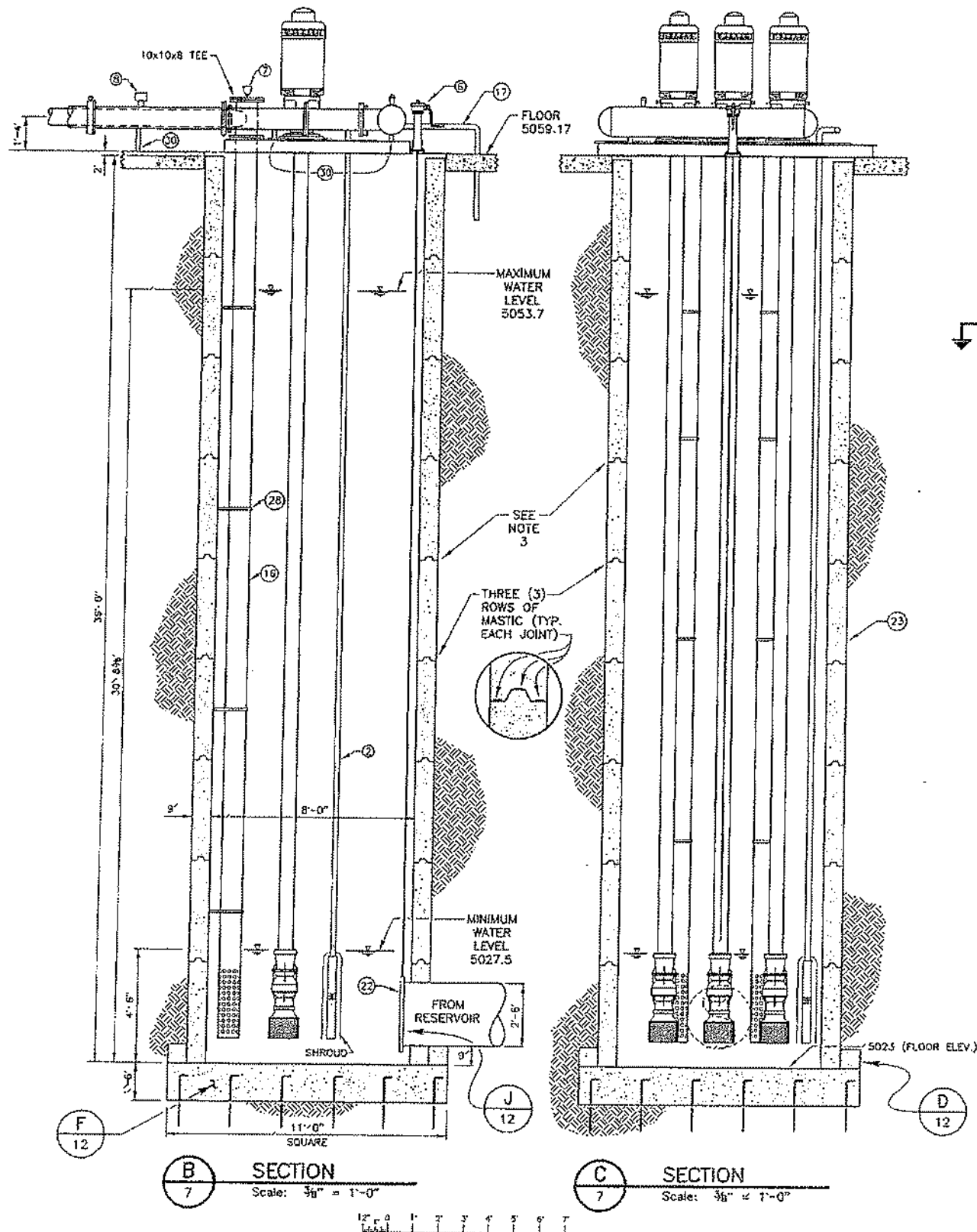
*WET WELL
 DIMENSIONS BY 2.5'
 TO LIP*

NOTES:

1. The manhole for the wet well shall comply with ASTM specification C478. The wet well shall have an inside diameter of 8'-0" and a wall thickness of 9". Manufacturer to certify design by a duly licensed professional engineer in the state of Colorado for 36 foot depth with full hydrostatic loading in addition to active earth pressure of 35 pcf.
2. Wet well shall be placed plumb, with a horizontal tolerance of 2 inches in 36 feet of vertical height.
3. Joints shall be primed with concrete sealant CS50 and wrapped with ConWrap CS-212 or approved equal. Apply three (3) lines of mastic at each joint.

NOTE:

Access -- Lock hatch and install warning sign: "ACCESS TO WET WELL VIA APPROPRIATE CABLE HARNESS".



ITEM LIST	
1	MAIN PUMP AND MOTOR (3) PER SPECS.
2	SUBMERSIBLE PUMP AND MOTOR (SHROUD)
3	CHECK VALVES (3)
4	PUMP ISOLATION VALVES (3)
5	STATION ISOLATION VALVES (2)
6	SLUICE GATE FLOORSTAND
7	AIR RELEASE VALVES (6)
8	FLOW SENSORS (3)
9	LEVEL PROBE HOLDER (2)
10	SCREEN ISOLATION VALVE AND STRAINER
11	PRESSURE REDUCING VALVE (2")
12	WET WELL ACCESS HATCH (SS HINGE)
13	VICTAULIC COUPLINGS (4)
14	DISCHARGE PIPE 10-INCH
15	COLLECTION PIPES 8-INCH
16	COLLECTION DIFFUSER TUBES 10-INCH WALL MOUNT (2)
17	BACKWASH RETURN LINE ASSEMBLY 2 1/2-INCH
18	COVER PLATES (ATTACHED TO SKID)
19	Z-PIPE 10-INCH (TO RIVER)
20	Z-PIPES 8-INCH (2) (FROM WELLS)
21	PUMP STATION SKID (ANCHOR TO FLOOR)
22	SLUICE GATE ASSEMBLY 30"x30"
23	WET WELL 8-FOOT DIAMETER, 9-INCH WALLS (9)
24	3/4" HOSEBIBB TEST CONNECTIONS (3)
25	6" BUTTERFLY VALVE (2) (N.C.)
26	6" DISCHARGE BYPASS
27	2" BLOW-OFF CONNECTIONS (2)
28	WALL BRACKETS (DIFFUSER TUBE)
29	10" SPOOL PIECE
30	FLOOR STAND SUPPORTS

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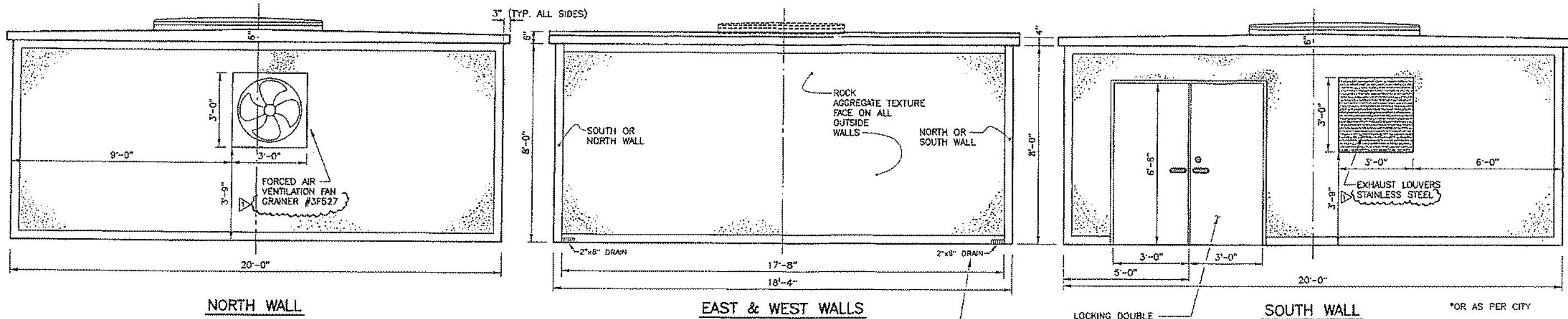
SOUTH PLATTE RESERVOIR PROJECT
PUMPING SYSTEM

ARVADA
CITY OF

NO.	DATE	BY	DESCRIPTION
1	10/20/03	CJC	REVISED FOR ARVADA - 1 AND 2
2	8/16/07	WBH	CHANGED
3	03/11	WBH	CHANGED
4		WBH	CHANGED
5		WBH	CHANGED
6		WBH	CHANGED
7		WBH	CHANGED
8		WBH	CHANGED
9		WBH	CHANGED
10		WBH	CHANGED
11		WBH	CHANGED
12		WBH	CHANGED
13		WBH	CHANGED
14		WBH	CHANGED
15		WBH	CHANGED
16		WBH	CHANGED
17		WBH	CHANGED
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19		WBH	CHANGED
20		WBH	CHANGED
21		WBH	CHANGED
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24		WBH	CHANGED
25		WBH	CHANGED
26		WBH	CHANGED
27		WBH	CHANGED
28		WBH	CHANGED
29		WBH	CHANGED
30		WBH	CHANGED

SHEET: **7**

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NORTH WALL

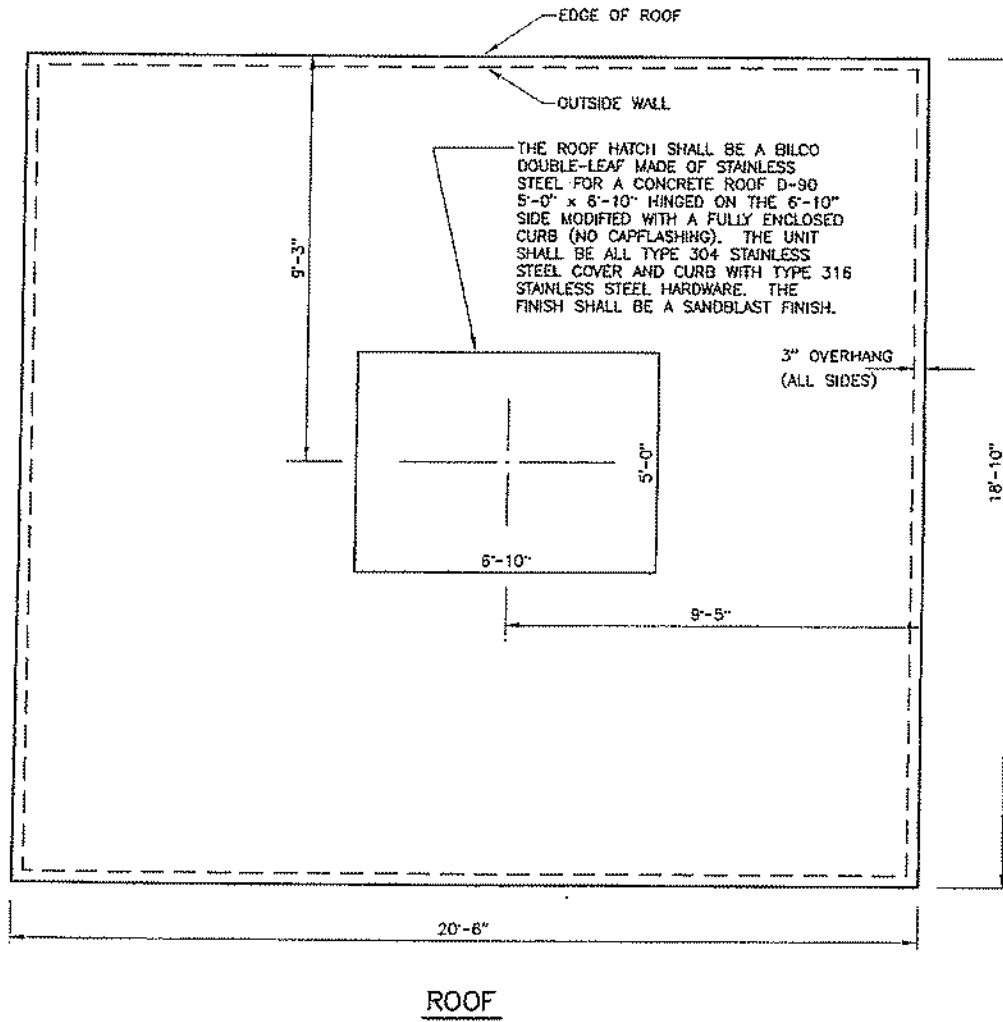
EAST & WEST WALLS

SOUTH WALL

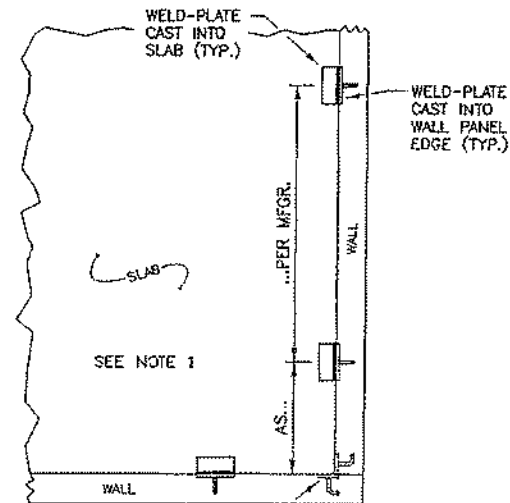
*OR AS PER CITY

NOTES

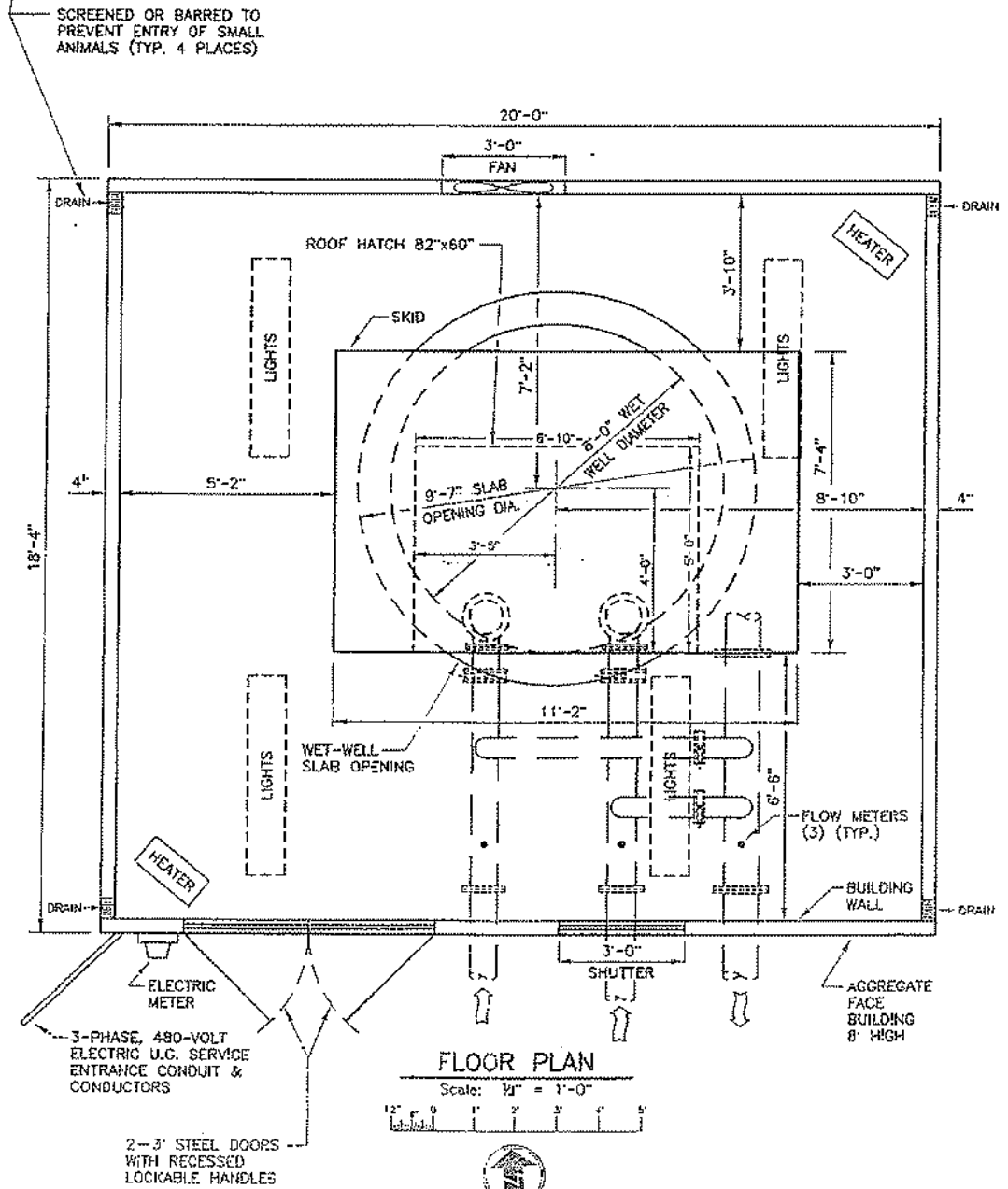
1. Prefabricated concrete building, anchor bolts and weld plates to be designed and certified by manufacturer. Contractor to coordinate placement of building anchor bolts with foundation.
2. Roof to drain east and west.



ROOF



TYPICAL WELD-PLATE
N.T.S.



FLOOR PLAN

Scale: 1/2" = 1'-0"

Applegate Group, Inc.
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 1499 West 120th Ave., Ste. 200 Loveland, CO 80538
 (303) 470-6611

SOUTH PLATE RESERVOIR PROJECT
PUMPHOUSE

CITY OF ARVADA

NO.	DATE	BY	CHKD.	DESCRIPTION
1	10/20/03	CC	MBL	REVISION FOR PUMPHOUSE - 11-10-03

Date: 6/22/03
 Job No: 03-1
 Drawn: []
 Design: []
 Check: []
 Scale: 1/2" = 1'-0"

LICENSED PROFESSIONAL ENGINEER
 PLYMOUTH COUNTY, COLORADO
 22848

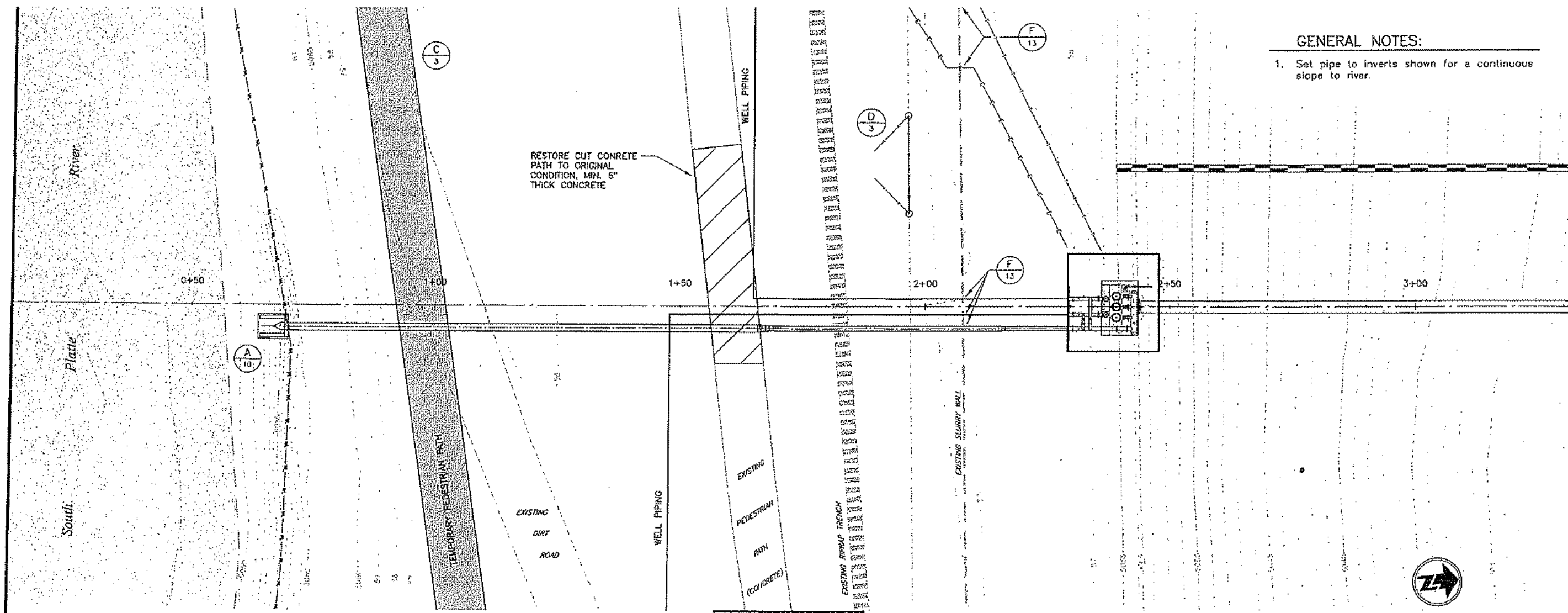
8
 Of 11

GENERAL NOTES:
 1. Set pipe to inverts shown for a continuous slope to river.

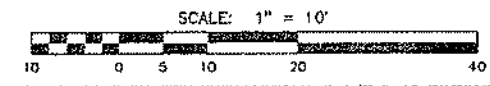
Applegate Group, Inc.
 Consulting for Law, Mining, and Water
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 Denver, CO 80231-2728
 (303) 452-6411

SOUTH PLATTE RESERVOIR PROJECT
PLAN AND PROFILE
OUTLET PIPE

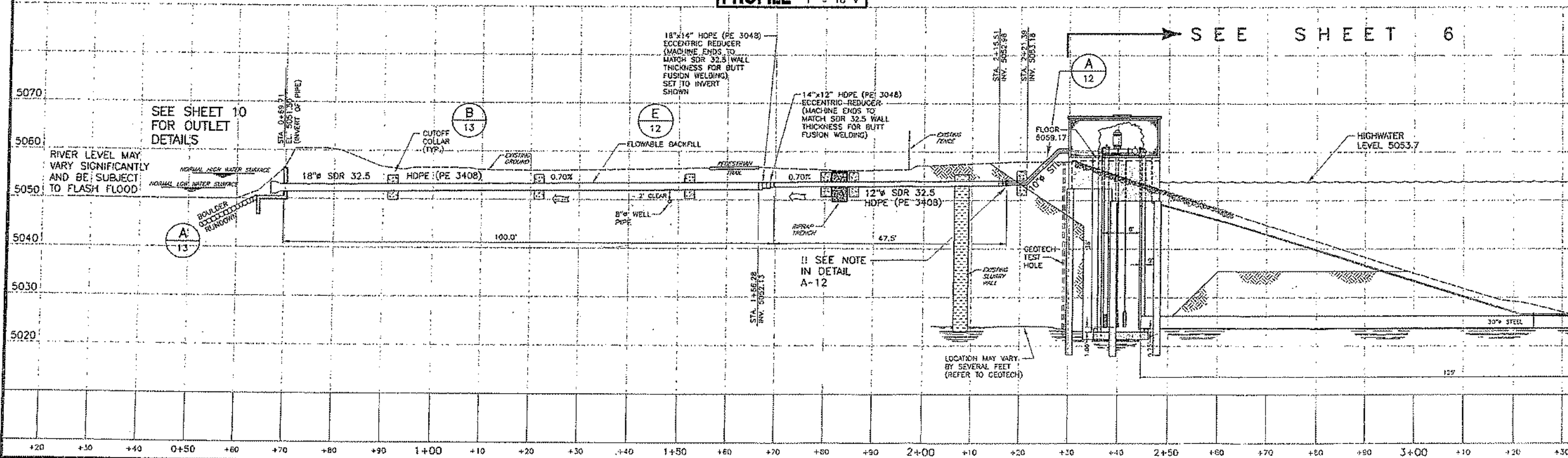
CITY OF ARVADA



PLAN SCALE: 1" = 10'
PROFILE 1" = 10' H
 1" = 10' V



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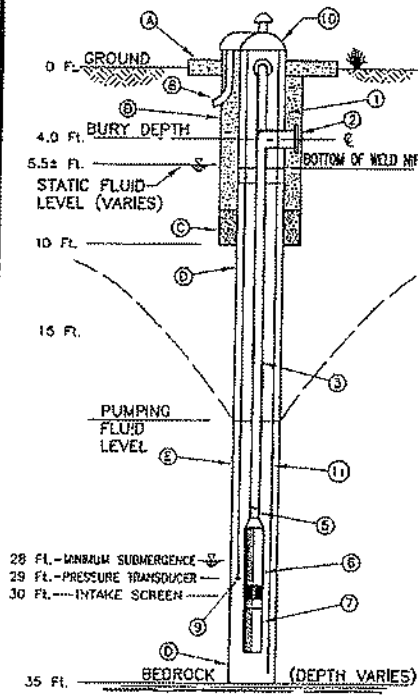


NO.	DATE	BY	DESCRIPTION

GRADUATED REGISTERED
 PAUL R. SORRELL
 22848
 PROFESSIONAL ENGINEER

Sheet: **9**
 Of: 12

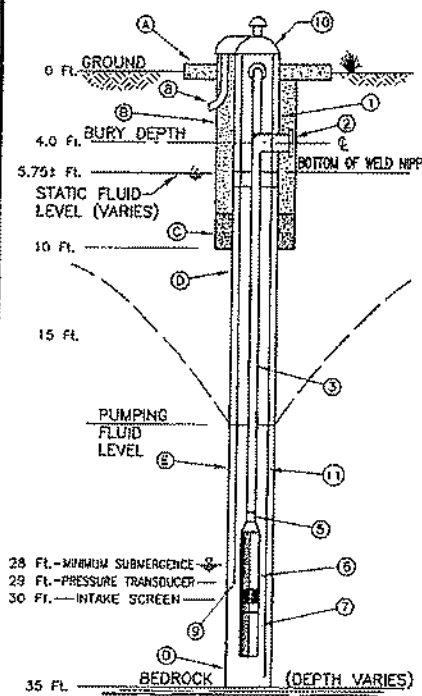
REDUCED PRINTS ARE ISSUED FOR CONVENIENCE ONLY - CONSULT FULLSIZE DRAWINGS IN CASE OF CONFLICTS



Shroud not shown for clarity

WELL 1
(formerly PW-1)

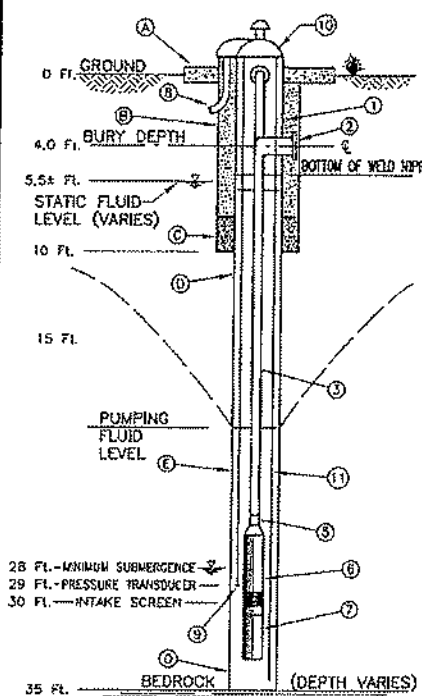
Capacity:	400 gpm
Head:	60 feet
Ground Elevation:	5058.0 feet
Pumping Fluid Level: (drawdown)	11 feet
Date Installed:	9/24/2001
Well Permit No.:	59852
Static Water Level: (4/21/2003)	5.5 feet
Casing (steel):	20 inch



Shroud not shown for clarity

WELL 2
(formerly PW-1R)

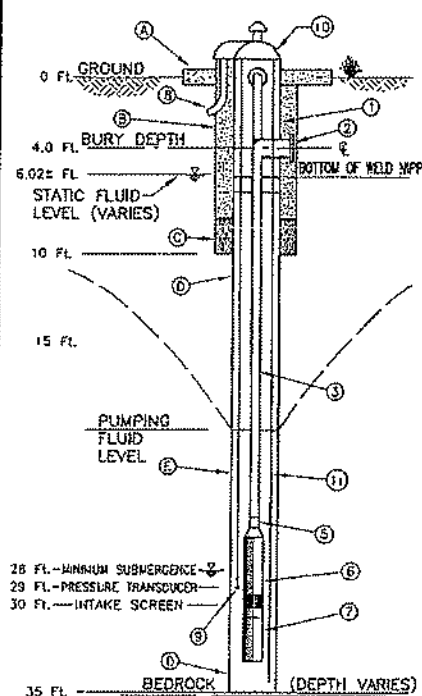
Capacity:	350 gpm
Head:	60 feet
Ground Elevation:	5056.5 feet
Pumping Fluid Level: (drawdown)	9.8 feet
Date installed:	1/30/03
Well Permit No.:	55693-F-R
Static Water Level: (4/21/2003)	5.75 feet
Casing (steel):	12 inch



Shroud not shown for clarity

WELL 3
(formerly PW-2)

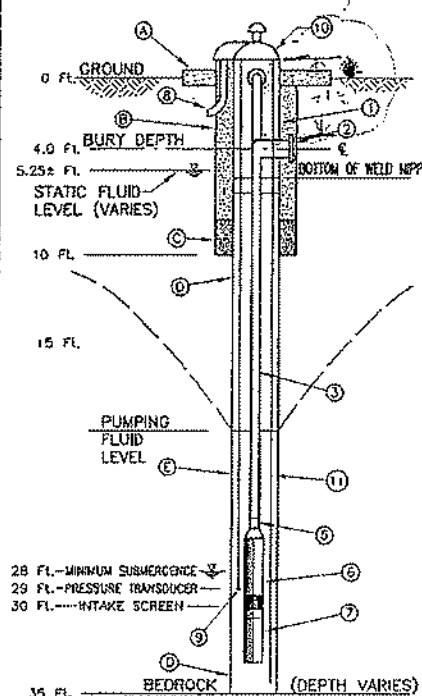
Capacity:	450 gpm
Head:	50 feet
Ground Elevation:	5057.7 feet
Pumping Fluid Level: (drawdown)	14.6 feet
Date Installed:	1/12/2003
Well Permit No.:	056813-F
Static Water Level: (4/21/2003)	5.5 feet
Casing (steel):	12 inch



Shroud not shown for clarity

WELL 4
(formerly PW-3)

Capacity:	300 gpm
Head:	50 feet
Ground Elevation:	5057.8 feet
Pumping Fluid Level: (drawdown)	11 feet
Date Installed:	1/28/2003
Well Permit No.:	058226-F
Static Water Level: (4/21/2003)	6.02 feet
Casing (steel):	12 inch



Shroud not shown for clarity

WELL 5
(formerly PW-4)

Capacity:	350 gpm
Head:	50 feet
Ground Elevation:	5056.6 feet
Pumping Fluid Level: (drawdown)	9.4 feet
Date Installed:	1/26/2003
Well Permit No.:	058227-F
Static Water Level: (4/21/2003)	5.25 feet
Casing (steel):	12 inch

NOTE

1. Wells shall be marked with permanent well and permit number

LEGEND

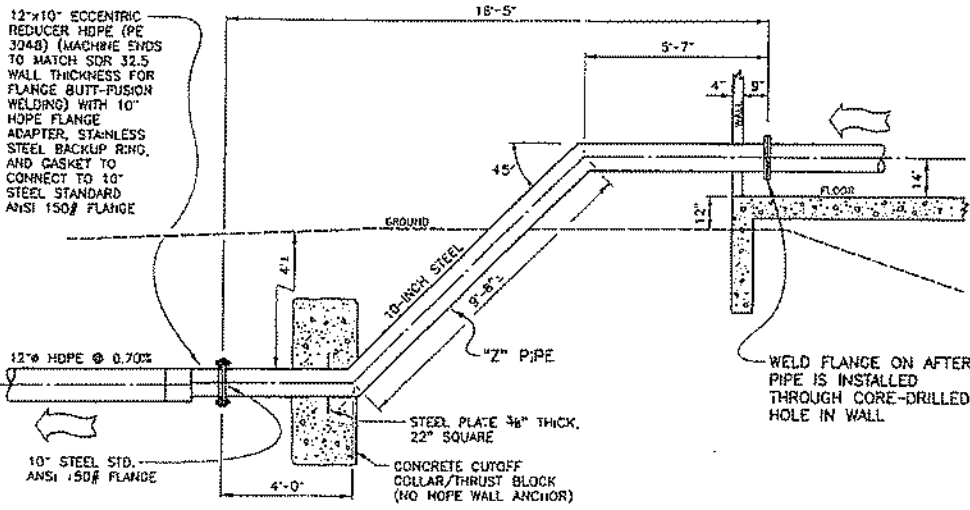
1. Pitless Unit (Baker #4PS1214WBWE06-F6E-SP) with pressure transducer
2. Flange connection (6-inch)
3. Drop pipe (6-inch)
4. [not used]
5. Check valve (6-inch)
6. Submersible pump with screen stainless steel
7. Motor, 3-phase, 480-volts (with shroud)
8. Electrical conduit and conductors
9. Pressure Transducer
10. Test connection
11. 1/4" polyethylene tubing for level measurement (each well)

INSTALLED BY OTHERS (EXISTING):

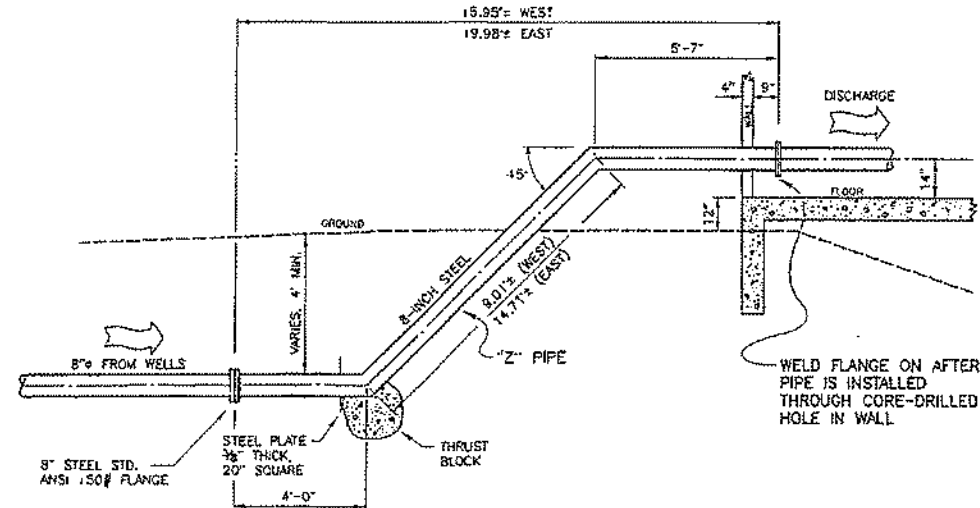
- A. Concrete pad (remove)
- B. Cement grout seal (replace)
- C. Bentonite pellet seal
- D. Casing (12-inch nominal, low-carbon steel, 0.375-inch wall thickness) (exception: Well 1 casing = 20" 0' to 15' depth, and 30" to 35' depth)
- E. Screen (12-inch nominal, 304 SS wire 15' long wrap, 0.125-inch slot) (exception: Well 1 screen = 20" 15' to 30' depth)

NO.	DATE	DESCRIPTION
1	7/20/07	DESIGNED
2	05-1	DRAWN
3		CHECKED
4		DATE
5		BY
6		CHK'D BY

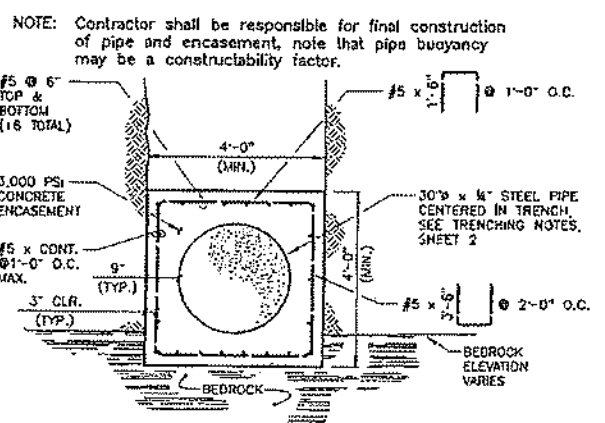




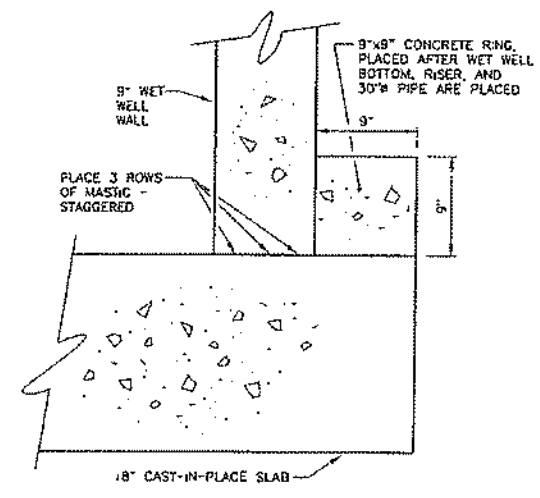
A Z-PIPE 10" OUTFLOW
12 N.T.S.



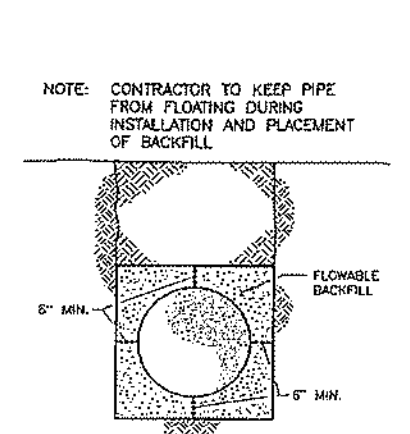
B Z-PIPE 8" FROM WELLS
12 N.T.S.



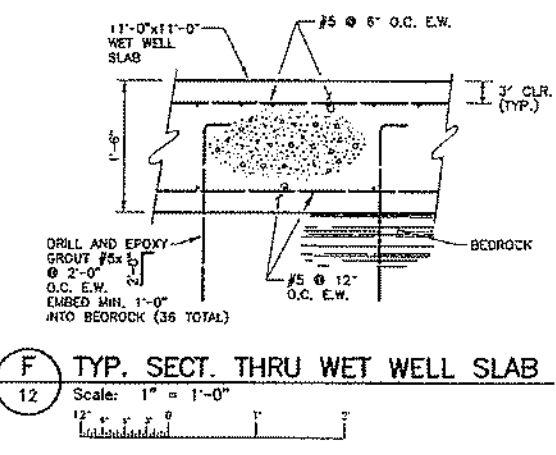
C PIPE TRENCH RESERVOIR
12 Scale: 1/2" = 1'-0"



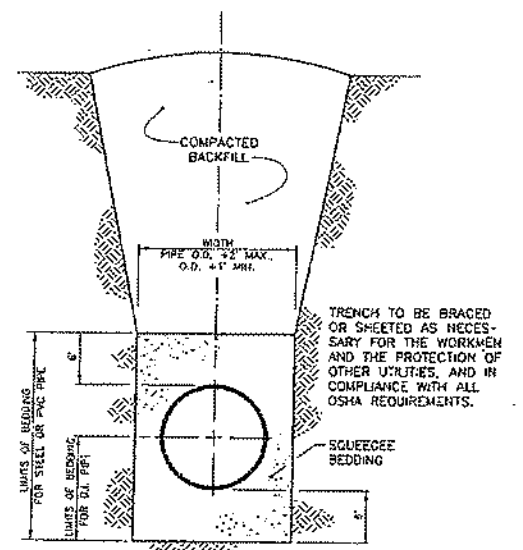
D CONNECTION WET WELL TO SLAB
12 Scale: 1 1/2" = 1'-0"



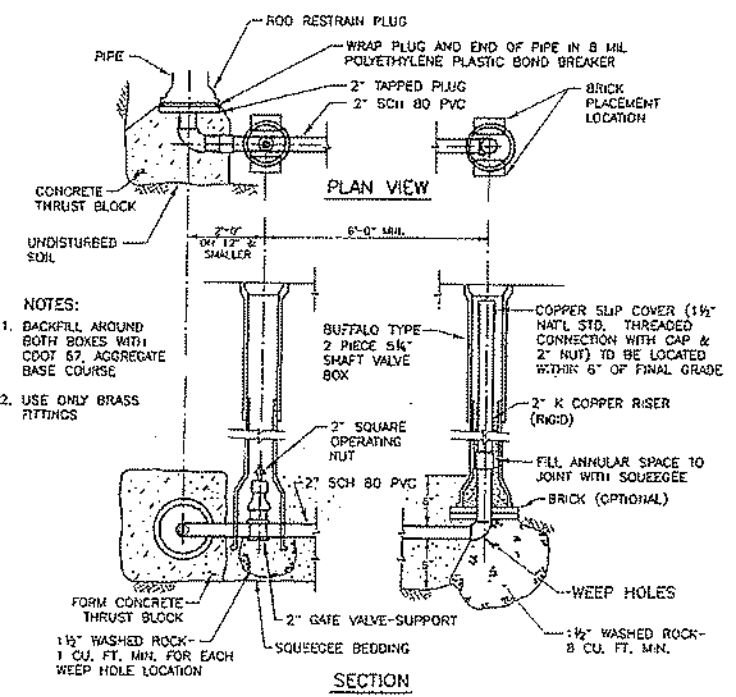
E PIPE TRENCH OUTFLOW
12 Scale: 1/2" = 1'-0"



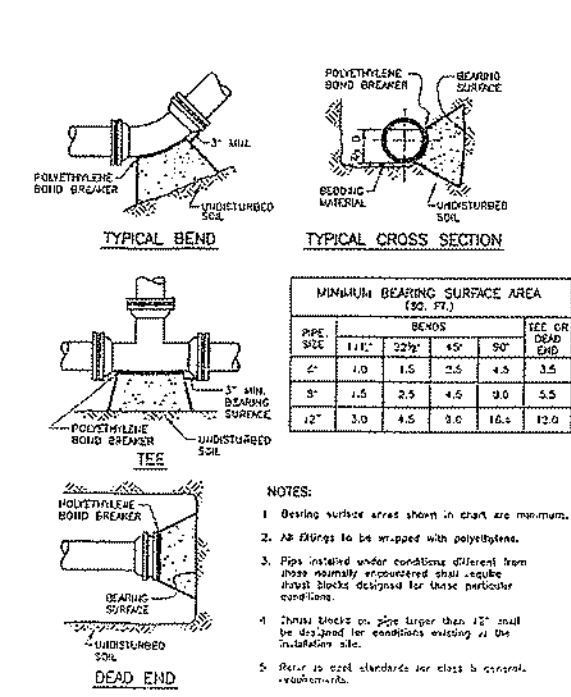
F TYP. SECT. THRU WET WELL SLAB
12 Scale: 1" = 1'-0"



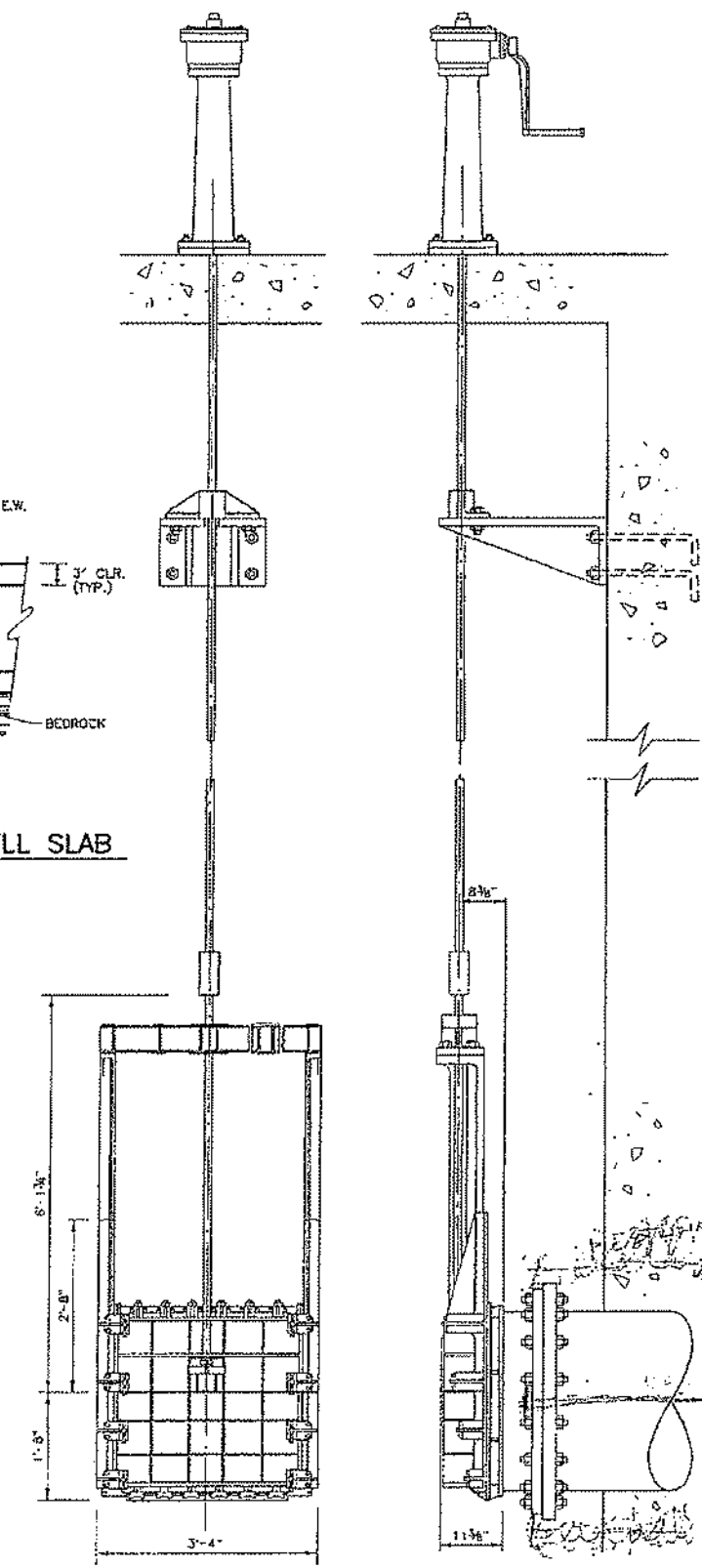
G PIPE TRENCH WELL PIPING
12 N.T.S.



H BLOW OFF 2" O
12 N.T.S.



I THRUST BLOCK
12 N.T.S.



J TYPICAL SLUICE GATE INSTALLATION
12 N.T.S.

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Applegate Group, Inc.
Consultants for Land, Mineral, and Water
1499 West 120th Ave., Ste. 205
Denver, CO 80234-3728
(303) 445-4611

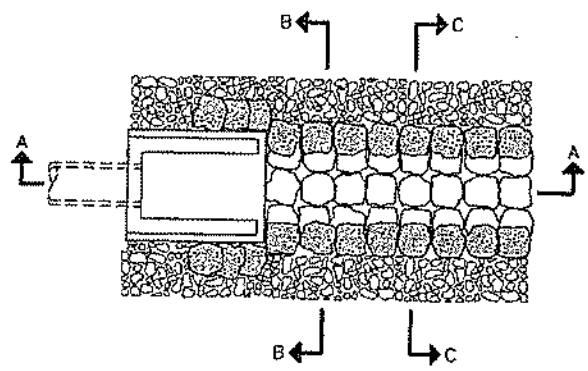
SOUTH PLATTE RESERVOIR PROJECT
DETAILS

ARVADA
CITY OF

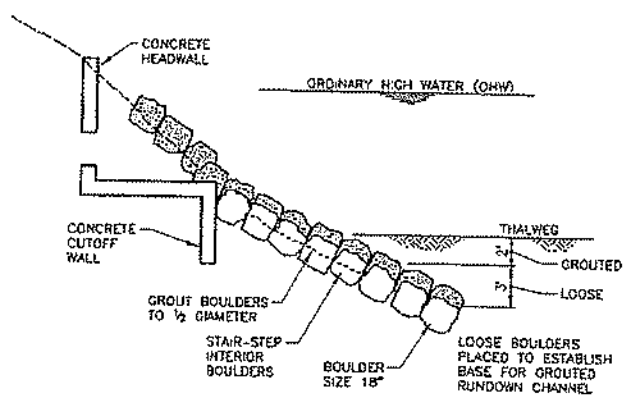
NO.	DATE	BY	DESCRIPTION

Scale: 1" = 1'-0"
Date: 8/06
Job No: 03
Drawn: JLS
Checked: JLS
Scale: HD

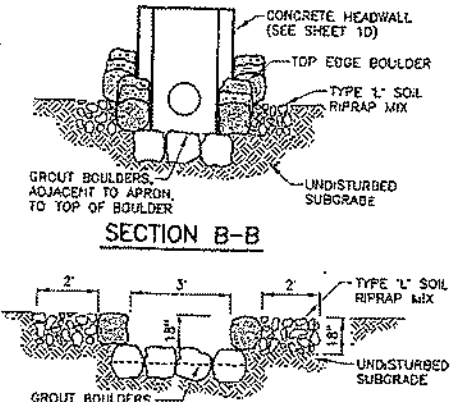
PROFESSIONAL ENGINEER
22848



PLAN

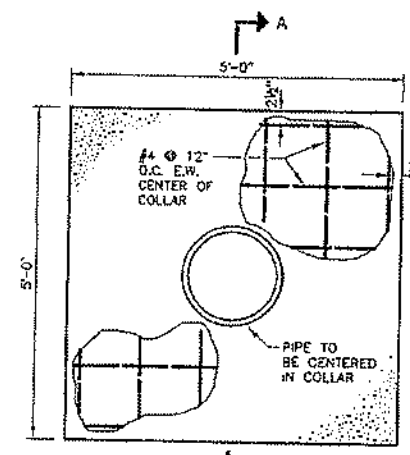


SECTION A-A

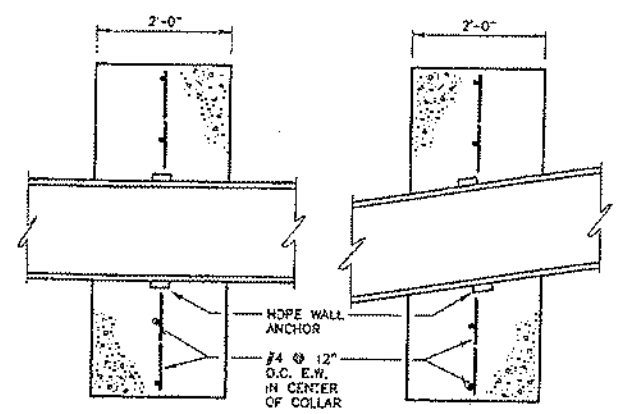


SECTION B-B

SECTION C-C



ELEVATION



LEVEL PIPE

SLOPED PIPE

SECTION A-A

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSIONS (INCHES)	d_{50} (INCHES)*
TYPE 1'	70-100	15	9**
	50-70	12	
	35-50	9	
	2-10	5	

* d_{50} = MEAN PARTICLE SIZE (INTERMEDIATE DIMENSION) BY WEIGHT
 **MIX WITH 30% (BY VOLUME) TOPSOIL AND BURY IT WITH 8+ INCHES OF TOPSOIL, ALL VIBRATION COMPACTED, AND REVEGETATE

CLASSIFICATION OF BOULDERS

BOULDER DESIGNATION	INDIVIDUAL SIZE AND RANGE IN SMALLEST DIMENSION OF INDIVIDUAL ROCK BOULDERS (INCHES)	MAXIMUM RATIO OF LARGEST TO SMALLEST ROCK DIMENSION OF INDIVIDUAL BOULDERS
B18	18 [17-20]	2.5

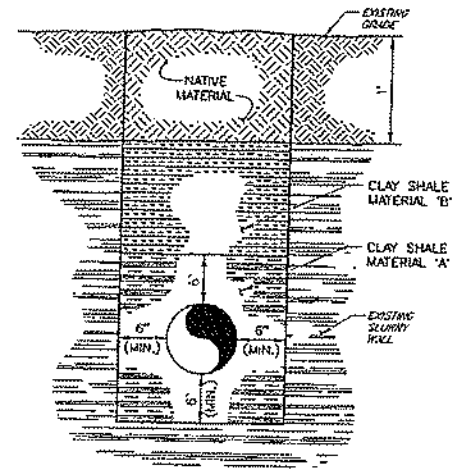
STRUCTURAL GROUT REQUIREMENTS FOR GROUTED BOULDERS

ITEM	*TYPE 'B'
Concrete	Type II, 7 Sack
Concrete Aggregate Mix - Maximum Diameter	3/4 inch
Compressive Strength	3,200 psi at 28 days
Slump	4 to 6 inches
Air Entrainment	7.5% ± 1.3%
Fiber Mesh	1.5 lbs/cy
Fly Ash (Class C) - Maximum Allowable Substitute	25%
Color Additive	As Required

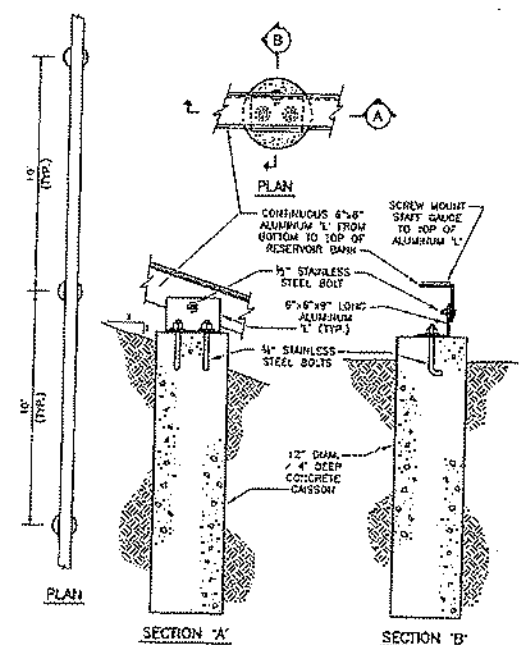
*Type 'B' has been designed for use in streams and rivers with significant perennial flows.

CLAY SHALE MATERIAL SPECIFICATIONS

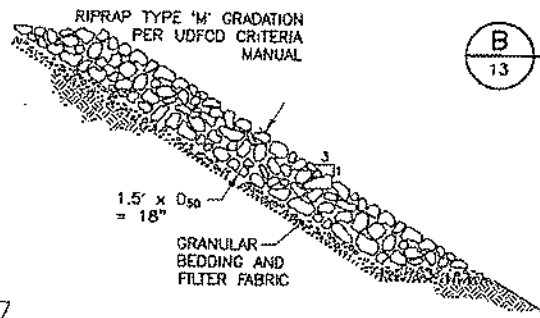
GRADATION	PLASTICITY INDEX	COMPACTION
A 100% PASSING 1 1/2" 50% PASSING #200	>10	95% OF STD. PROCTOR -1% TO +3% OF OPTIMUM MOISTURE
B 100% PASSING 6" 50% PASSING #20	>10	95% OF STD. PROCTOR -1% TO +3% OF OPTIMUM MOISTURE



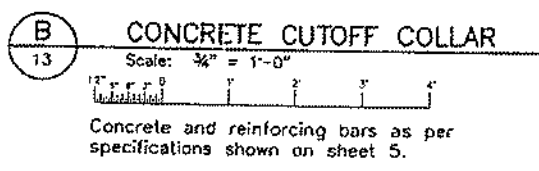
F SLURRY WALL CROSSING
13 N.T.S.



G STAFF-GAUGE MOUNTING
13 N.T.S.

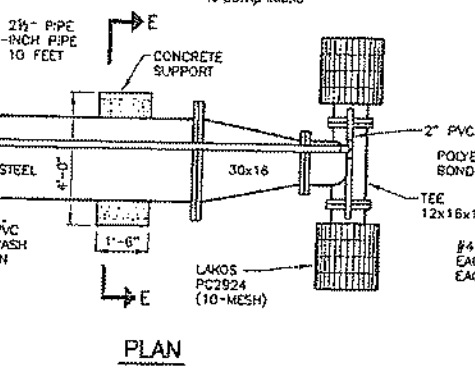
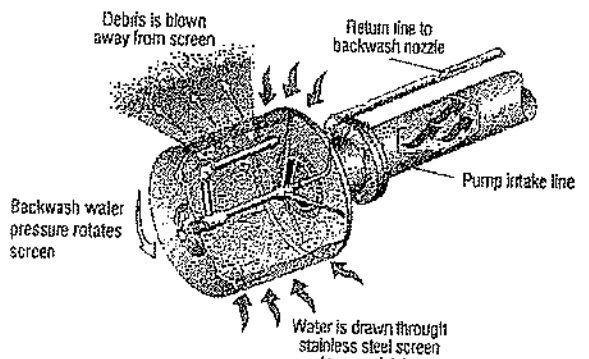


E RIPRAP SLOPE PROTECTION
13 N.T.S.

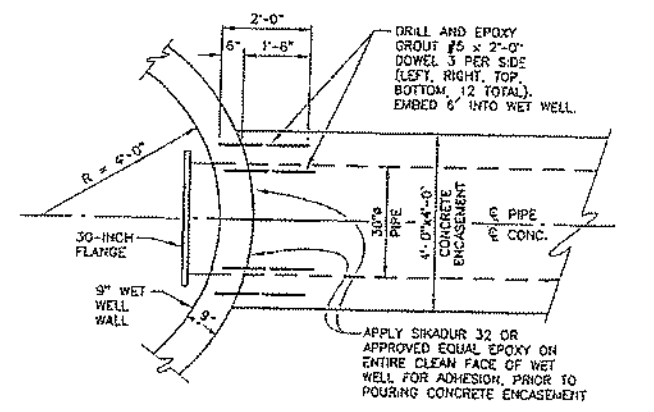


B CONCRETE CUTOFF COLLAR
13 Scale: 3/8" = 1'-0"

Concrete and reinforcing bars as per specifications shown on sheet 5.

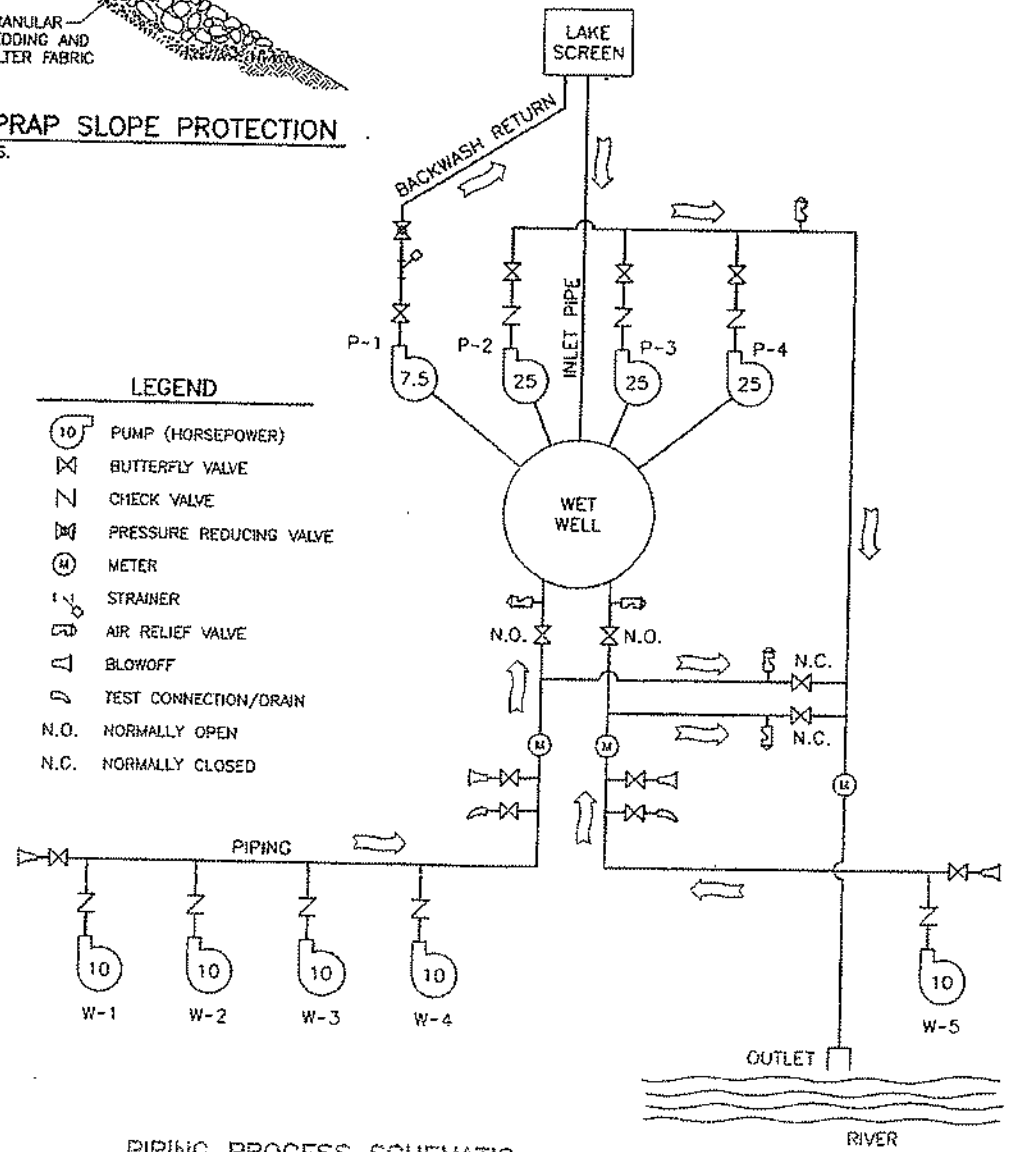


D SELF-CLEANING PUMP INLET SCREENS
13 Scale: 3/8" = 1'-0"



C WET WELL PIPE ENCASEMENT CONNECTION
13 Scale: 1/2" = 1'-0"

- LEGEND**
- 10 PUMP (HORSEPOWER)
 - ✕ BUTTERFLY VALVE
 - ∇ CHECK VALVE
 - ∇ PRESSURE REDUCING VALVE
 - ⊙ METER
 - ⊙ STRAINER
 - ∇ AIR RELIEF VALVE
 - ∇ BLOWOFF
 - ∇ TEST CONNECTION/DRAIN
 - N.O. NORMALLY OPEN
 - N.C. NORMALLY CLOSED



PIPING PROCESS SCHEMATIC
N.T.S.

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Applegate Group, Inc.
 Consultants for Land, Materials, and Water
 1459 West 120th Ave., Ste. 200 1441 Dodge Dr., Ste. 200
 Denver, CO 80231-7126 Loveland, CO 80538
 (303) 452-0811

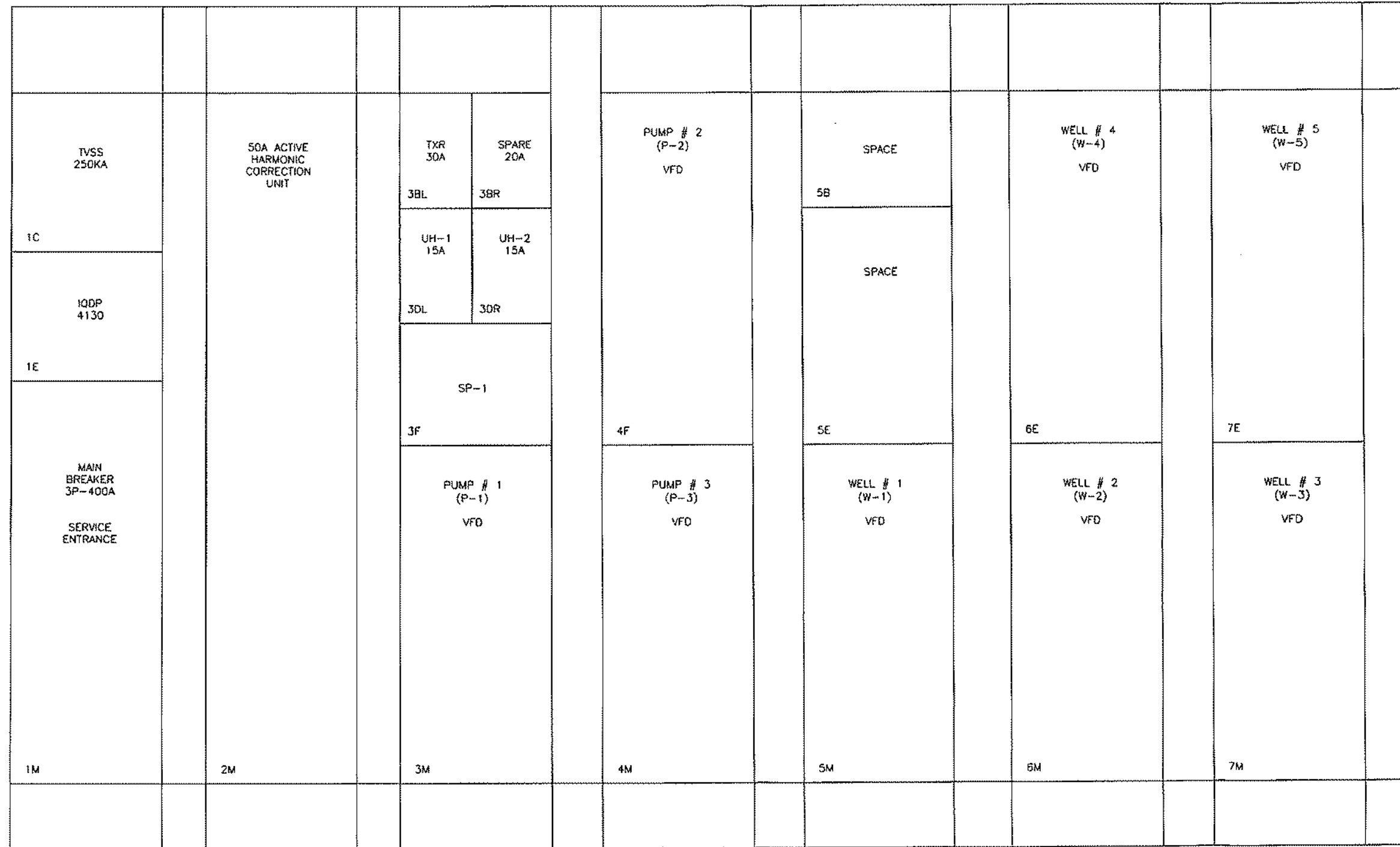
SOUTH PLATE RESERVOIR PROJECT
 DETAILS
 PIPING PROCESS DIAGRAM

CITY OF ARVADA

NO.	DATE	BY	CHK'D	DESCRIPTION

Drawn: B/22/1
 Date: 05-1
 Design: [Signature]
 Check: [Signature]
 Scale: NOT

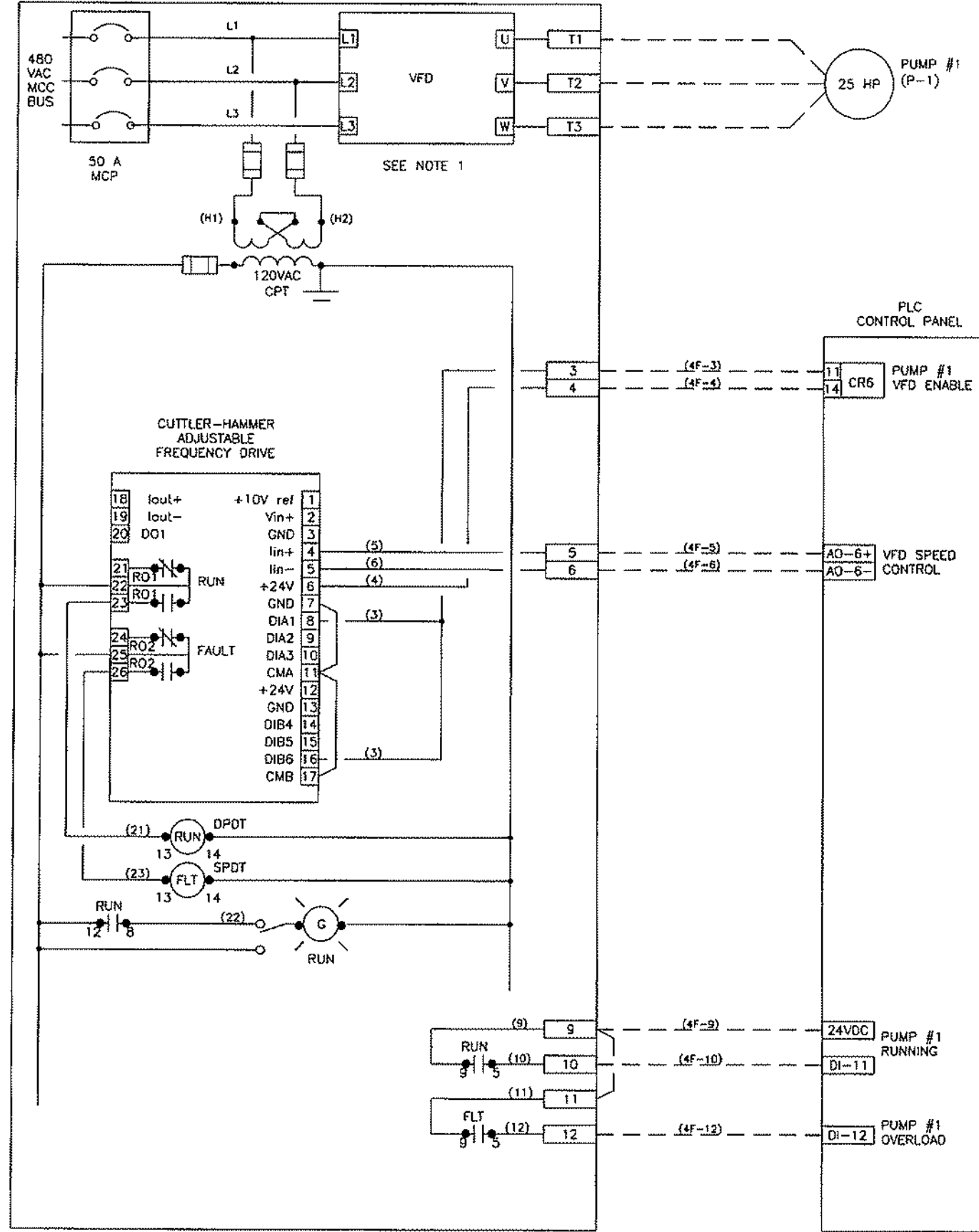
Sheet: **13**



MCC-1 ELEVATION

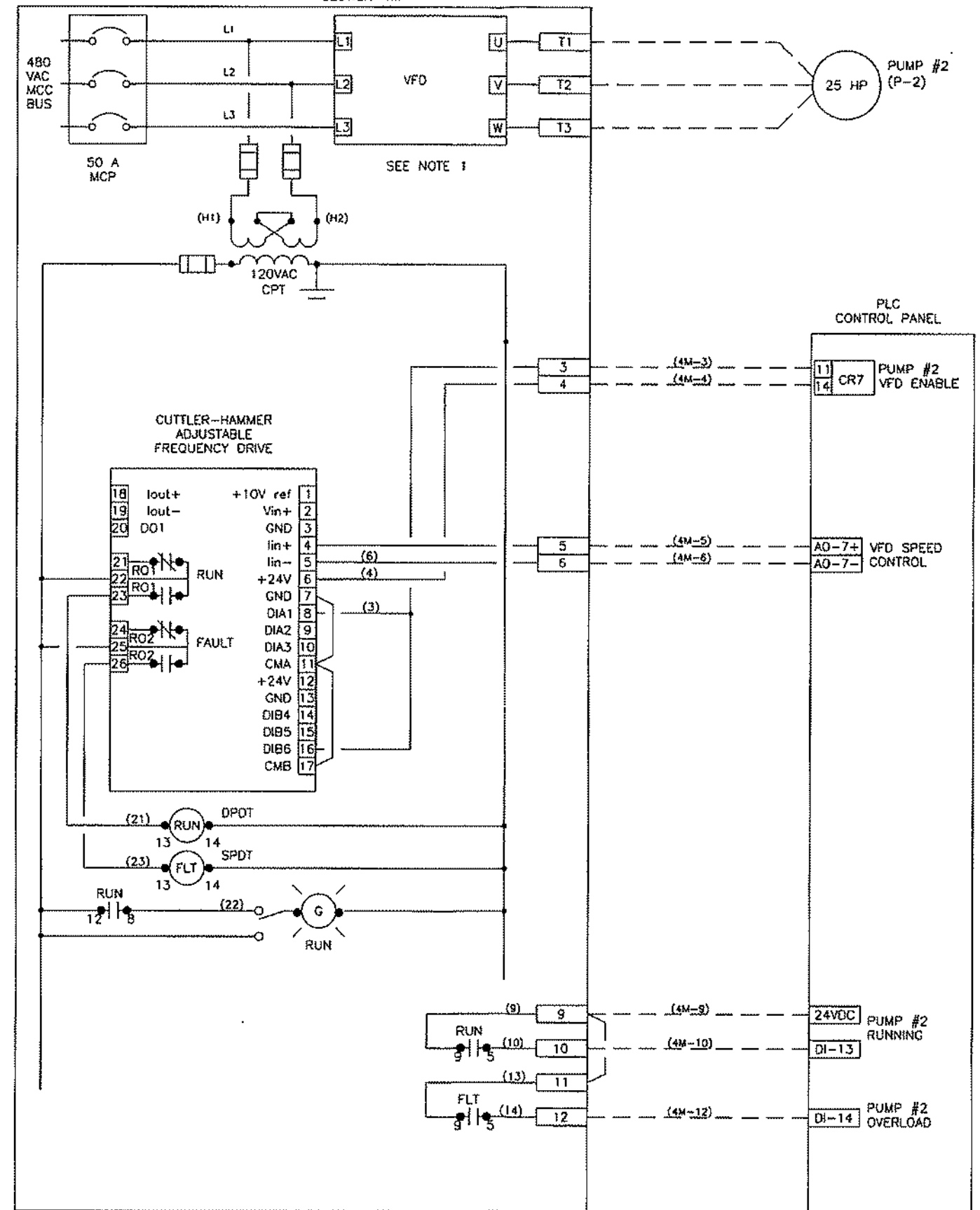
REVISIONS		BROWNS HILL ENGINEERING & CONTROLS, LLC 8871 S AMMONS ST LITTLETON, CO 80128 (720) 344-7771	TOWN OF ARVADA	
A			SOUTH PLATTE RESERVOIR PROJECT	
B			MCC	
C			MCC LAYOUT	
D			DATE: 10/20	JOB #03-070
E		DESIGNED BY: LMG	DRAWN BY: LMG	1/15

PUMP #1 (P-1)
SECTION 4F



NOTE 1: THE SV-9000 VFD HAS AN INTERNAL OUTPUT FILTER.

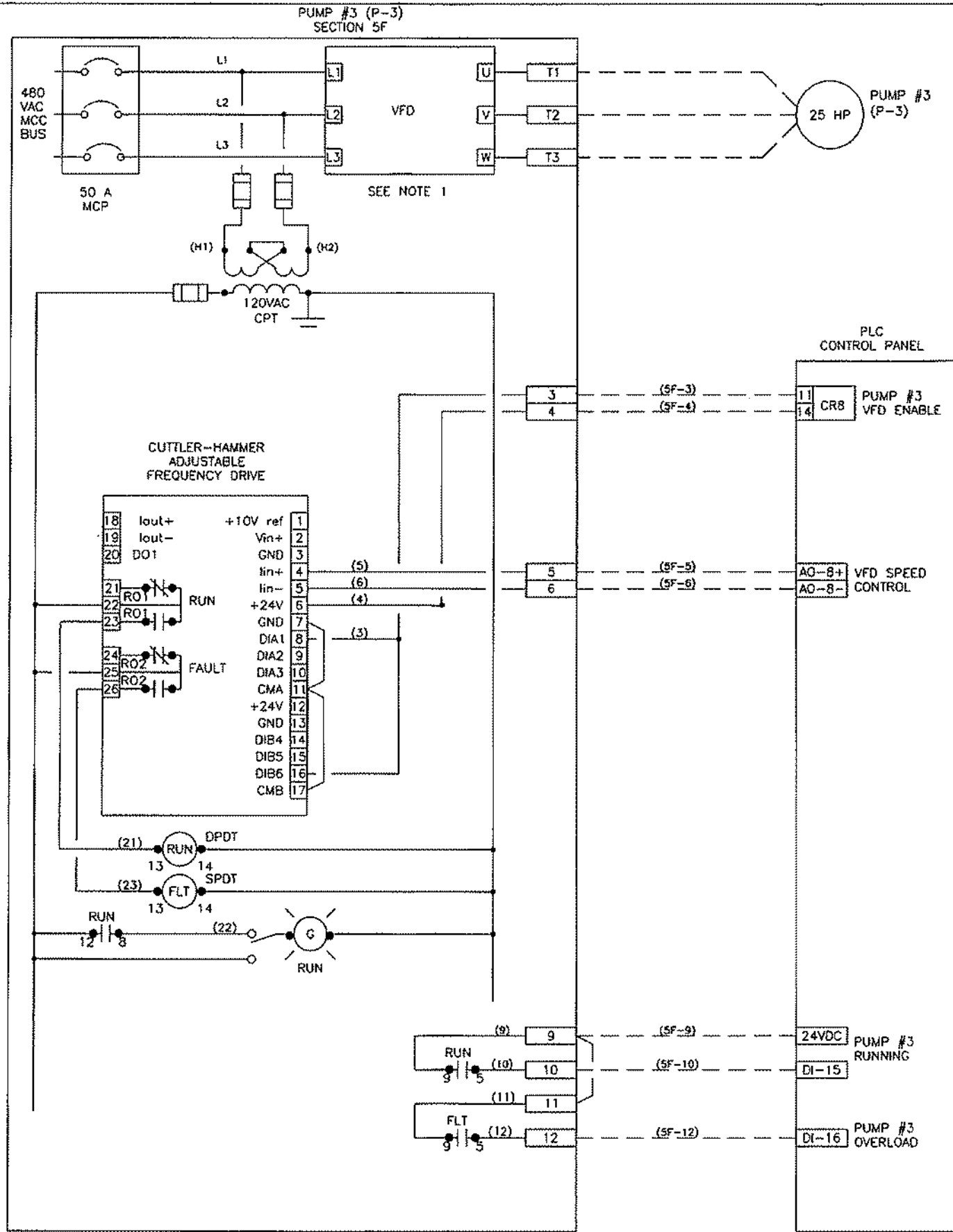
PUMP #2 (P-2)
SECTION 4M



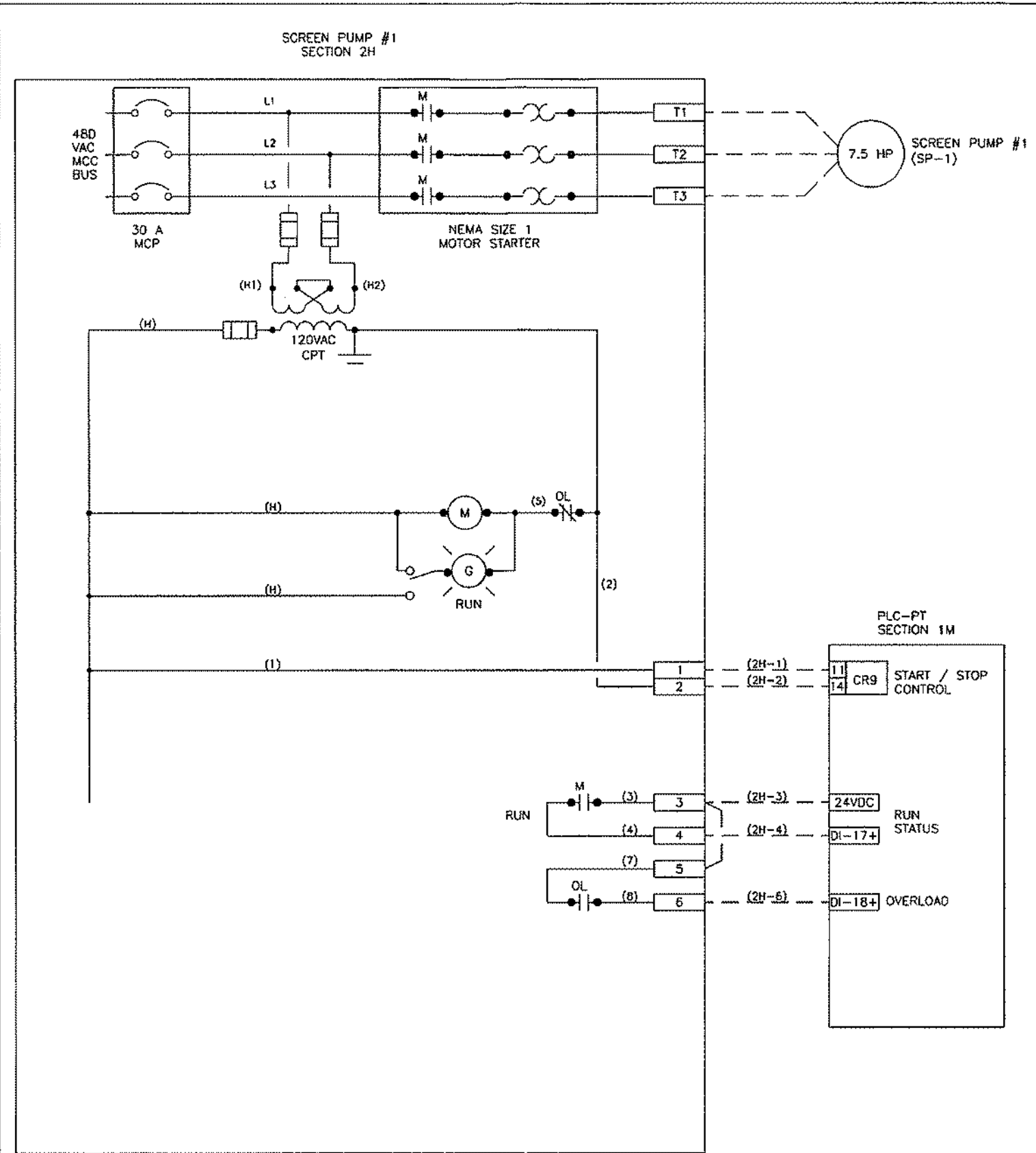
REVISIONS	
A	Per Engineers comments on 12/3
B	
C	
D	
E	
DESIGNED BY: LAA DRAWN BY: LMG	

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ENGINEERING
& CONTROLS, LLC
8871 S AMMONS ST
LITTLETON, CO 80128
(720) 344-7771

CITY OF ARVADA
SOUTH PLATTE RESERVOIR PROJECT
MCC - P1 & P2
WIRING DIAGRAM
DATE: 10/03 | JOB #03-070 | 02
FILE #: | 15



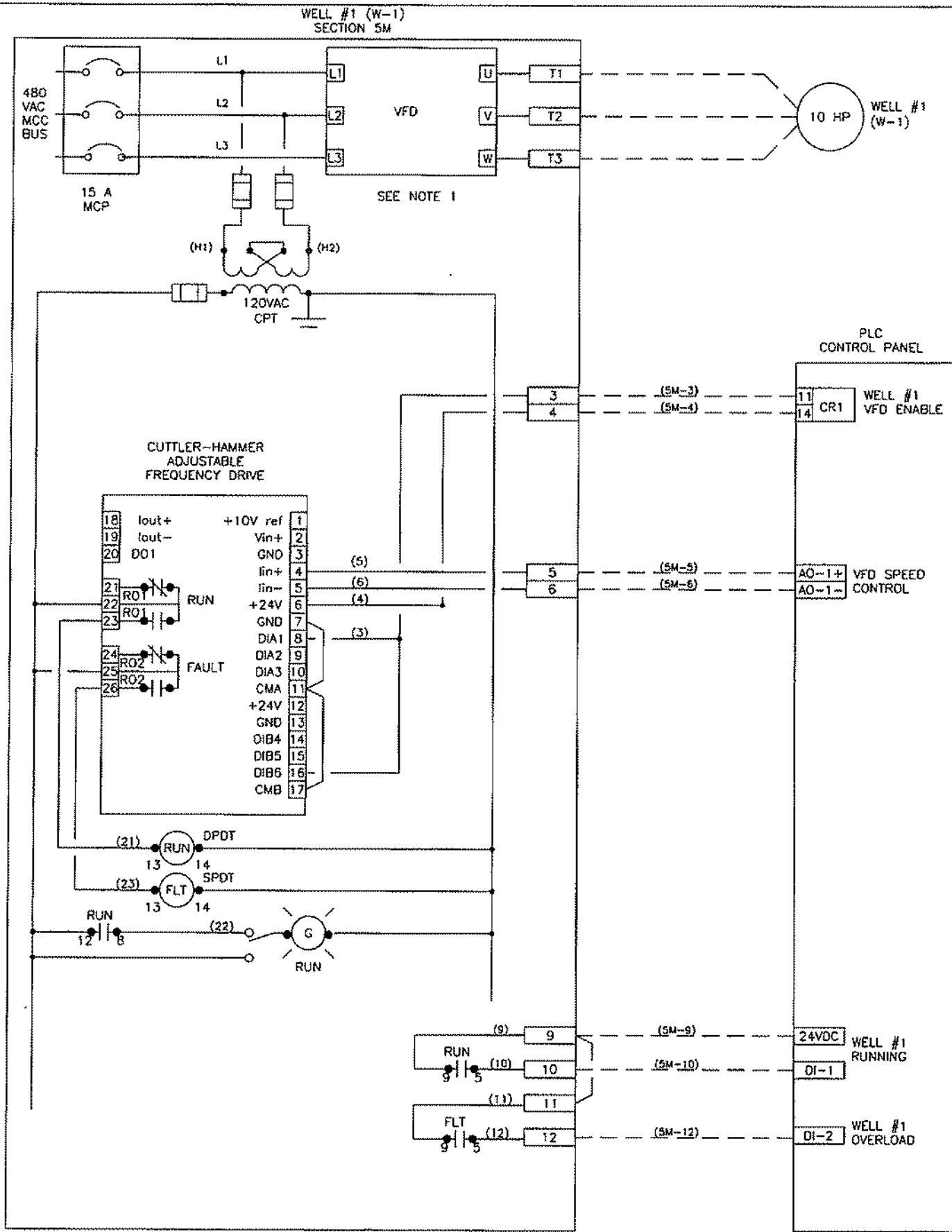
NOTE 1: THE SV-9000 VFD HAS AN INTERNAL OUTPUT FILTER.



REVISIONS	
A	Per Engineers comments on 12/3
B	
C	
D	
E	
DESIGNED BY: LAA DRAWN BY: LMG	

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LITTLETON, CO 80128
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CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT MCC - P3 & SP1 WIRING DIAGRAM	
DATE: 10/03	JOB #03-070
FILE #:	03
	15



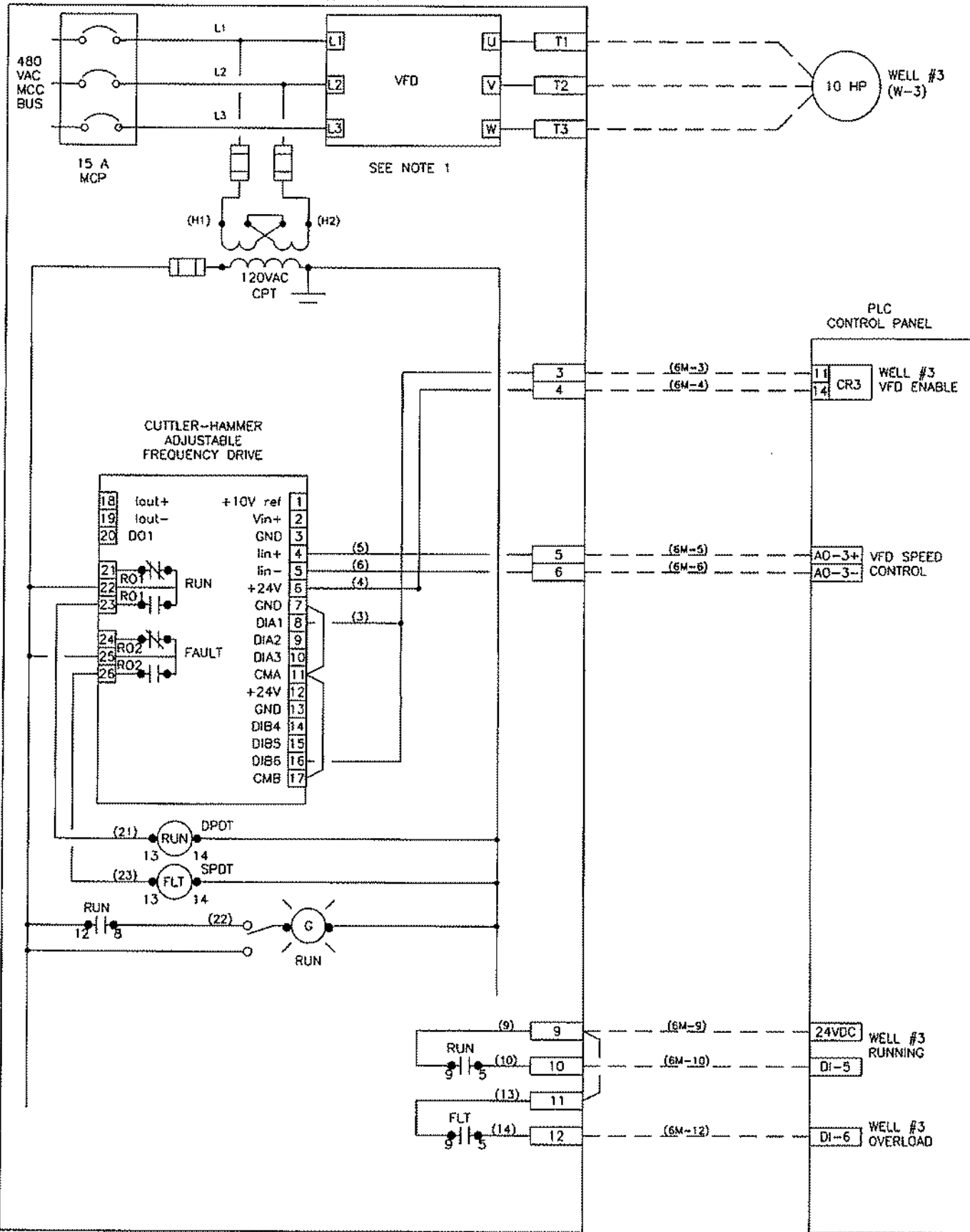
NOTE 1: THE SV-9000 VFD HAS AN INTERNAL OUTPUT FILTER.

REVISIONS	
A	Per Engineers comments on 12/3
B	
C	
D	
E	
DESIGNED BY: LAA DRAWN BY: LMG	

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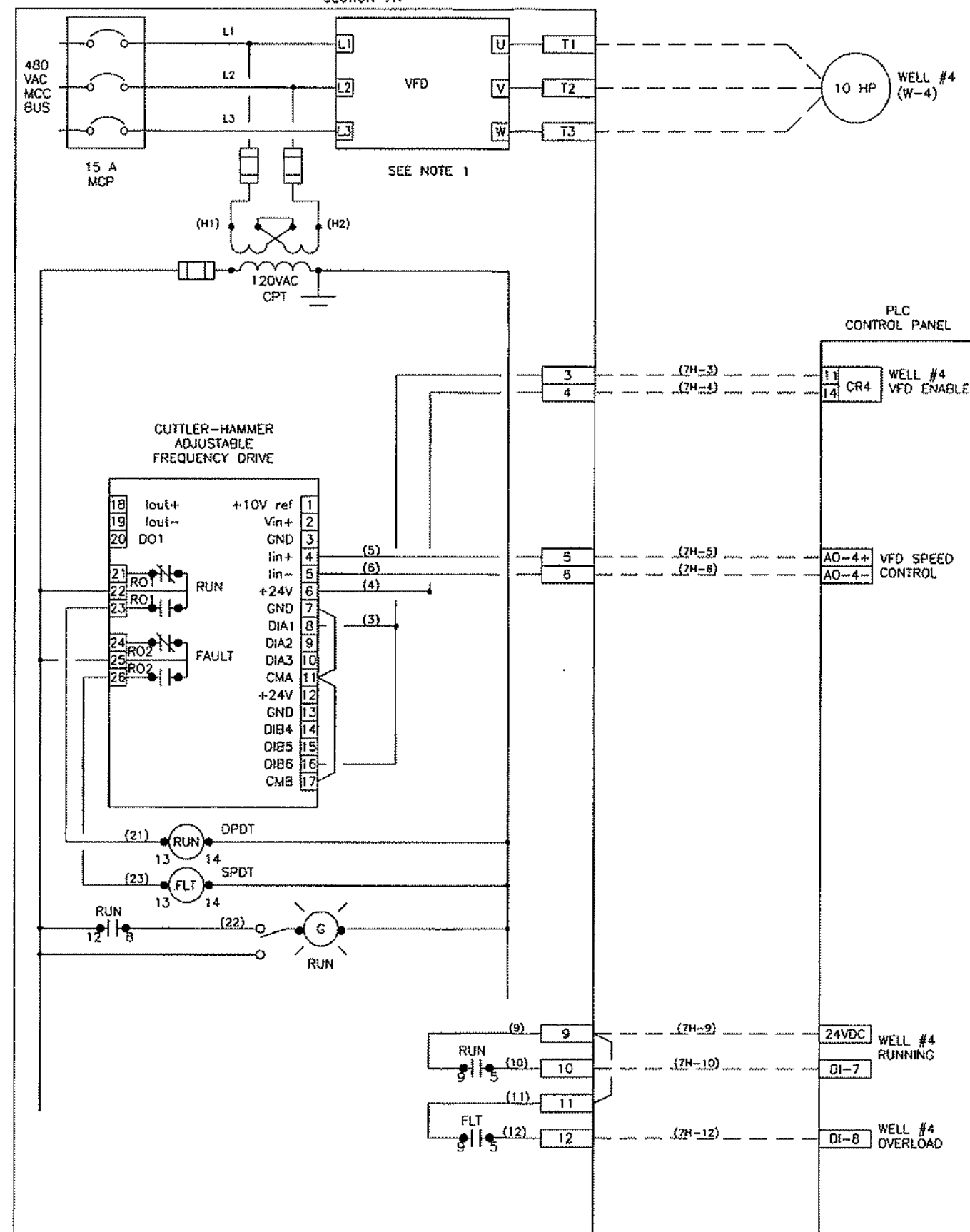
CITY OF ARVADA
 SOUTH PLATTE RESERVOIR PROJECT
 MCC - W1 & W2
 WIRING DIAGRAM
 DATE: 10/03 JOB #03-070 04
 FILE #:

WELL #3 (W-3)
SECTION 6M



NOTE 1: THE SV-9000 VFD HAS AN INTERNAL OUTPUT FILTER.

WELL #4 (W-4)
SECTION 7H

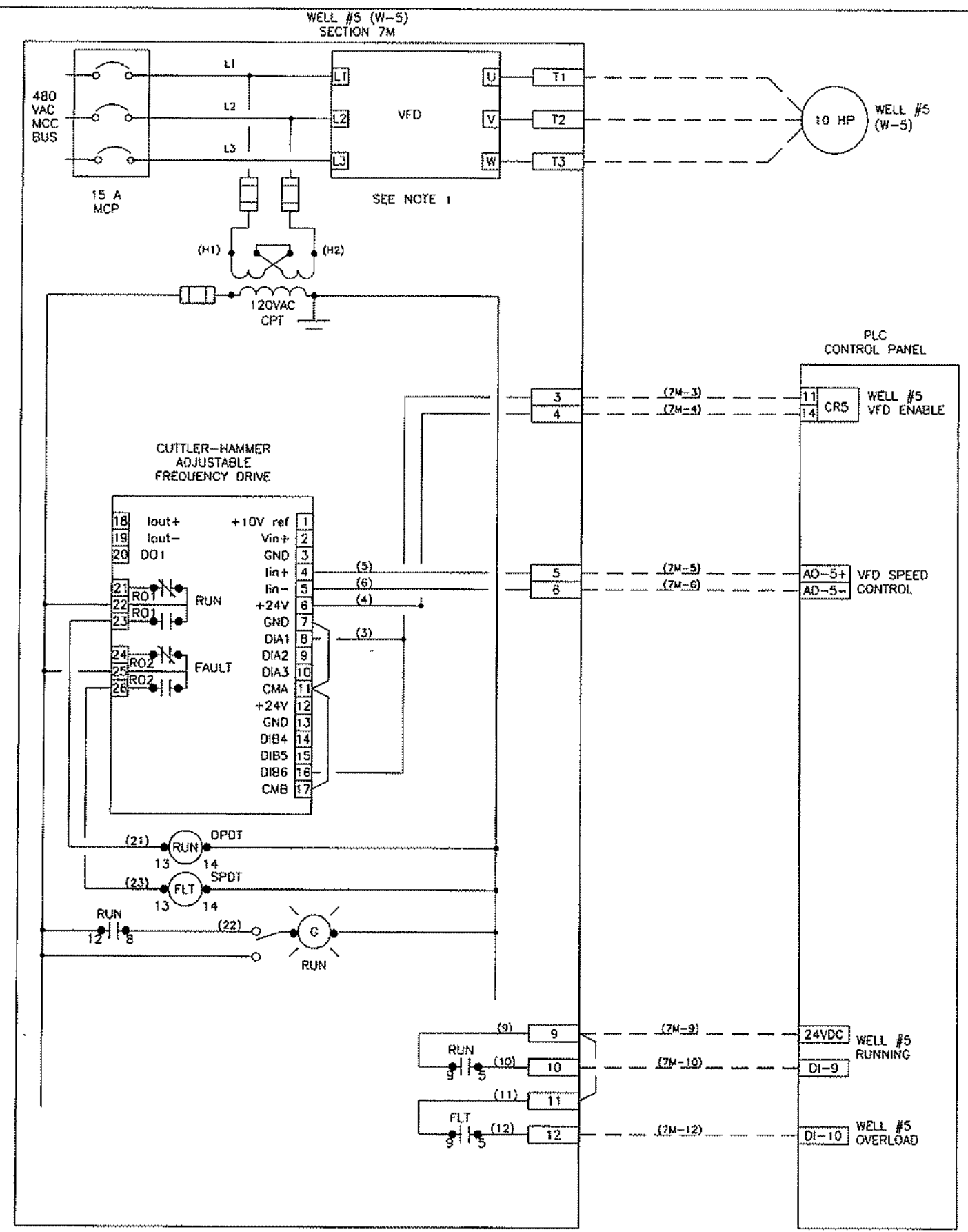


REVISIONS	
A	Per Engineers comments on 12/3
B	
C	
D	
E	
DESIGNED BY: LAA DRAWN BY: LMG	

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& CONTROLS, LLC
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CITY OF ARVADA
SOUTH PLATE RESERVOIR PROJECT
MCC - W3 & W4
WIRING DIAGRAM
DATE: 10/03 | JOB #03-070 | 05
FILE #:

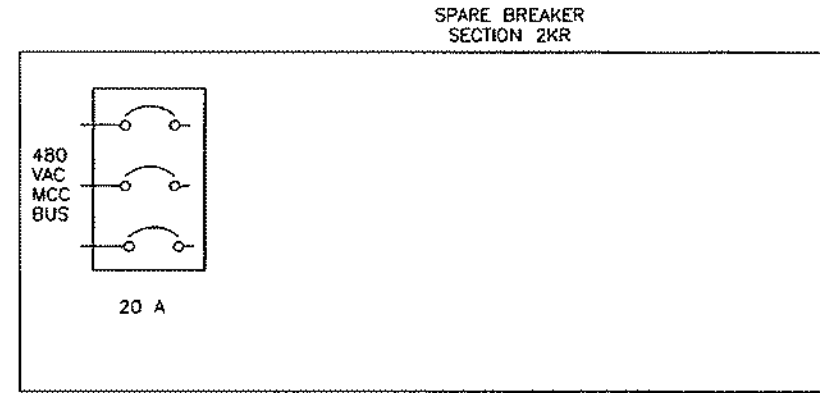
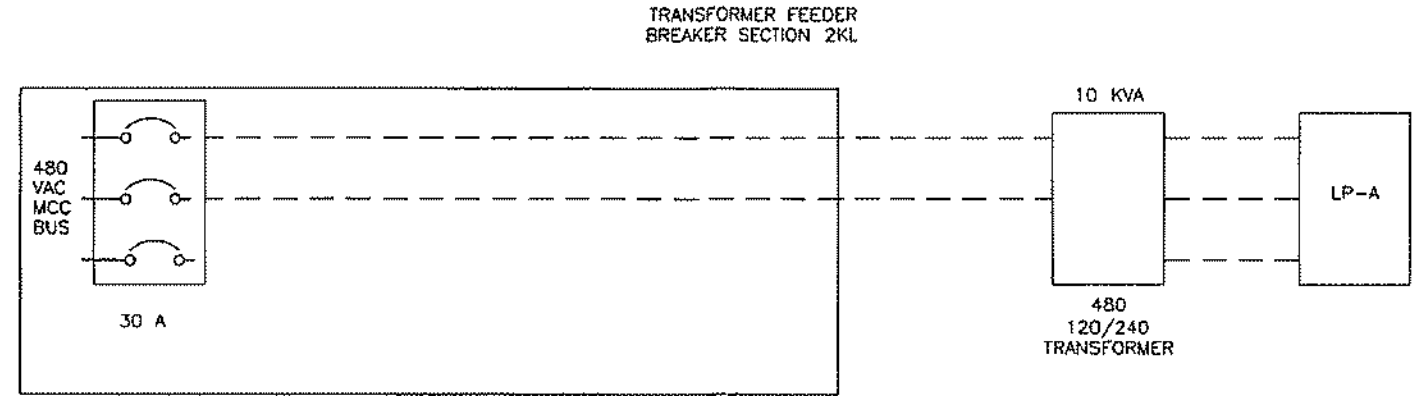
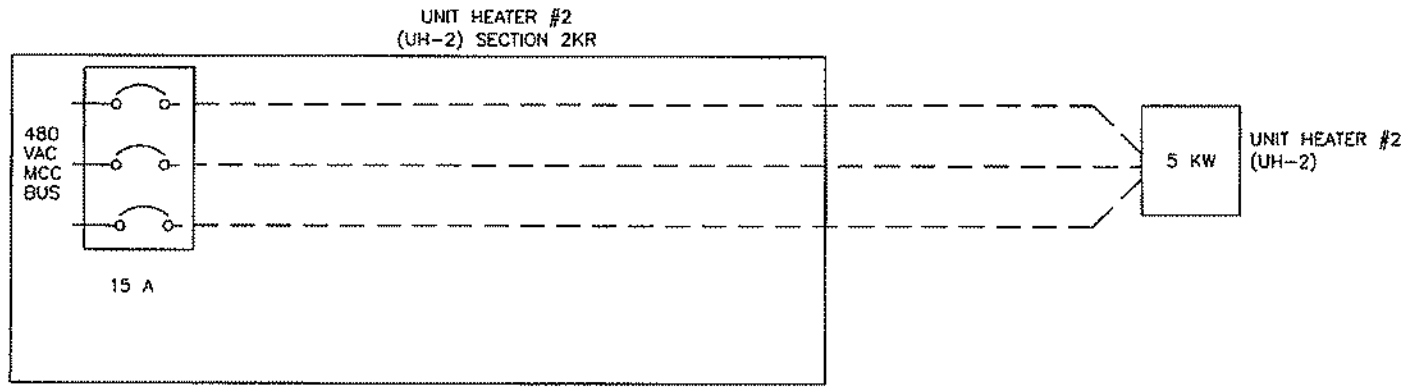
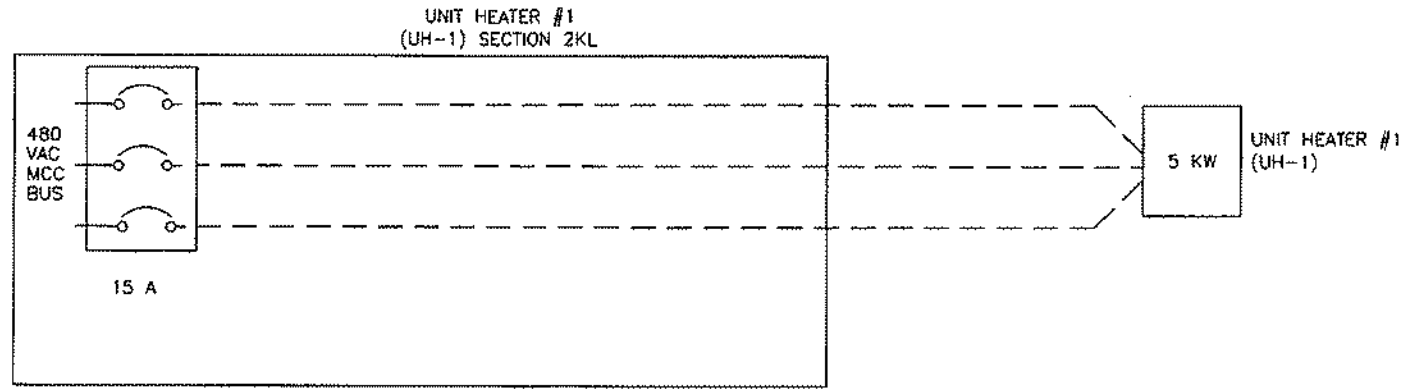
Browns Hill Engineering & Controls
 12/24/2003 2:23 PM
 D06-MCC-W5.dwg



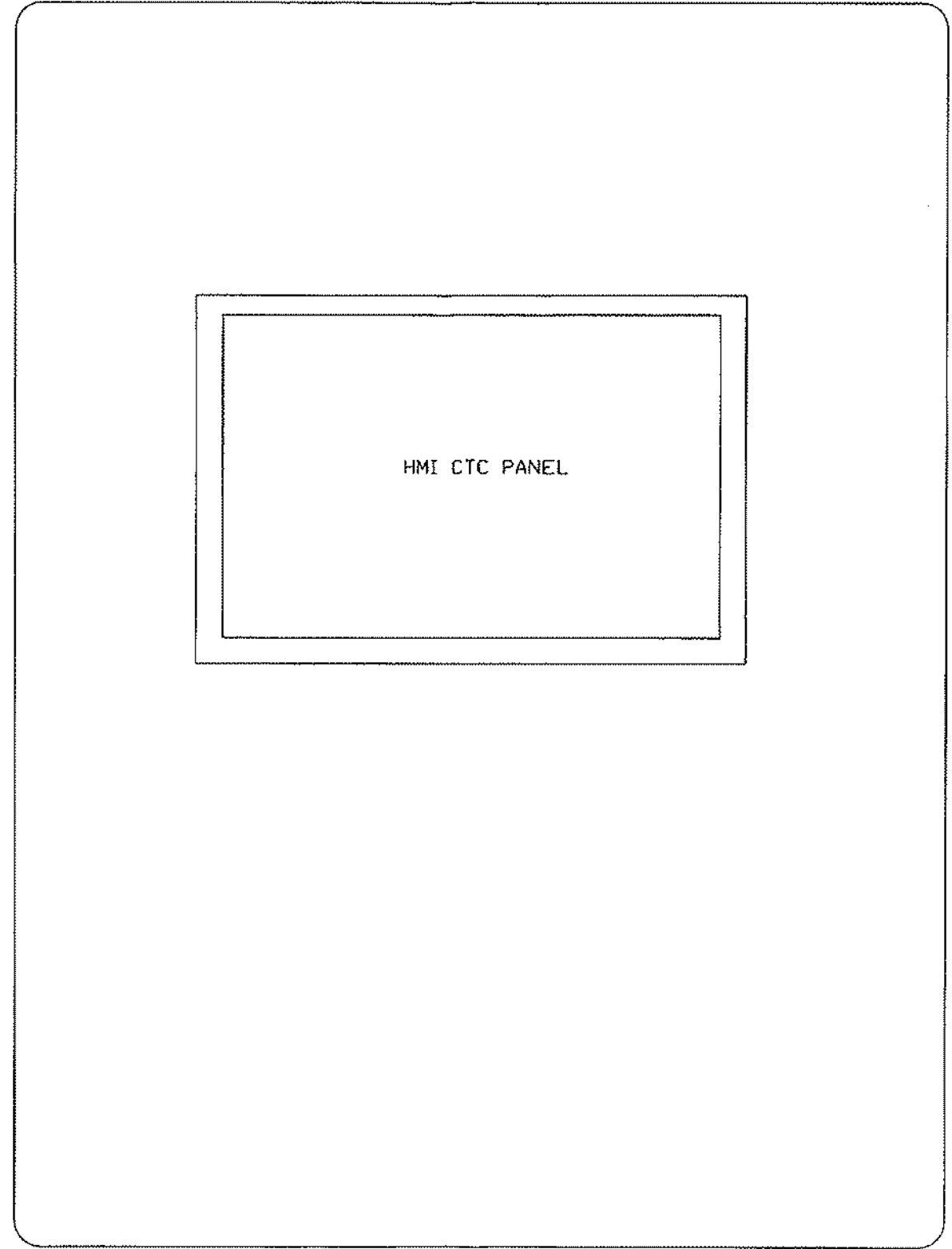
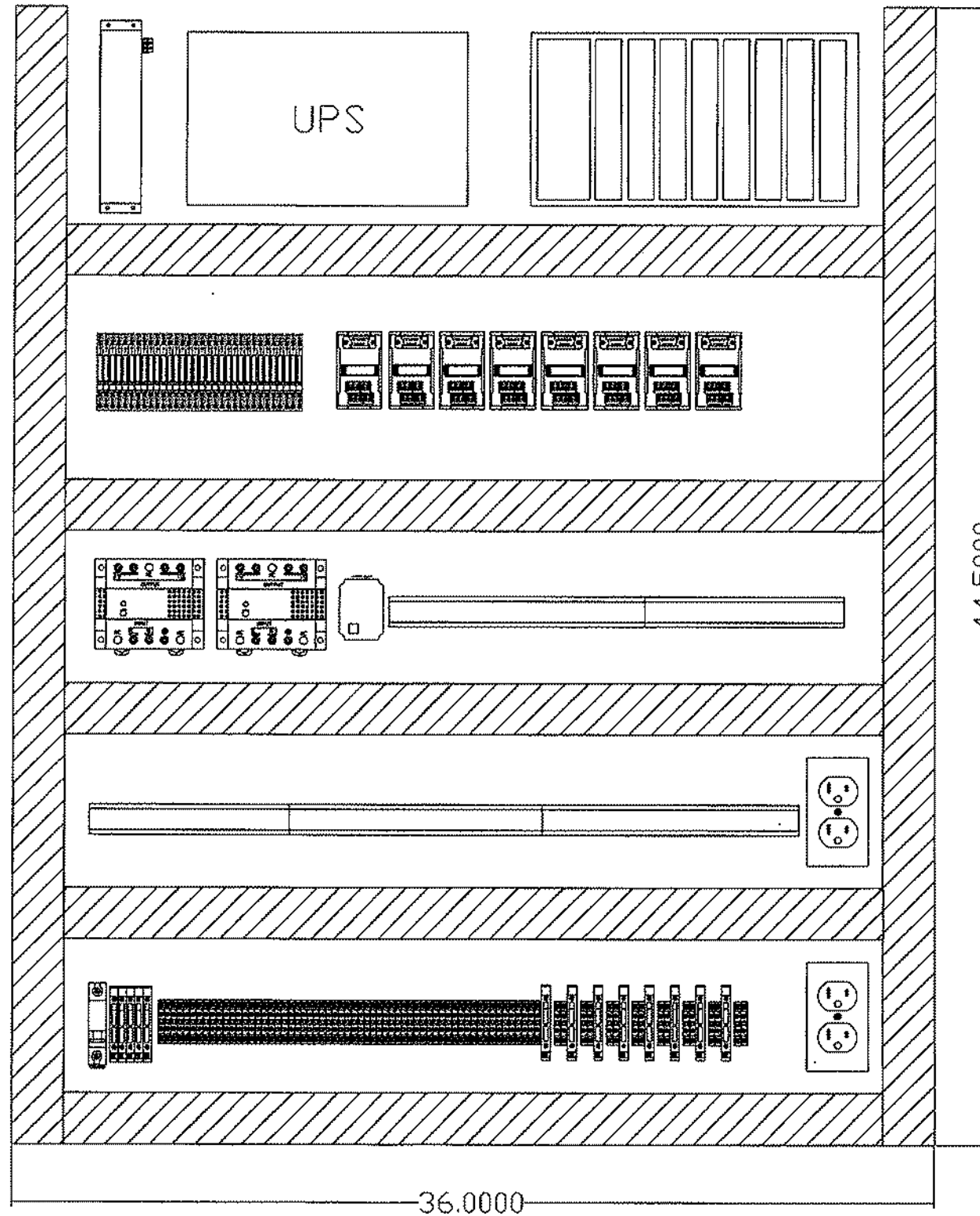
NOTE 1: THE SV-9000 VFD HAS AN INTERNAL OUTPUT FILTER.

THIS SIDE
LEFT BLANK
FOR FUTURE
USE

REVISIONS		BROWNS HILL ENGINEERING & CONTROLS, LLC 8871 S AMMONS ST LITTLETON, CO 80128 (720) 344-7771	CITY OF ARVADA	
A	Per Engineers comments on 12/3		SOUTH PLATE RESERVOIR PROJECT	
B			MCC - W5	
C			WIRING DIAGRAM	
D			DATE: 10/03	JOB #03-070 06
E		FILE #:	15	
DESIGNED BY: LAA		DRAWN BY: LMG		



REVISIONS		BROWNS HILL ENGINEERING & CONTROLS, LLC 8871 S AMMONS ST LITTLETON, CO 80128 (720) 344-7771	CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT MCC - UH1 & UH2 WIRING DIAGRAM		
A			DATE: 10/03	JOB #03-070	07
B			FILE #:		15
C					
D					
E					
DESIGNED BY: LAA		DRAWN BY: LAA			



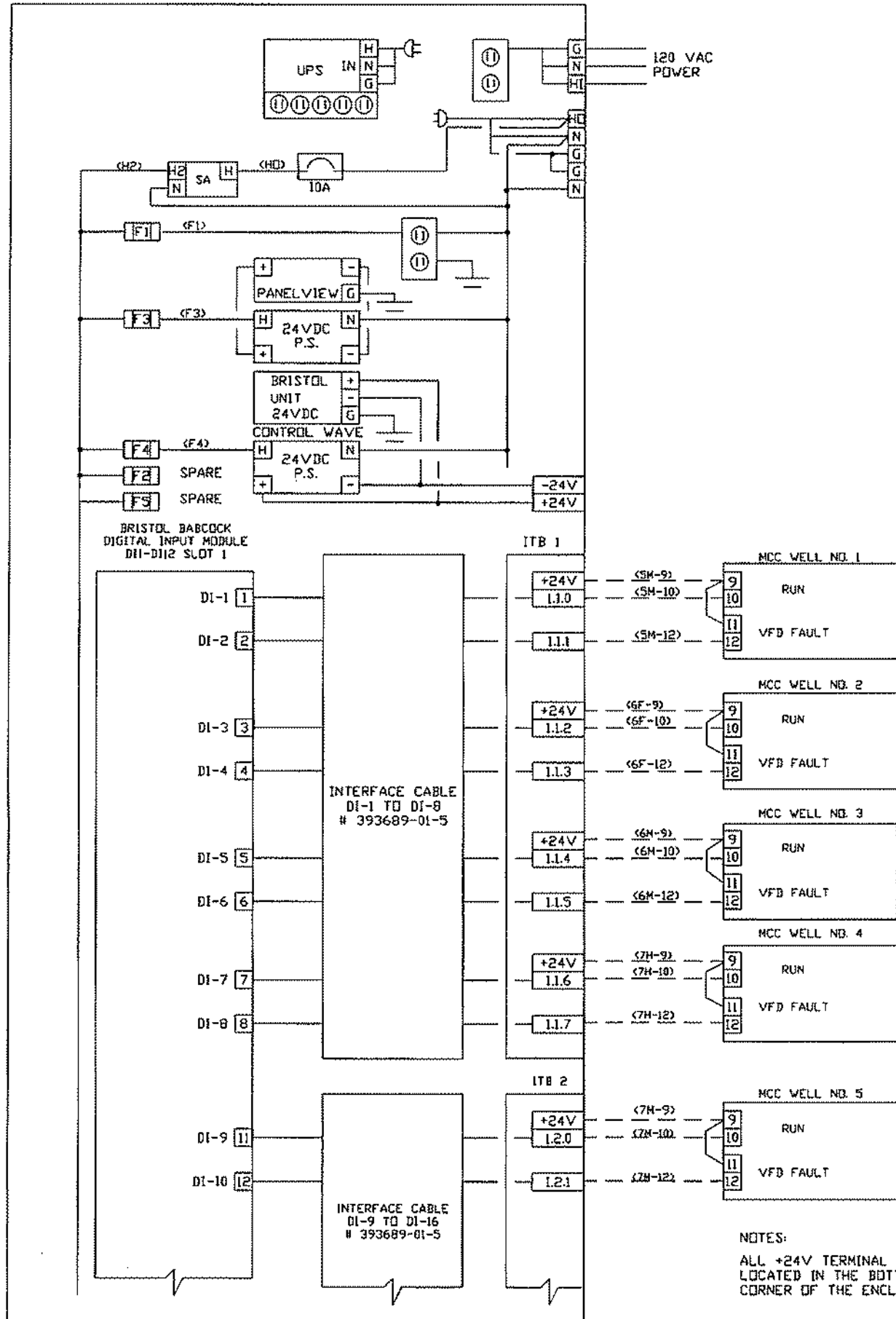
- NOTES:
1. ALL TERMINALS WITH THE SAME LABEL ARE JUMPED TOGETHER.
 2. WIRES WITHOUT A LABEL SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK

REVISIONS	
A	
B	
C	
D	
E	
DESIGNED BY: JDJ	DRAWN BY: RJC

BROWNS HILL ENGINEERING & CONTROLS, LLC
 9871 S AMMONS ST
 LITTLETON, CO 80128
 (720) 344-7771

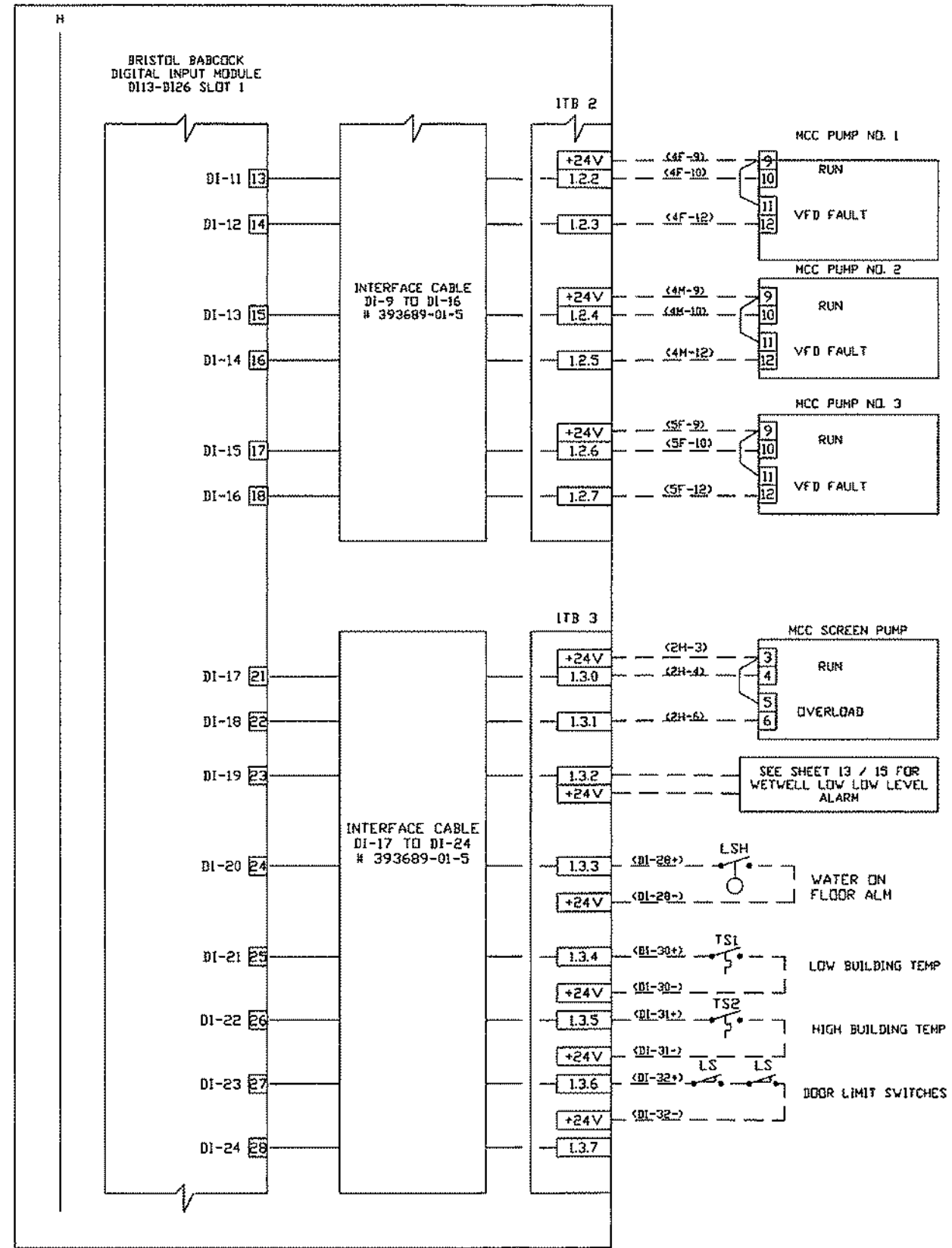
CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT PLC CONTROL PANEL PANEL LAYOUT		
DATE: 10/03	JOB #03-070	08
FILE #:		15

PLC CONTROL PANEL



NOTES:
 1. ALL +24V TERMINAL BLOCKS ARE LOCATED IN THE BOTTOM RIGHT HAND CORNER OF THE ENCLOSURE.
 2. WIRES WITHOUT A LABEL SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK

PLC CONTROL PANEL

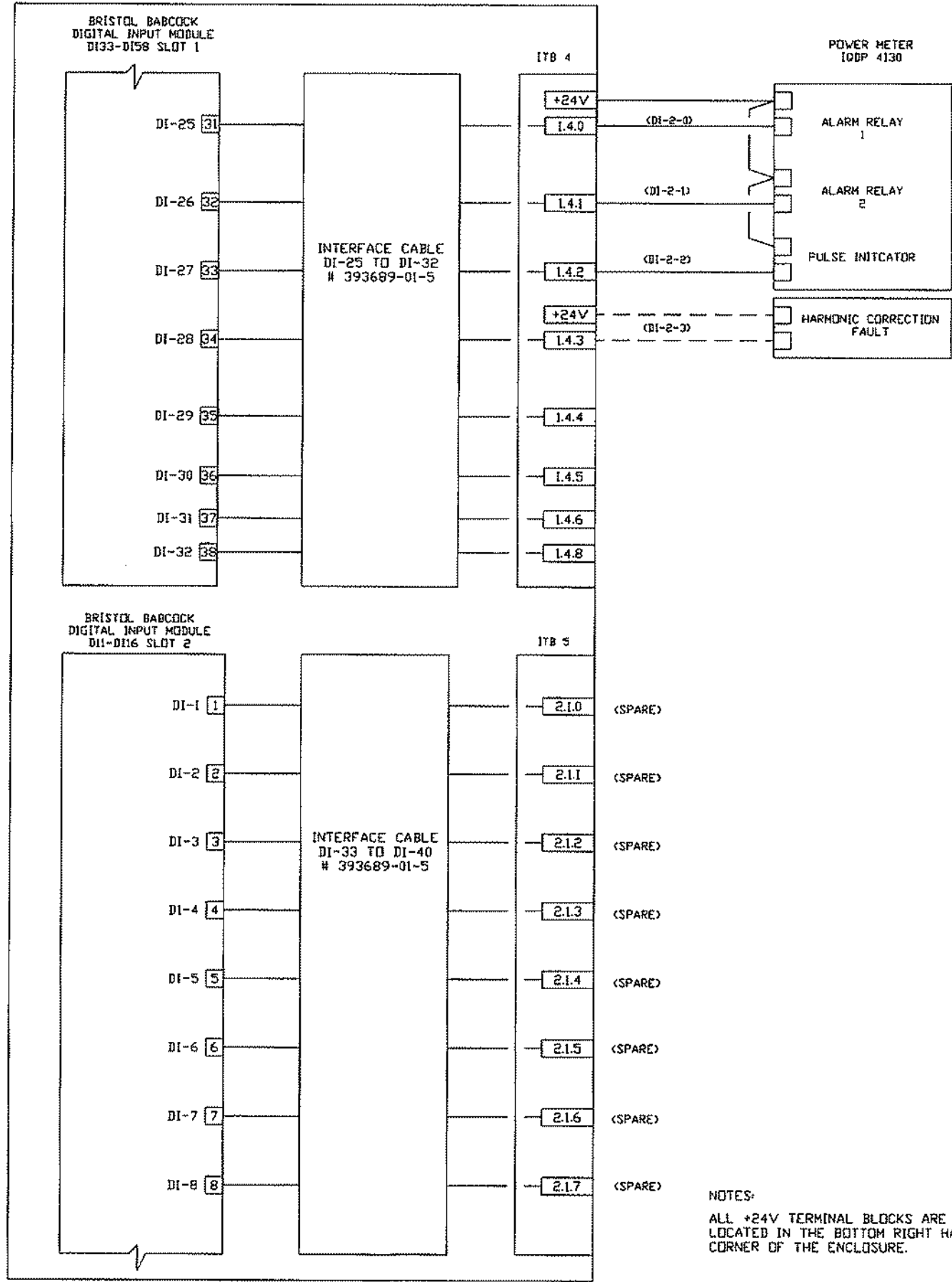


NOTES:
 1. ALL TERMINALS WITH THE SAME LABEL ARE JUMPED TOGETHER.
 2. WIRES WITHOUT A LABEL SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK

REVISIONS	
A	As Built 02/04
B	
C	
D	
E	
DESIGNED BY: JDJ DRAWN BY: LMG	

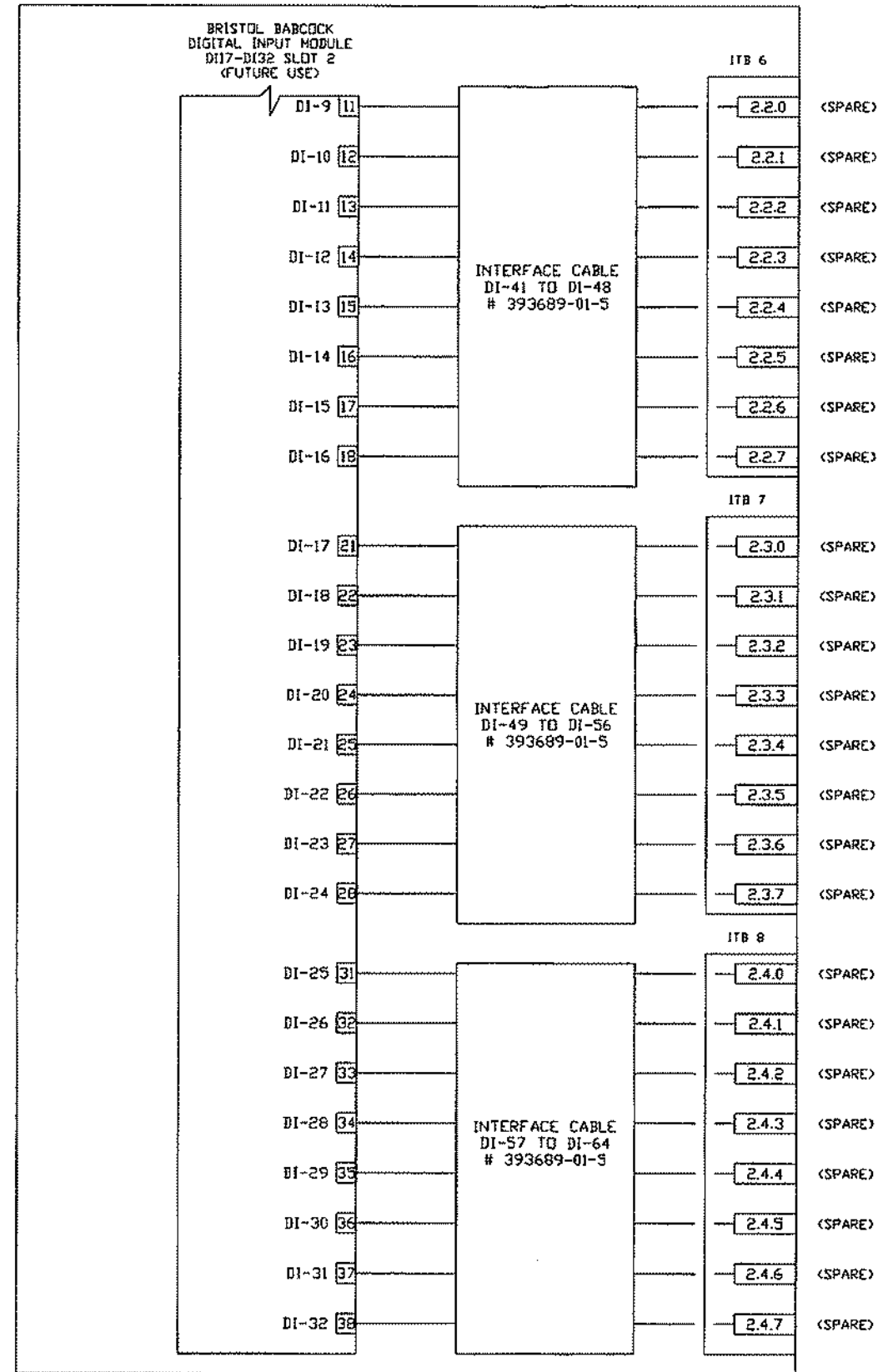
BROWNS HILL ENGINEERING & CONTROLS, LLC 8971 S AMMONS ST LITTLETON, CO 80128 (720) 344-7771	CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT PLC CONTROL PANEL WIRING DIAGRAM	
	DATE: 9/03	JOB #03-070
FILE #:		9

PLC CONTROL PANEL



NOTES:
 ALL +24V TERMINAL BLOCKS ARE LOCATED IN THE BOTTOM RIGHT HAND CORNER OF THE ENCLOSURE.

PLC CONTROL PANEL



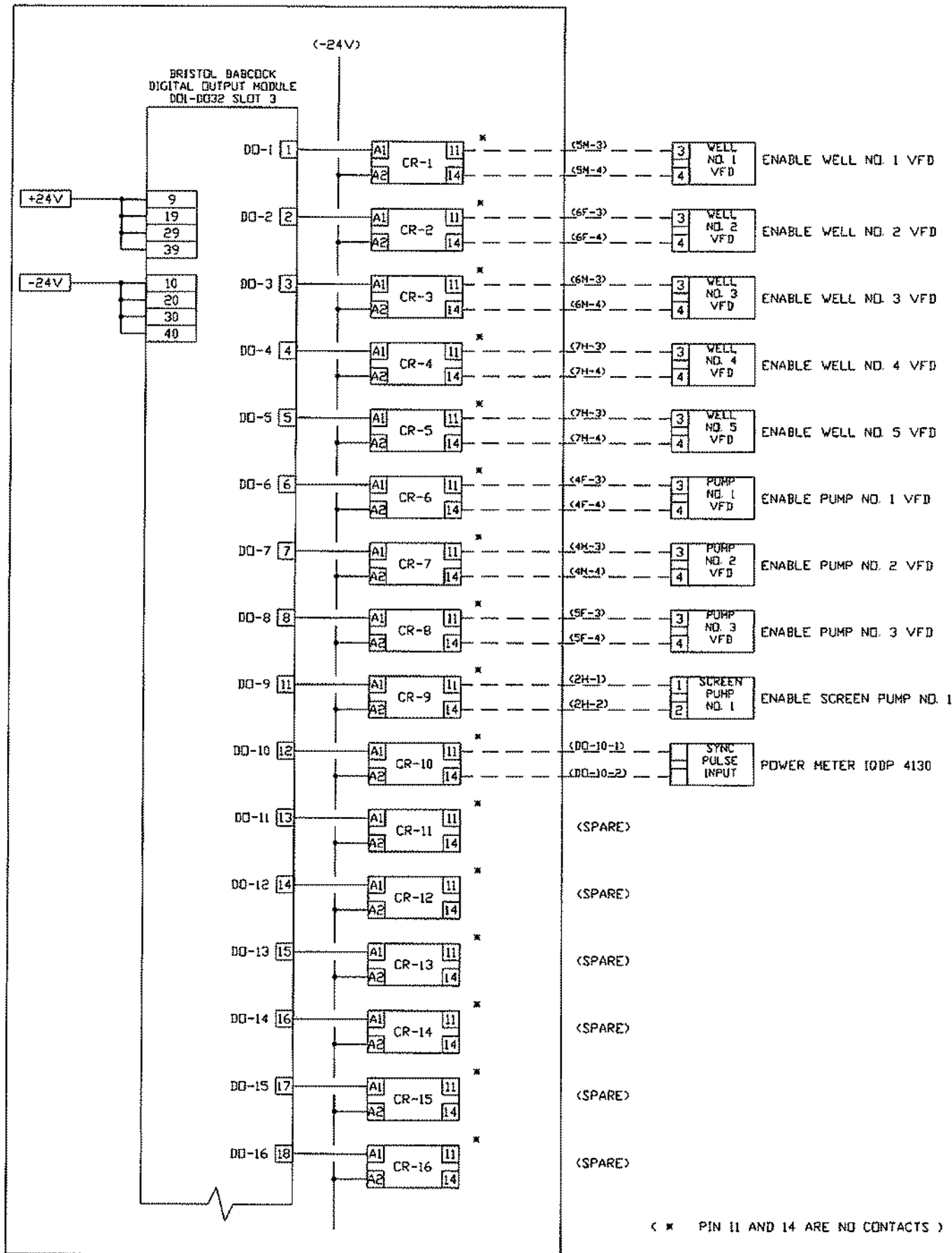
NOTES:
 1. ALL TERMINALS WITH THE SAME LABEL ARE JUMPED TOGETHER.
 2. WIRES WITHOUT A LABEL, SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK

REVISIONS	
A	As Built 02/04
B	
C	
D	
E	
DESIGNED BY: JBJ DRAWN BY: LMG	

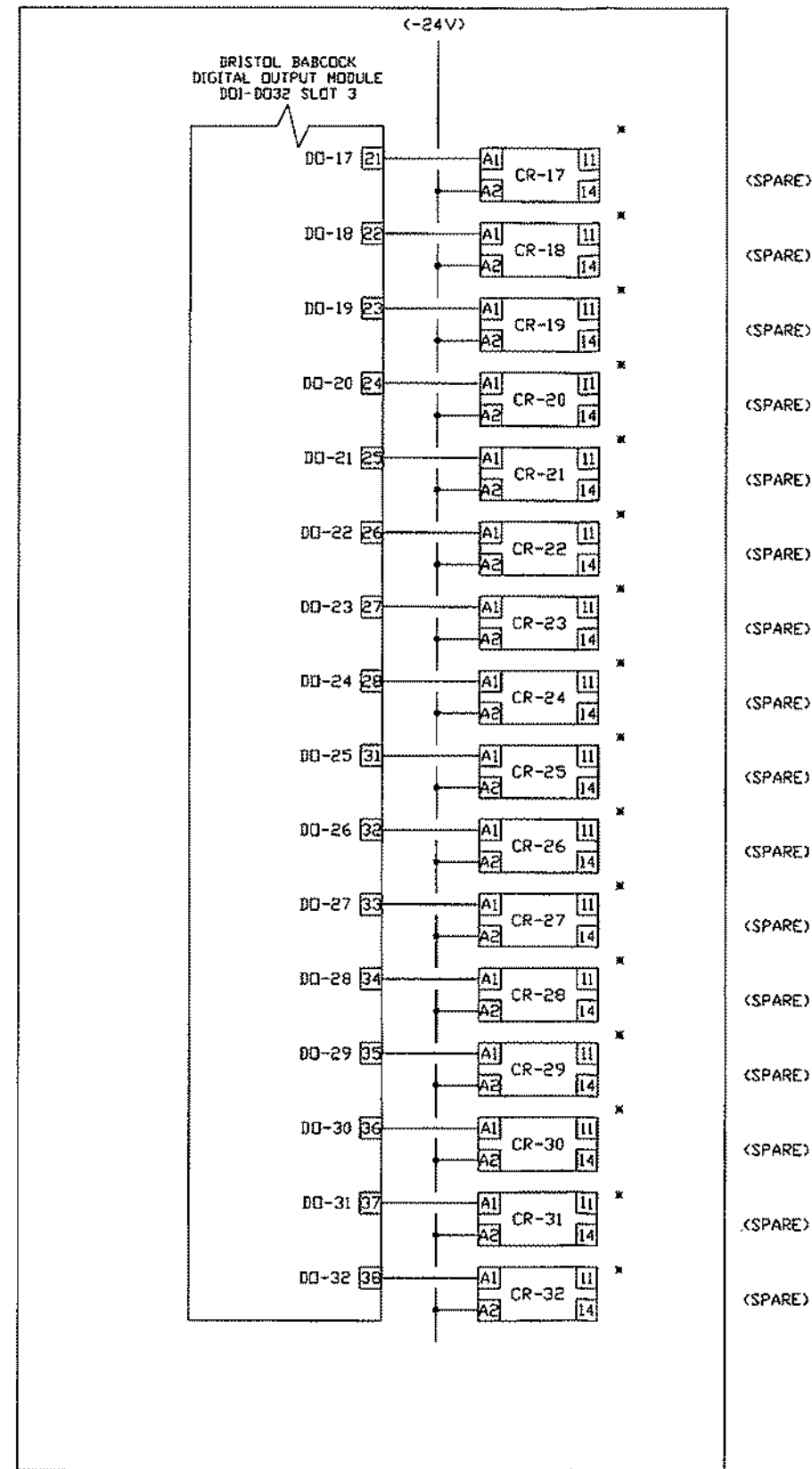
BROWNS HILL ENGINEERING & CONTROLS, LLC
 8871 S AMMONS ST
 LITTLETON, CO 80128
 (720) 344-7771

CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT PLC CONTROL PANEL WIRING DIAGRAM		
DATE: 9/03	JOB #03-070	10
FILE #:		15

PLC CONTROL PANEL



PLC CONTROL PANEL



NOTES:

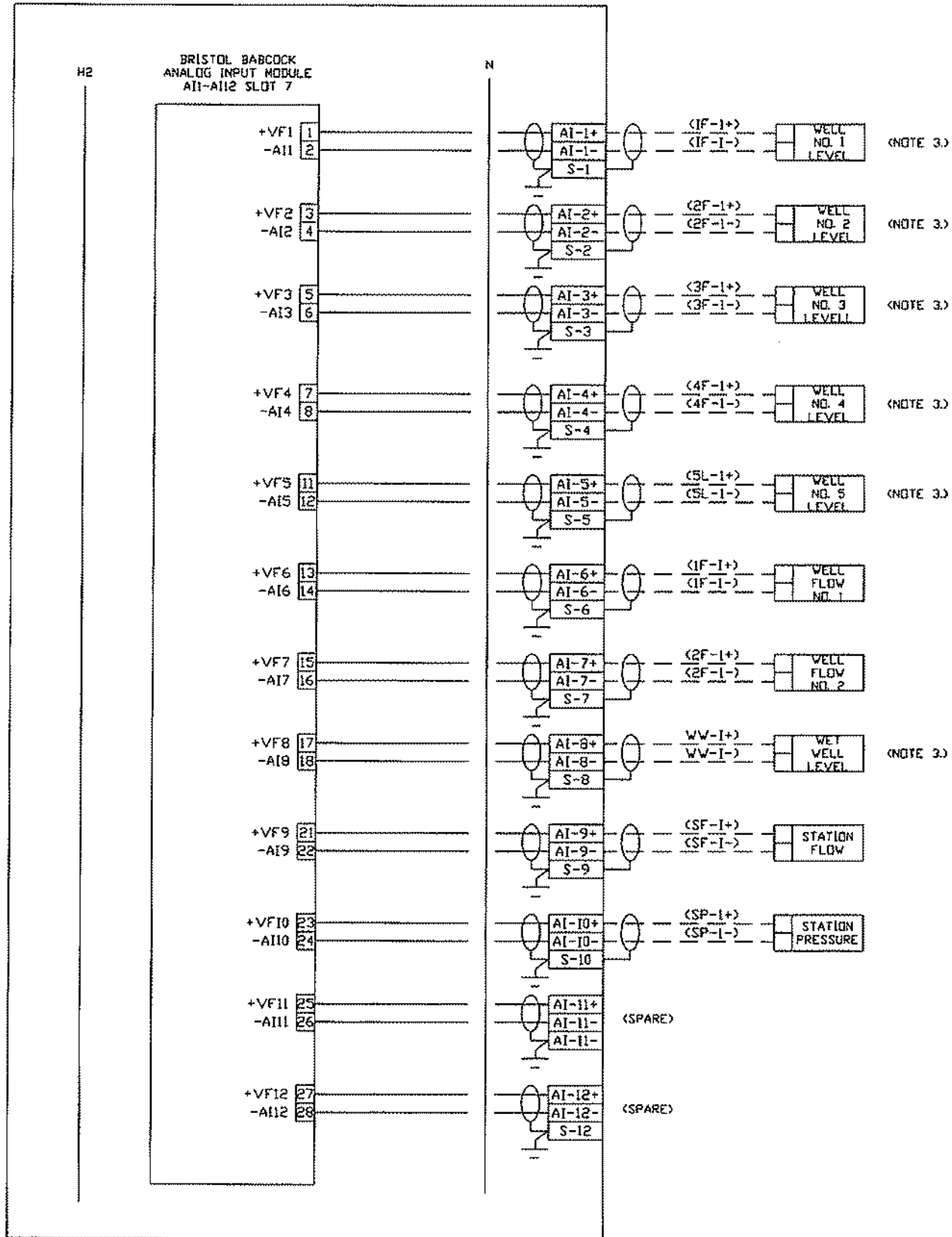
- ALL TERMINALS WITH THE SAME LABEL ARE JUMPED TOGETHER.
- WIRES WITHOUT A LABEL SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK

REVISIONS	
A	As Built 02/04
B	
C	
D	
E	
DESIGNED BY: JDJ DRAWN BY: LMG	

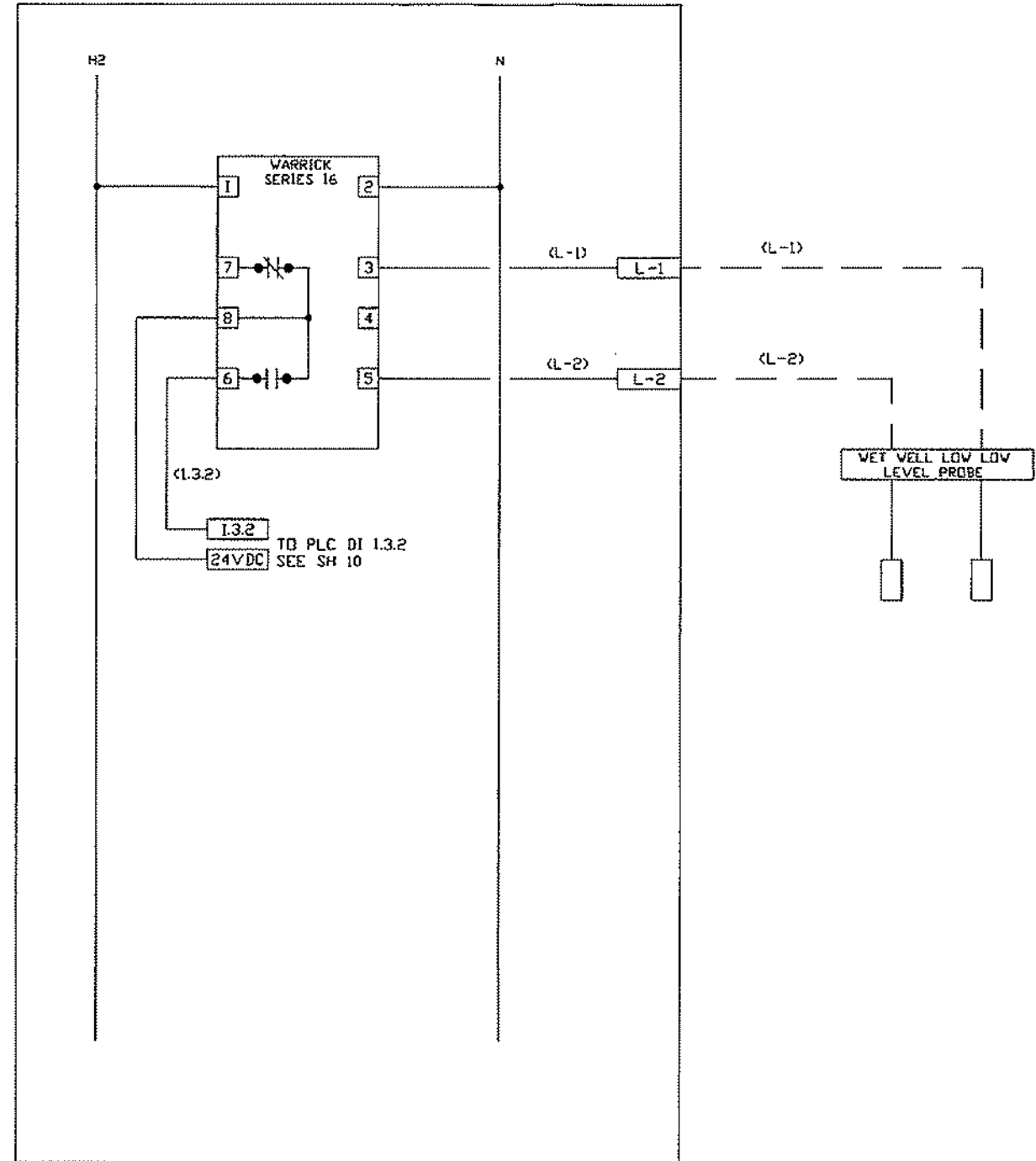
BROWNS HILL
 ENGINEERING
 & CONTROLS, LLC
 8871 S AMMONS ST
 LITTLETON, CO 80128
 (720) 344-7771

CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT PLC CONTROL PANEL WIRING DIAGRAM		
DATE: 9/03	JOB #03-070	11
FILE #:		15

PLC CONTROL PANEL



PLC CONTROL PANEL



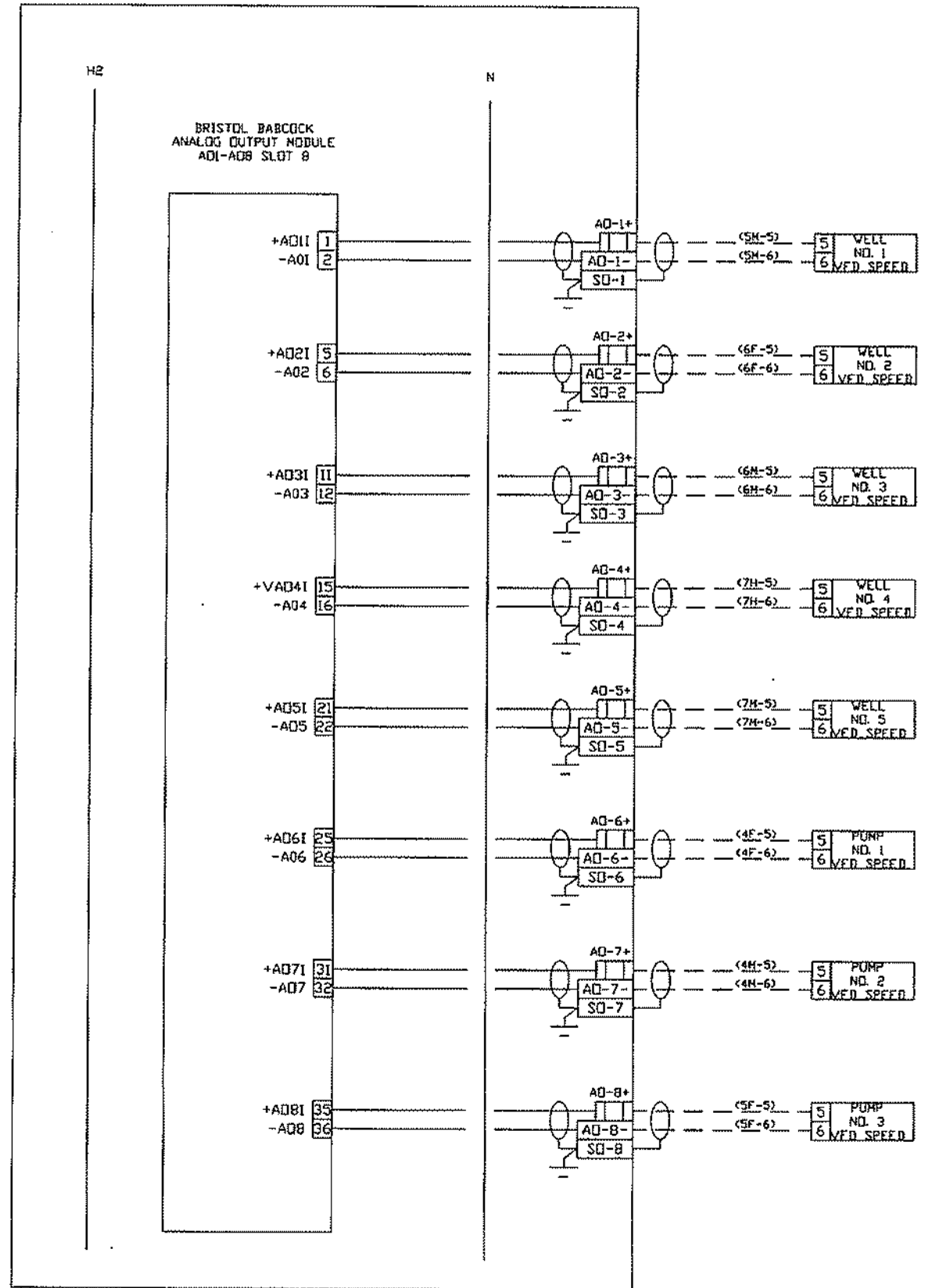
NOTES:

1. ALL TERMINALS WITH THE SAME LABEL ARE JUMPED TOGETHER.
2. WIRES WITHOUT A LABEL SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK.
3. ALL WELL LEVELS ARE PROTECTED BY A 24VDC TVSS TERMINAL BLOCK.

REVISIONS	
A	As Built 02/04
B	
C	
D	
E	
DESIGNED BY: JBJ DRAWN BY: JBJ	

BROWNS HILL ENGINEERING & CONTROLS, LLC		CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT PLC CONTROL PANEL WIRING DIAGRAM	
8871 S AMMONS ST LITTLETON, CO 80128 (720) 344-7771		DATE: 9/03	JOB #03-070
		FILE #:	12
			15

PLC CONTROL PANEL



NOTES:

1. ALL TERMINALS WITH THE SAME LABEL ARE JUMPED TOGETHER.
2. WIRES WITHOUT A LABEL SHALL BE LABELED WITH THE SAME LEGEND AS THE TERMINAL BLOCK

REVISIONS	
A	As Built 02/04
B	
C	
D	
E	
DESIGNED BY: JJJ	DRAWN BY: JJJ

BROWNS HILL ENGINEERING & CONTROLS, LLC
 8871 S AMMONS ST
 LITTLETON, CO 80128
 (720) 344-7771

CITY OF ARVADA SOUTH PLATTE RESERVOIR PROJECT PLC CONTROL PANEL WIRING DIAGRAM		
DATE: 9/03	JOB #03-070	13
FILE #:		15

D14 PLC.dwg

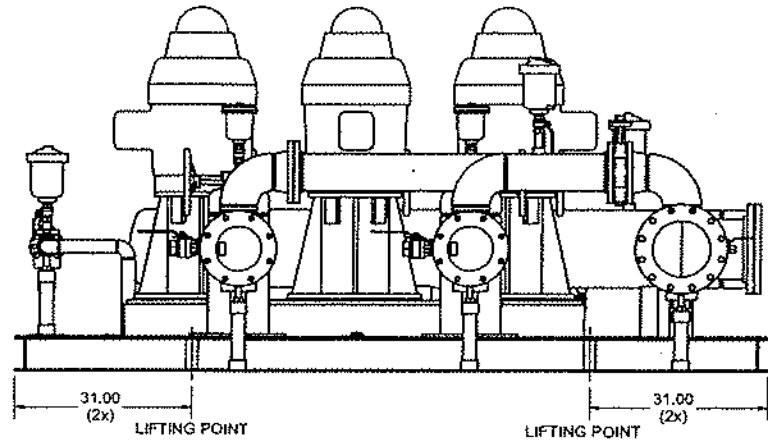
12/24/2003 2:33 PM

Browns Hill Engineering & Controls

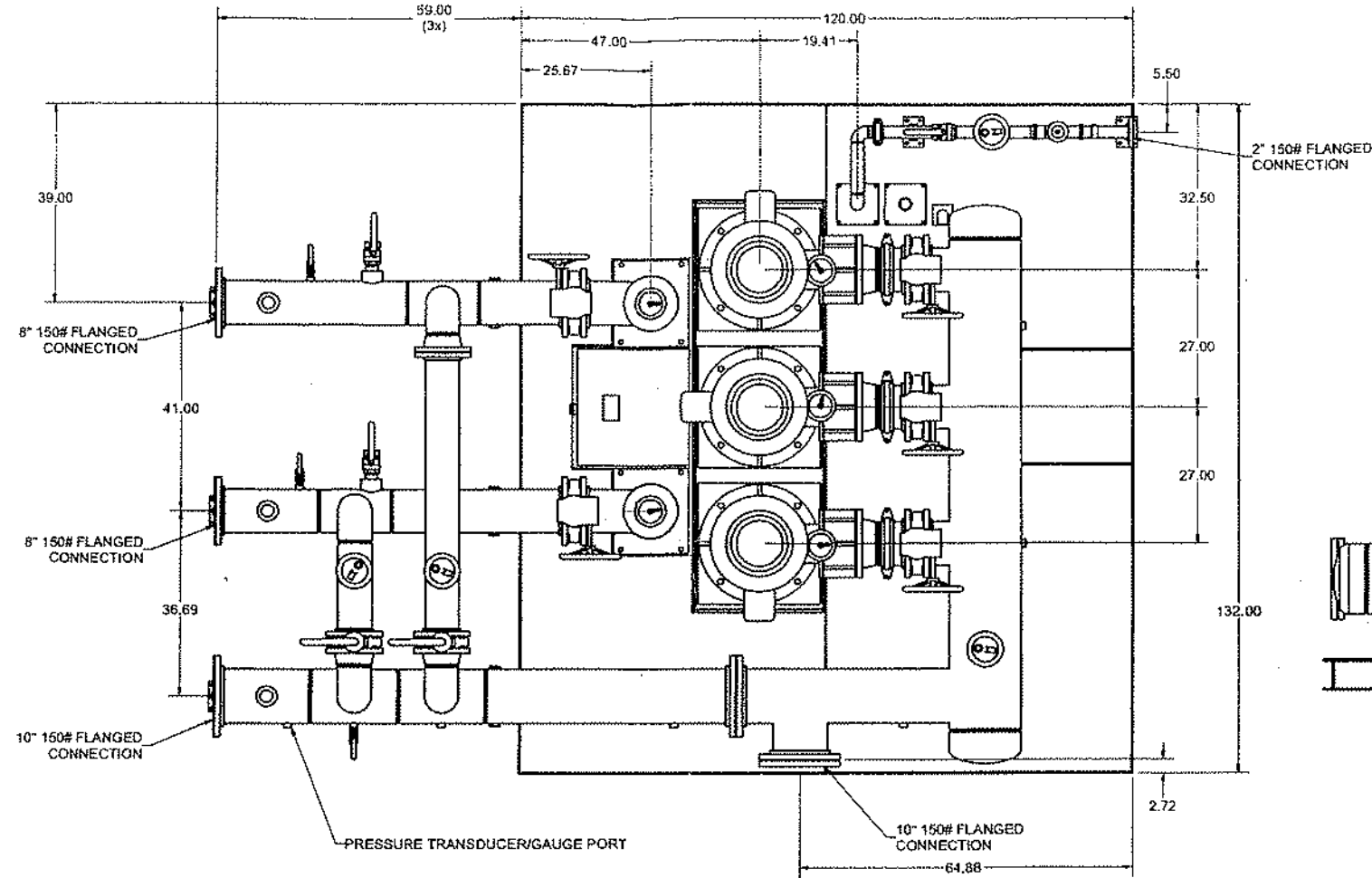
APPENDIX F

ARVADA PUMP STATION METRON DRAWINGS

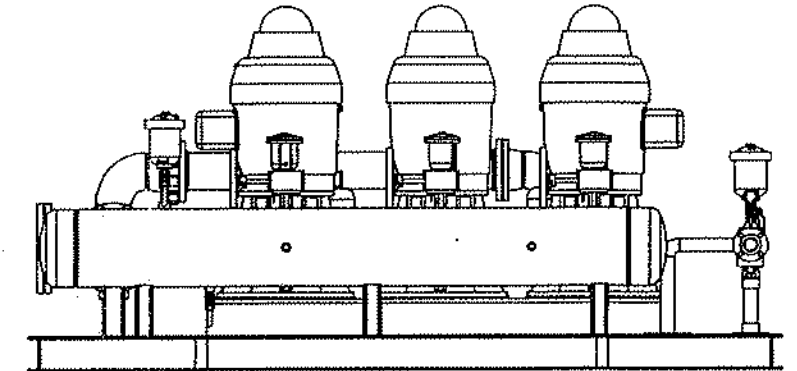
REVISION HISTORY				
REV	DESCRIPTION	DATE	BY	APP
0	Original	10/28/2003	BC	
A	Changed discharge heads from 10" to 8". Changed PMP from 7.5hp to 5hp.	11/17/2003	BC	MH
B	Extended wet well, changed meter run & discharge pipe sizes, changed main pumps	12/8/2003	BC	MH
C	Lengthened skid and enlarged roof hatch	12/17/2003	BC	MH
D	Lengthened skid to 120", revised roof hatch size	12/29/2003	BC	MH
E	Added gland plate for sluice gate valve	1/5/2004	BC	MH
F	Added misc. notes and pipe stands, added diffuser pipe detail	1/13/2004	BC	



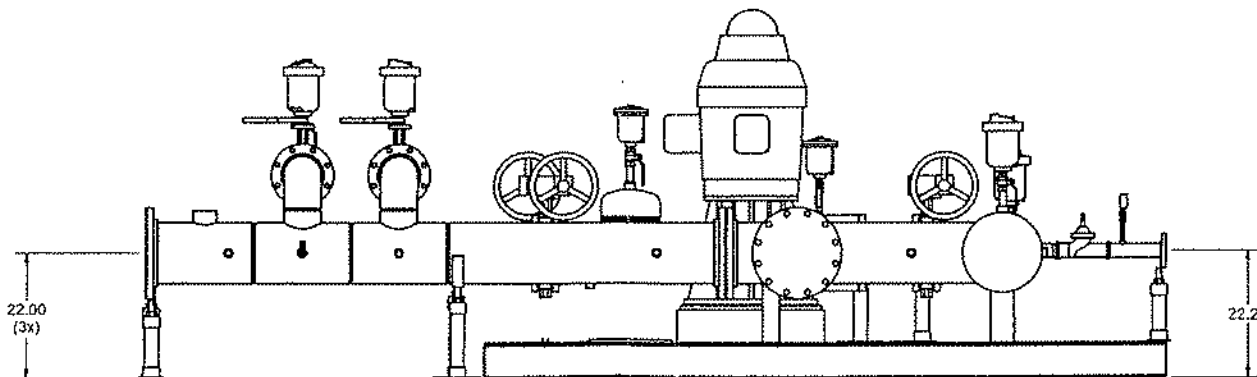
LEFT SIDE ELEVATION



PLAN VIEW



RIGHT SIDE ELEVATION



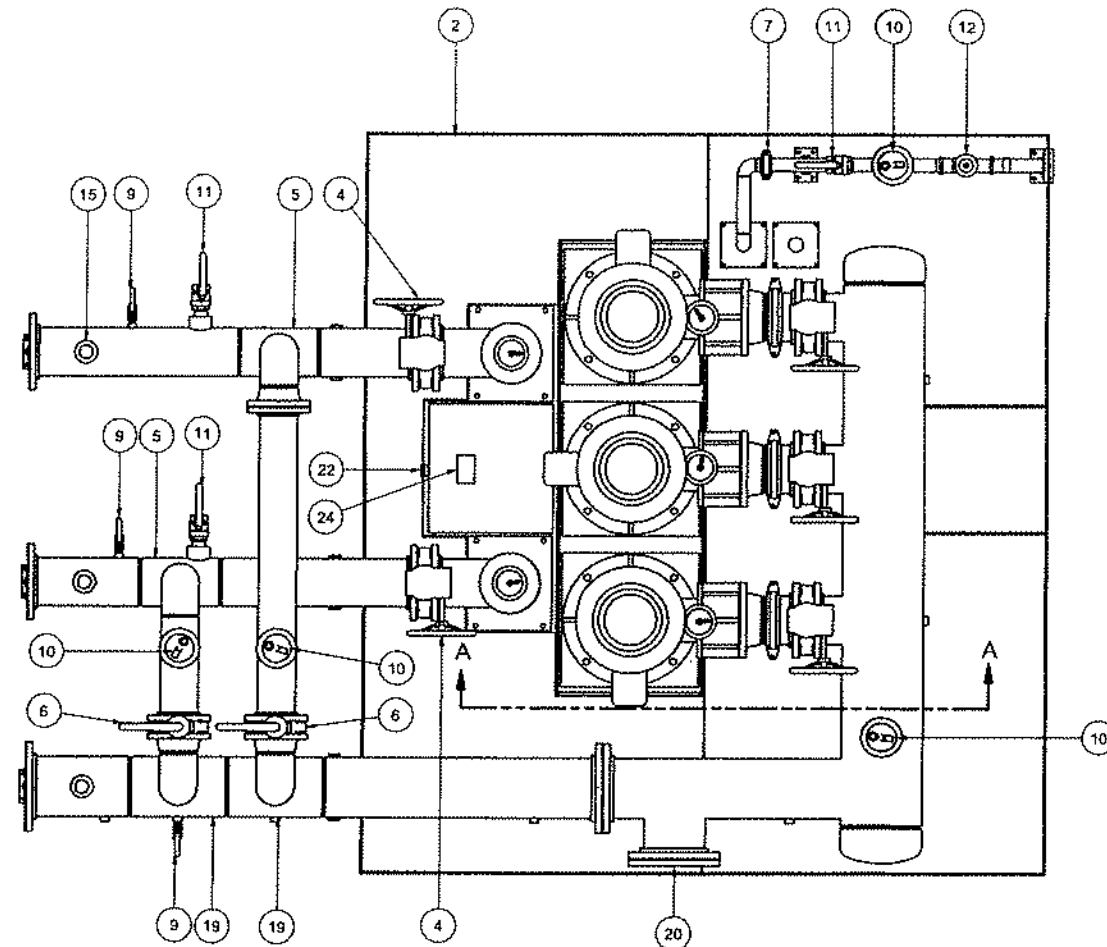
FRONT ELEVATION

NOTES:

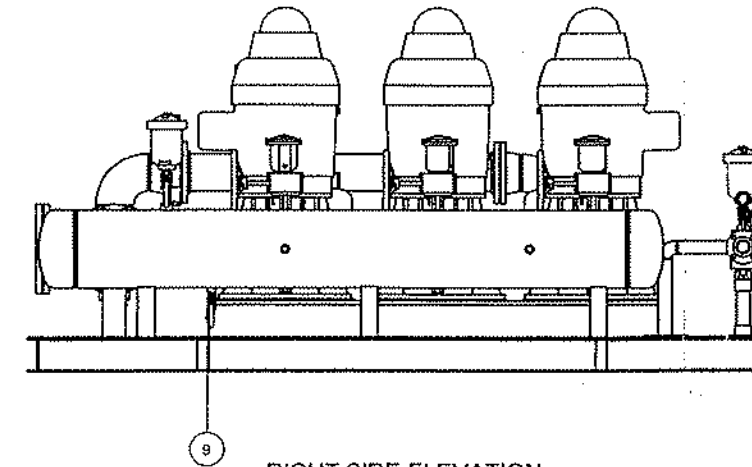
- 8.0" MAIN STATION SUCTION, 150# FLANGED CONNECTION
10.0" MAIN STATION DISCHARGE, 150# FLANGED CONNECTION
- PRIMER ALL BARE METAL WITH MIN. OF 5MIL OF FAST DRY MULTI-PURPOSE EPOXY.
FINISH COAT WITH MIN. 5MIL OF POLYURETHANE STD. GREEN COLOR.
SKID BOTTOM TO BE COVERED WITH 10MILS. OF AMINE CURED COAL TAR EPOXY.
- POWER FEED TO SKID AND CONTROL PANEL NOT METRON
SCOPE OF SUPPLY (LABOR OR SUPPLIES).
- SKID TO BE FIELD LEVELED AND ANCHORED, BY CUSTOMER, TO
CONCRETE PAD USING CONCRETE ANCHOR BOLTS. IF CONCRETE PAD
IS NOT LEVEL, CONTRACTOR TO SHIM THE SKID AND FILL VOIDS WITH A
NON-SHRINK GROUT. SHIMS AND ANCHORS BOLTS TO BE PROVIDED BY
CONTRACTOR
- HYDROSTATIC TEST SYSTEM TO MIN. OF 150% OF SYSTEM PRESSURE
- SEE ATTACHED SHIPPING COMPONENT LIST FOR ITEMS THAT SHIP
WITH JOB BUT LOOSE FROM SKID. (IF APPLICABLE)
- SPREADER BAR AND PROPER CRANE LIFTING EQUIPMENT WILL BE
NEEDED TO UNLOAD SKID AND SET INTO PLACE. INSTALLATION AND
CRANE RENTAL BY CUSTOMER. DAMAGE TO SKID DURING UNLOADING
IS NOT METRON'S RESPONSIBILITY. LIFT SKID WITH EXTREME CAUTION
AND CARE.
- APPROX. DRY WEIGHT: 15,000 LBS
APPROX. WET WEIGHT: 17,500 LBS
- METRON INC. IS NOT RESPONSIBLE FOR THE WINTERIZATION OF THE
PUMPING STATION.
- (2) 3/4" BALL VALVES PROVIDED IN PIPING AS DRAINS AND FOR
WATER HOSE CONNECTION AND WINTERIZATION.
- ALL DIMENSIONS ARE IN INCHES.
- CONTRACTOR TO MOUNT SLUICE GATE VALVE OPERATOR
TO THE SKID AND DRILL SKID AS NECESSARY FOR PROPER OPERATION.
- ALL DRAINS PIPED BACK INTO WET WELL

TOLERANCES ARE: X ± .030 XX ± .015 XXX ± .005 ANGLES ± 0°30' REMOVE BURRS & SHARP CORNERS	bcondron 10/28/2003	METRON, INC. DENVER, CO.
	mhedges 10/31/2003	
GENERAL DIMENSION LAYOUT VWP-IRR-25/25/25+5-4215/15+72/75 CITY OF ARVADA, SO PLATTE RESERVOIR		Y031230-095990 SCALE SHEET 1 OF 4

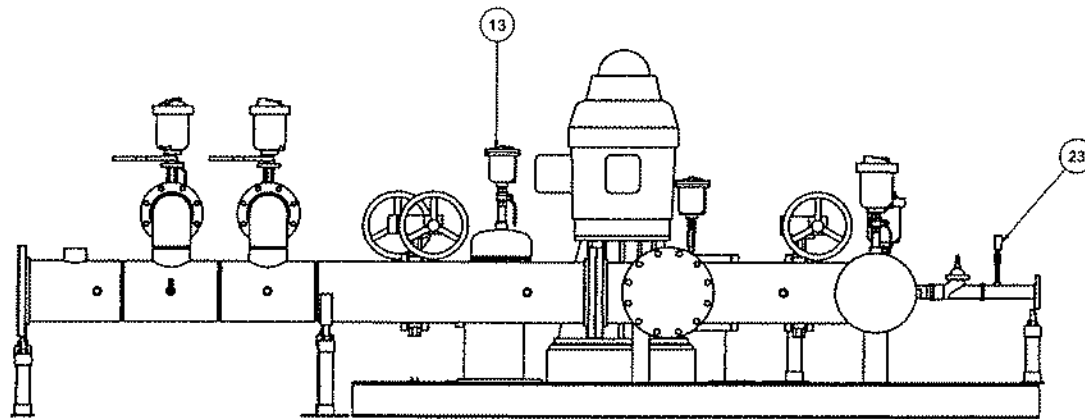
REVISION HISTORY				
REV	DESCRIPTION	DATE	BY	APP.
O	Original	10/28/2003	BC	
A	Changed discharge heads from 10" to 8". Changed PMP from 7.5hp to 5hp.	11/17/2003	BC	MH
B	Extended wet well, changed meter run & discharge pipe sizes, changed main pumps	12/8/2003	BC	MH
C	Lengthened skid and enlarged roof hatch	12/17/2003	BC	MH
D	Lengthened skid to 120", revised roof hatch size	12/29/2003	BC	MH
E	Added gland plate for sluice gate valve	1/5/2004	BC	MH
F	Added misc. notes and pipe stands, added diffuser pipe detail	1/13/2004	BC	-



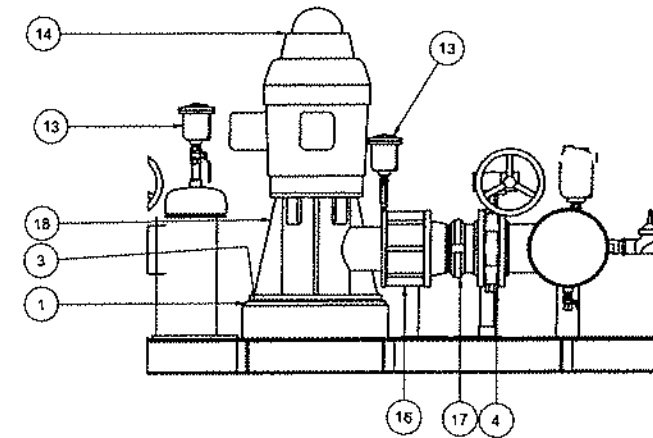
PLAN VIEW



RIGHT SIDE ELEVATION



FRONT ELEVATION



SECTION A-A

Parts List		
ITEM	QTY	DESCRIPTION
1	1	3/4" Thick Pump Plate
2	1	3/16" Thick Diamond Deck Plate
3	3	1/4" Thick Neoprene Pad
4	5	8" Lug Style Butterfly Valve
5	2	8" X 8" X 6" Reducing Tee
6	2	6" Lug Style Butterfly Valve
7	1	2" Victaulic Flex Coupling
8	1	Water Level Probe
9	4	3/4" NPT Ball Valve
10	4	1" Air Release Valve
11	3	2" NPT Ball Valve
12	1	2" Pressure Reducing Valve W/ Strainer
13	5	1/2" Air/Vacuum Release Valve
14	3	25hp Motor w/reverse ratchet
15	3	Flow Meter
16	3	8" Silent Check Valve
17	3	8" Victaulic Flex Coupling
18	3	8" Discharge head
19	2	10" X 10" X 6" Reducing Tee
20	1	10" Blind Flange 150#
21	1	10" Straight
22	1	Padlock Hasp
23	1	Pressure Gauge
24	1	Warning Nameplate

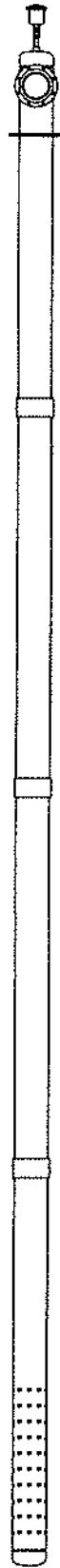
TOLERANCES ARE :
 X ± .030 XX ± .015
 .XXX ± .005 ANGLES ± 0° 30'
 REMOVE BURRS & SHARP CORNERS

bcondron 10/28/2003
 mhedges 10/31/2003

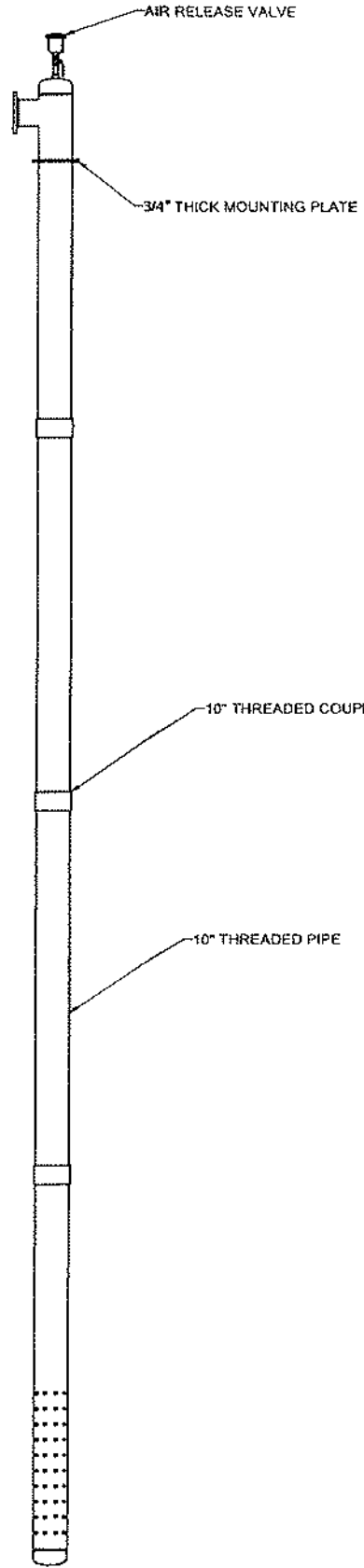
Metron METRON, INC.
 DENVER, CO.

ITEMIZED PIPE DETAILS
 VWP-IRR-25/25/25+5-4215/15+72/75
 CITY OF ARVADA, SO PLATTE RESERVOIR


Y031230-095990
 SCALE SHEET 2 OF 4
 REV. E



DIFFUSER PIPE



2" PIPE FOR STILLING WELL

TOLERANCES ARE: X ± .030 XX ± .015 XXX ± .005 ANGLES ± 0° 30' REMOVE BURRS & SHARP CORNERS	lcondron 10/28/2003	 METRON, INC. DENVER, CO.
	mhedges 10/31/2003	
DIFFUSER PIPE DETAIL VWP-IRR-25/25/25+5-4215/15+72/75 CITY OF ARVADA, SO PLATTE RESERVOIR	Y031230-095990	REV. E
SCALE	SHEET 3 OF 4	

WARNING

THIS IS A PRELIMINARY DRAWING OF A TYPICAL PUMP HOUSE OF THE SIZE AND TYPE INDICATED. LOCATION OF OPTIONAL HARDWARE MAY VARY FROM THE FINAL STATION CONFIGURATION AND SIZE.

ILLUSTRATIONS OF SLAB AND PUMP HOUSE ARE NOT INTENDED AS A SUBSTITUTE FOR CONSTRUCTION DRAWINGS PROVIDED TO THE CONTRACTOR BY AN ENGINEER.

THIS DRAWING PROVIDED FOR PLANNING PURPOSES ONLY, NOT CONSTRUCTION.

PUMP HOUSE SLAB SHOULD BE BUILT TO LOCAL STANDARDS. METRON IS NOT RESPONSIBLE FOR ANY PUMP ROOM COMPONENTS OTHER THAN WHAT IS INCLUDED ON THE PUMP SKID DRAWINGS.

METRON IS NOT RESPONSIBLE FOR OFF LOADING INSTALLATION OR POSITIONING OF SKID, BUT IS AVAILABLE FOR OVERSIGHT.

ACCESS HATCH MUST BE LOCATED TO ACCOMMODATE REMOVAL OF ALL PUMPS FOR MAINTENANCE/SERVICE.

CRANE AND SPREADER BARS TO BE USED IN CONJUNCTION FOR OFF LOADING THE SKID AT JOB SITE. METRON IS NOT RESPONSIBLE FOR DAMAGE INCURRED DURING THE OFF LOADING PROCESS.

POWER FEEDS TO PUMP HOUSE HEATER, FANS, CONTROL PANELS, AND SKID ARE SUPPLIED BY CONTRACTOR, NOT METRON.

METRON IS NOT RESPONSIBLE FOR THE WINTERIZATION OF THE PUMPING STATION.

METRON STRONGLY RECOMMENDS AN ISOLATION VALVE IN THE PIPING WHICH FEEDS WATER TO THE WET WELL FROM THE LAKE.

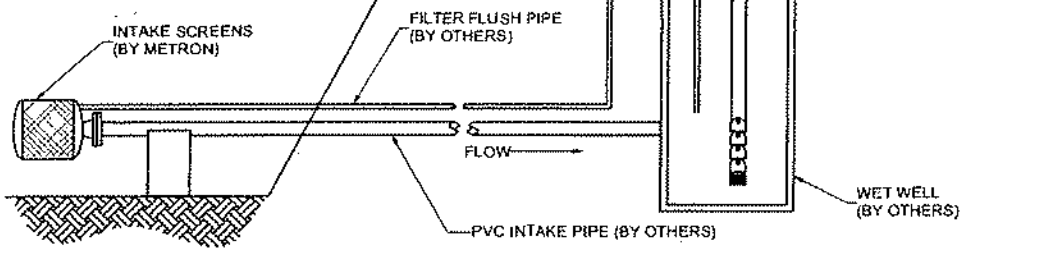
ADEQUATE FLEXIBILITY TO THE LOCATIONS WHERE PIPING WILL PENETRATE PUMP HOUSE WALL SHOULD BE CONSIDERED. CONNECTION PIPING TO THE PUMP STATION SHOULD BE INSTALLED AFTER THE PUMP STATION IS INSTALLED.

NOTE: TYPICAL DRAWING OF WET WELL APPLICATION. MAY NOT ACCURATELY REFLECT CUSTOMER SPECIFIC APPLICATION.

TAKE STRUCTURE

INTAKE STRUCTURE DIMENSIONS

96" DIA. 484" (DEEP) WET WELL, INSIDE DIMENSIONS
 _____ DIA. _____ (LENGTH) INLET PIPE
 LAKE SCREEN MODEL CW2000 (2 REQ'D)



IMPORTANT: WITH AMIAD FILTER PRESSURE RELIEF VALVE (SUPPLIED BY OTHER) MUST BE INSTALLED DOWN STREAM OF SYSTEM TO PROTECT FROM IRRIGATION SYSTEM OVER PRESSURE



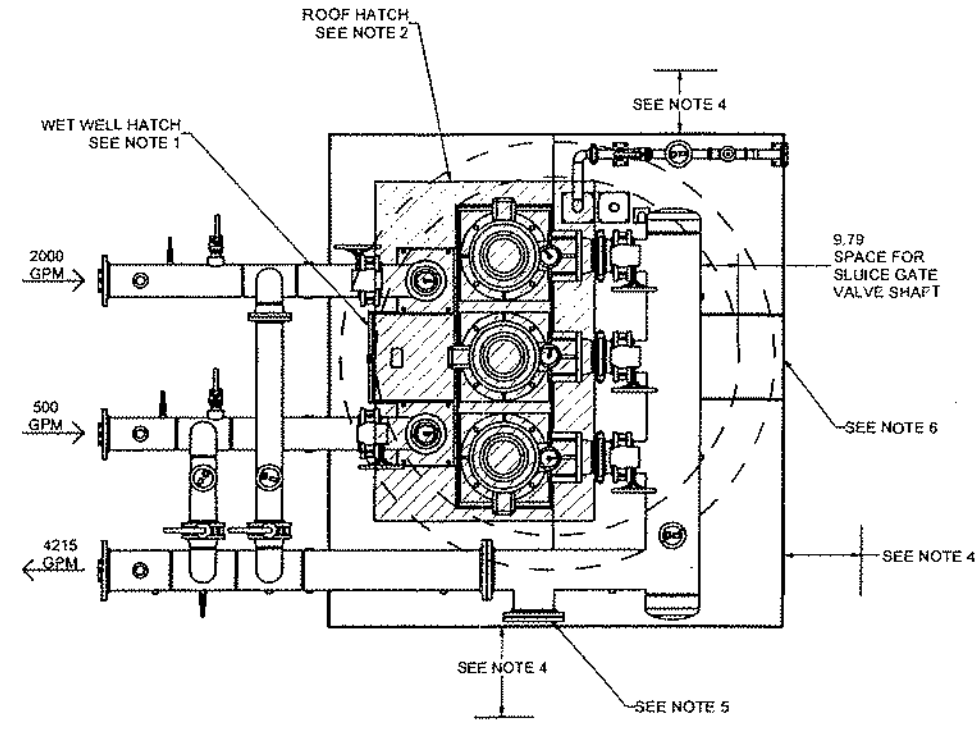
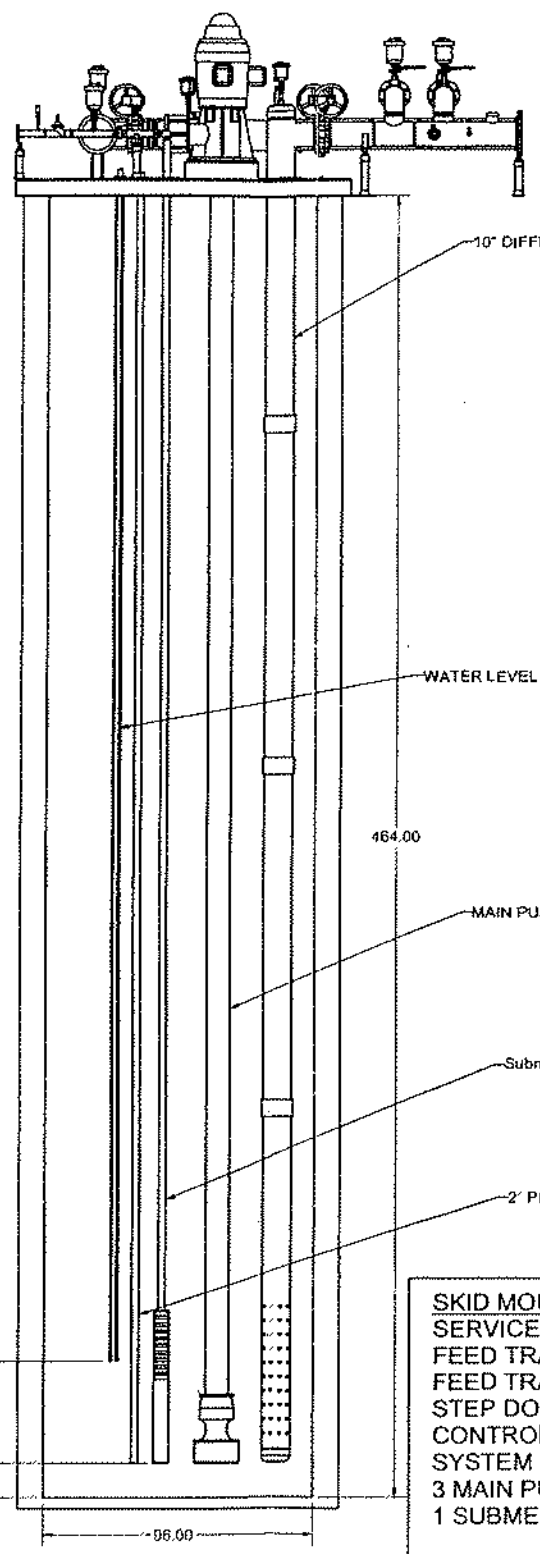
Site Preparation Drawing
 METRON, INC.
 1505 W. THIRD AVE.
 DENVER, COLORADO 80223
 PHONE (303) 592-1903
 FAX (303) 534-1947

DESIGN POINT:
 CURRENT 4215 gpm @ 15 psig
 FUTURE N/A gpm @ N/A psig

SITE PREP
 VWP-IRR-25/25/25+5-4215/15+72/75
 CITY OF ARVADA, SO PLATTE RESERVOIR

SCALE: N.T.S. DATE: 10/28/2003 DWG # Y031230-095990

DRAWN BY: bcondron APPROVED BY: mhedges



SLAB TOP VIEW

- Note 1: WET WELL ACCESS HATCH 21" x 23"
- Note 2: ROOF HATCH FOR ACCESS TO PUMP MINIMUM ROOF ACCESS HATCH SIZE 90" x 60" MUST BE LOCATED OVER ALL PUMPS & DIFFUSER PIPES
- Note 3: SKID HEIGHT APPROX. 71.0"
- Note 4: RECOMMENDED MINIMUM DIMENSIONS AROUND SKID PERIMETER ARE 24"
- Note 5: FUTURE POSSIBLE ADDITION OF SUBMERSIBLE FEED
- Note 6: GLAND PLATE FOR SLUICE GATE VALVE. BASED ON SUPPLIED DRAWINGS FROM BT CONSTRUCTION

SKID MOUNTED POWER REQUIREMENTS
 SERVICE ENTRANCE RATED MAIN DISCONNECT - BY OTHERS
 FEED TRANSFORMER - BY OTHERS
 FEED TRANSFORMER DISCONNECT - BY OTHERS
 STEP DOWN TRANSFORMER - BY OTHERS
 CONTROL PANEL DISCONNECT - BY OTHERS
 SYSTEM POWER 460 VOLTS, 3 PH, 60HZ
 3 MAIN PUMPS 25 HP
 1 SUBMERSIBLE PUMP 5 HP

PIPE CONNECTIONS
 (2X) 8.0" MAIN STATION SUCTION FLANGE CONNECTION.
 10.0" MAIN STATION DISCHARGE FLANGE CONNECTION.
 2.0" DIA. LAKE INTAKE SCREEN FLUSH LINE FLANGED CONNECTION.

SHEET 4 OF 4

REVISION HISTORY				
REV	DESCRIPTION	DATE	BY	APP.
O	Original	10/28/2003	BC	
A	Changed discharge heads from 10" to 8". Changed PMP from 7.5hp to 5hp.	11/17/2003	BC	MH
B	Extended wet well, changed meter run & discharge pipe sizes, changed main pumps	12/8/2003	BC	MH
C	Lengthened skid and enlarged roof hatch	12/17/2003	BC	MH
D	Lengthened skid to 120', revised roof hatch size	12/29/2003	BC	MH
E	Added gland plate for sluice gate valve	1/5/2004	BC	MH
F	Added misc. notes and pipe stands, added diffuser pipe detail	1/13/2004	BC	-

APPENDIX G

ARVADA PUMP STATION METRON DESIGN SPECIFICATIONS



METRON, INC.
 1505 West Third Avenue
 Denver, Colorado 80223-2811
 Phone (303) 592-1903 • FAX (303) 534-1947

ORDER ACKNOWLEDGEMENT

REMIT TO: METRON, INC.
 P.O. BOX 17851
 DENVER, COLORADO
 80127-0851

JOB NO: 095990

ORDER DATE: 10/15/03

SOLD TO: BT CONSTRUCTION, INC.
 9885 EMPORIA ST.
 HENDERSON CO 80640
 USA

YOUR ORDER NO:
 YOUR JOB:
 CITY OF ARVADA
 SHIP TO: CO: BT CONSTRUCTION
 9820 MCKAY ROAD
 THORNTONN CO 80640
 USA

ATTN: ERIC @ 303-591-3462

CUST NO	SHIP CHARGES	EXPECT TO SHIP DATE	TERM
04317		02/16/04	Net 30 Days

ITEM	CATALOG NUMBER / DESCRIPTION	PL	ORDER QUANTITY	UNIT PRICE	AMOUNT
001	<p>CUSTOM PACKAGED PUMP SYSTEM PER QUOTE 20030919 WVP-IRR-4215/15+72/75-25/25/25+5-480/3/60-PNT-PEFF-CVBN-BFCTRLN- PARLS-AIRRLS-DRNS-WVLV-WSVLV-BOV-PXR-PG-WRNSGN-2LC-SW-UL Pump Station Model Number: VWP-25/25/25+5-4041/15 - Pump Station Serial Number: AGJ-03-095990-01</p> <p>The Metron Packaged Pumping System is designed to deliver 4215 GPM at a station discharge pressure of approximately 15 PSI using three (3) vertical turbine pumps controlled by individual variable frequency drives (VFD) provided by others. System also includes one (1) submersible pump that is started across-the-line (controls provided by others) to supply water to the Lake Inlet Screens. All pumps extend 37'-8" into a 38'-8" deep, 8-foot diameter wet well. Incoming power to the pumping station is 480-volts, 3-phase, and 60-hertz.</p> <p>STANDARD MECHANICAL FEATURES INCLUDE:</p> <ul style="list-style-type: none"> 1 Structural steel skid with "diamond" plate decking; continuous welds. 1 Wet well access hatch with padlock capability to prevent unauthorized entry. 1 H.R. steel pump mounting plate x " thick. 1 Schedule 40 piping and fittings. 1 Two (2) drains x 3/4-inch with one (1) hose bib. 	A4	1		

CONTINUED



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 1505 West Third Avenue
 Denver, Colorado 80223-2811
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 YOUR JOB:

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 SHIP TO: CO: BT CONSTRUCTION
 9820 MCKAY ROAD
 THORNTON CO 80640
 USA

ATTN: ERIC @ 303-591-3462

CUST NO	SHIP CHARGES	EXPECT TO SHIP DATE	TERMS
04317		02/16/04	Net 30 Days

ITEM	CATALOG NUMBER / DESCRIPTION	PI	ORDER QUANTITY	UNIT PRICE	AMOUNT
	<p>1 Steel grit blasted to near white metal finish before the application of protective coatings.</p> <p>1 Spare Parts: packing for the main vertical turbine pumps and touch-up paint.</p> <p>ADDITIONAL FEATURES INCLUDE:</p> <p>3 25 HP, 1770 RPM, Flowserve vertical turbine pump. Requires a net positive suction head of 14.1-feet to meet design performance of 1405 GPM @ 23.8 PSI to account for static lift and frictional losses on the skid. Wafer style silent check valve, isolation butterfly valve, and U.S. Motors premium efficiency vertical hollow-shaft motor with WPI enclosure and NRR provided.</p> <p>1 5 HP, 3450 RPM, submersible pump. Design point is 72 GPM @ 77.9 PSI to account for static lift and frictional losses on the skid. Isolation butterfly valve and submersible motor provided.</p> <p>1 IRR Pump station is designed and manufactured for use in turf irrigation applications.</p> <p>1 PNT Paint System - fast dry multi-purpose epoxy base coat and gloss aliphatic polyurethane finish coat giving a total dry film thickness of 6 to 9 mils; amine-cured coal-tar epoxy with a dry film thickness of 16 mils applied to the underside of the skid for corrosion resistance to moisture from the wet well.</p> <p>3 PEFF Premium Efficiency Motors - drives the main pumps; manufactured by U.S. motors.</p>				

CONTINUED



METRON, INC.
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 Denver, Colorado 80223-2811
 Phone (303) 592-1903 • FAX (303) 534-1947

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 80127-0851

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 HENDERSON CO 80640
 USA

CITY OF ARVADA
 SHIP TO: CO: BT CONSTRUCTION
 9820 MCKAY ROAD
 THORNTON CO 80640
 USA

ATTN: ERIC @ 303-591-3462

CUST NO	SHIP CHARGE	EXPECT TO SHIP DATE	TERMS		
04317		02/16/04	Net 30 Days		
ITEM	CATALOG NUMBER / DESCRIPTION	QTY	ORDER QUANTITY	UNIT PRICE	AMOUNT
	3 CVBN Check Valves - wafer-style, non-slam; cast iron body; bronze plug and seat with Buna-N seal for zero leakage; stainless steel valve spring and seat retainers; valve plug guided at both ends by a center shaft integral with the valve plug; alignment of the center shaft provided by guide bushings; Cal-Matic Series 1400-BN.				
	3 MPARLS Main Pump Air Release Valves - located on the discharge of the main duty pumps; automatic float operated valve designed to release accumulated air from a piping system while the system is in operation and under pressure; cast iron body; stainless steel trim and float; synthetic seating.				
	1 AIRRLS Air Release Valve - located on the pump discharge manifold; automatic float operated valve designed to release accumulated air from a piping system while the system is in operation and under pressure; cast iron body; stainless steel trim and float; synthetic seating.				
	1 DRNS Drains Lines - from the packing drain area of each main pump discharge head, packing gland by-pass connection of each main pump, exhaust port of the air release valves on the discharge of each main pump and on the pump discharge manifold; drain lines are run to discharge into the wet well. Drain line from the heat exchanger outlet connection is by others.				
	1 WVLV Washdown Valve - brass hose bib " on the discharge piping.				
	1 WSVLV Water Sample Valves - " isolation ball valve on each of				

CONTINUED



METRON, INC.
 1505 West Third Avenue
 Denver, Colorado 80223-2811
 Phone (303) 592-1903 • FAX (303) 534-1947

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 DENVER, COLORADO
 80127-0851

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 THORNTONN CO 80640
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04317		02/16/04	Net 30 Days			
ITEM	CATALOG NUMBER	DESCRIPTION	QTY	ORDER QUANTITY	UNIT PRICE	AMOUNT
		<p>the 8" fill lines from the wells for taking water samples; two (2) water sample valves required.</p> <p>1 BOV Blow-Off Valves - 2" isolation valve and connection on each of the 8" fill lines from the wells for blowing out the lines with air; two (2) blow off valves required.</p> <p>1 PXR Pressure Transducer - range of 0 to 100 PSI; stainless steel wetted components; ±0.13% accuracy; 4 - 20 mAmp output signal; loop powered.</p> <p>1 PG Discharge Pressure Gauge - liquid filled; 2-1/2" diameter; graduations from 0 to 100 PSI; isolation valve.</p> <p>1 WRNSGN Warning Sign - 3" x 5" phenolic plate attached to the wet well access hatch; red with white lettering engraved stating "WARNING - ACCESS TO WET WELL VIA APPROPRIATE CABLE HARNESS".</p> <p>1 2LC 2-Point Level Control For The Wet Well - consists of two (2) Warrick Model 3W2 Probes with 100-feet of wire for installation in the stilling well; one (1) Warrick Model 16MB1001010 solid state plug-in module with 10-second delay for installation by others in the Owner's electrical control panel.</p> <p>1 SW Stilling Well - 2" schedule 40 pipe into which the Owner will lower a submersible pressure transmitter that he is responsible for providing.</p> <p>1 UL Packaged Pumping Skid is U.L. listed.</p> <p>ADDITIONAL SYSTEM COMPONENTS</p> <p>1. Cross-Over Pipe Assembly - connects the 2-pipes to the pumping station. Assembly includes two (2) saddle support stands, Standon #S92, for 8" pipe, one (1) saddle support stand.</p>				
						CEBT INDEL

ORIGINAL



METRON, INC.
 1505 West Third Avenue
 Denver, Colorado 80223-2811
 Phone (303) 592-1903 • FAX (303) 534-1947

ORDER ACKNOWLEDGEMENT

SHIP TO: METRON, INC.
 P.O. BOX 17851
 DENVER, COLORADO
 80127-0851

JOB NO: 095990

ORDER DATE: 10/15/03

YOUR ORDER NO:
 YOUR JOB:

SOLD TO: BT CONSTRUCTION, INC.
 9885 EMPORIA ST.
 HENDERSON CO 80640
 USA

CITY OF ARVADA
 SHIP TO: CO: BT CONSTRUCTION
 9820 NCKAY ROAD
 THORNTON CO 80640
 USA

ATTN: ERIC @ 303-591-3462

CUST NO	SHIP CHARGES	EXPECT TO SHIP DATE	TERMS		
04317		02/16/04	Net 30 Days		
ITEM	CATALOG NUMBER / DESCRIPTION	P.I.	ORDER QUANTITY	UNIT PRICE	AMOUNT
	<p>Standon #S92, for 10" pipe, two (2) flange support stands, Standon #S89, for 8" pipe, and one (1) flange support stand, Standon #S89, for 10" pipe. Assembly also includes two (2) butterfly isolation valves x 6" with lever operator, two (2) butterfly isolation valves x 8" with gear operator, two (2) air release valves x 1"; one (1) fixed insertion vortex flow meter with a range of 0-cfm to 100-cfm, one (1) fixed insertion vortex flow meter with a range of 0-cfm to 401-cfm, and one (1) fixed insertion vortex flow meter with a range of 0-cfm to 845-cfm. Flow meters to be calibrated in cubic feet per second and acre-feet. Programming software is by others.</p> <p>2. Inlet Z-Pipe from the Wells - 8" pipe with flanged by plain end connections. Includes an 8" Victaulic flexible coupling to eliminate the need for the Contractor to weld the connecting flange inside the pump house after the pipe has been installed through the core-drilled hole in the wall. Underground thrust plate 24" x 24" x 1/2" thick is included but transition coupling to the inlet pipeline is by the Contractor.</p> <p>3. Outlet Z-Pipe - 10" with flanged by plain end connections. Includes a 10" Victaulic flexible coupling to eliminate the need for the Contractor to weld the connecting flange inside the pump house after the pipe has been installed through the core-drilled hole in the wall. Underground thrust plate 24" x 24" x 1/2" thick is included but transition coupling to the inlet pipeline is by the Contractor.</p> <p>4. Self-Cleaning Lake Intake Screen - consisting of two (2) units with 2350 GPM capacity each when equipped with a 10-mesh</p>				

ORIGINAL



METRON, INC.

1505 West Third Avenue
Denver, Colorado 80223-2811
Phone (303) 592-1903 • FAX (303) 534-1947

ORDER ACKNOWLEDGEMENT

MIT TO: METRON, INC.
P.O. BOX 17851
DENVER, COLORADO
80127-0851

JOB NO: 095990

ORDER DATE: 10/15/03

YOUR ORDER NO:
YOUR JOB:

SOLO TO: BT CONSTRUCTION, INC.
9885 EMPORIA ST.
HENDERSON CD 80640
USA

CITY OF ARVADA
SHIP TO: CD: BT CONSTRUCTION
9820 MCKAY ROAD
THORNTON CD 80640
USA

ATTN: ERIC @ 303-591-3462

CUST. NO.	SHIP CHARGES	EXPECTED SHIP DATE	TERMS
04317		02/16/04	Net 30 Days

ITEM	CATALOG NUMBER	DESCRIPTION	P	ORDER QUANTITY	UNIT PRICE	AMOUNT
		screen. Each unit is 26" diameter x 48-1/2" long overall (32" long screen) and each has a 14" flange. Manifold assembly, unpainted, provided for the mounting of the screens onto a common device. In-line strainer, pressure reducing valve, and pressure gauge with isolation cock provided. Backwash return line is by Contractor.				
		5. Two (2) Wet Well Down-Pipe with Diffuser Tube - consisting of a 10" x 10" x 8" tee, air release valve x 1/2", three (3) lengths of 10" schedule 40 pipe with threaded ends; and one (1) 10" schedule 40 pipe diffuser tube approximately 7'-8" long that extends to within 1'-0" of the bottom of the wet well. Wall mounting brackets are by contractor.				
002	CUSTOM	INLET Z-PIPE X 8"	A4	2		
003	CUSTOM	OUTLET Z-PIPE X 10"	A4	1		
004	CUSTOM	CROSS OVER PIPE ASSEMBLY WITH FLOW METERS	A4	1		
005	CUSTOM	WET WELL DOWN-PIPE AND DIFFUSER TUBE	A4	2		
006	CUSTOM	SELF-CLEANING LAKE INTAKE SCREEN	A4	1		

CONTINUED



METRON, INC.

1505 West Third Avenue
 Denver, Colorado 80223-2811
 Phone (303) 592-1903 • FAX (303) 534-1947

ORDER ACKNOWLEDGEMENT

SHIP TO: METRON, INC.
 P.O. BOX 17851
 DENVER, COLORADO
 80127-0851

JOB NO: 095990

ORDER DATE: 10/15/03

YOUR ORDER NO:
 YOUR JOB:

SOLD TO: BT CONSTRUCTION, INC.
 9885 EMPORIA ST.
 HENDERSON CO 80640
 USA

CITY OF ARVADA
 SHIP TO: CO: BT CONSTRUCTION
 9820 MCKAY ROAD
 THORNTONN CO 80640
 USA

ATTN: ERIC @ 303-591-3462

CUST NO	SHIP CHARGES	EXPECT TO SHIP DATE	TERMS		
04317		02/16/04	Net 30 Days		
ITEM	CATALOG NUMBER / DESCRIPTION	PL	ORDER QUANTITY	UNIT PRICE	AMOUNT
007	ASSEMBLY CONSISTING OF TWO (2) SCREENS AND ONE (1) MANIFOLD (UNPAINTED) CUSTOM INSTALLATION KIT (3) VERTICAL TURBINE PUMPS WITH COLUMN ASSEMBLY (3) VERTICAL MOTDRS X 25 HP (1) SUBMERSIBLE PUMP WITH 5 HP MOTOR (1) SUBMERSIBLE PUMP COLUMN ASSEMBLY (1) METER RUN X 10" PIPE WITH FLOW METER (1) LOT - MISCELLANEOUS GASKETS AND FASTENERS	04	1	.00	.00
008	CUSTOM FREIGHT TO JOBSITE	14	1		
009	CUSTOM SERVICE WORK - INSTALLATION OVERSITE	14	1		
010	CUSTOM SERVICE WORK - START-UP AND TRAINING	14	1		
011	CUSTOM SERVICE WORK - FOLLOW-UP SITE VISIT	14	1		
TOTAL					

APPENDIX H

ARVADA PUMP STATION WET WELL PUMP CURVES

Customer :
 Item number : Arvada So. Platte Reservo
 Service :
 Vendor reference : 9999-W0000
 Date : December 8, 2003

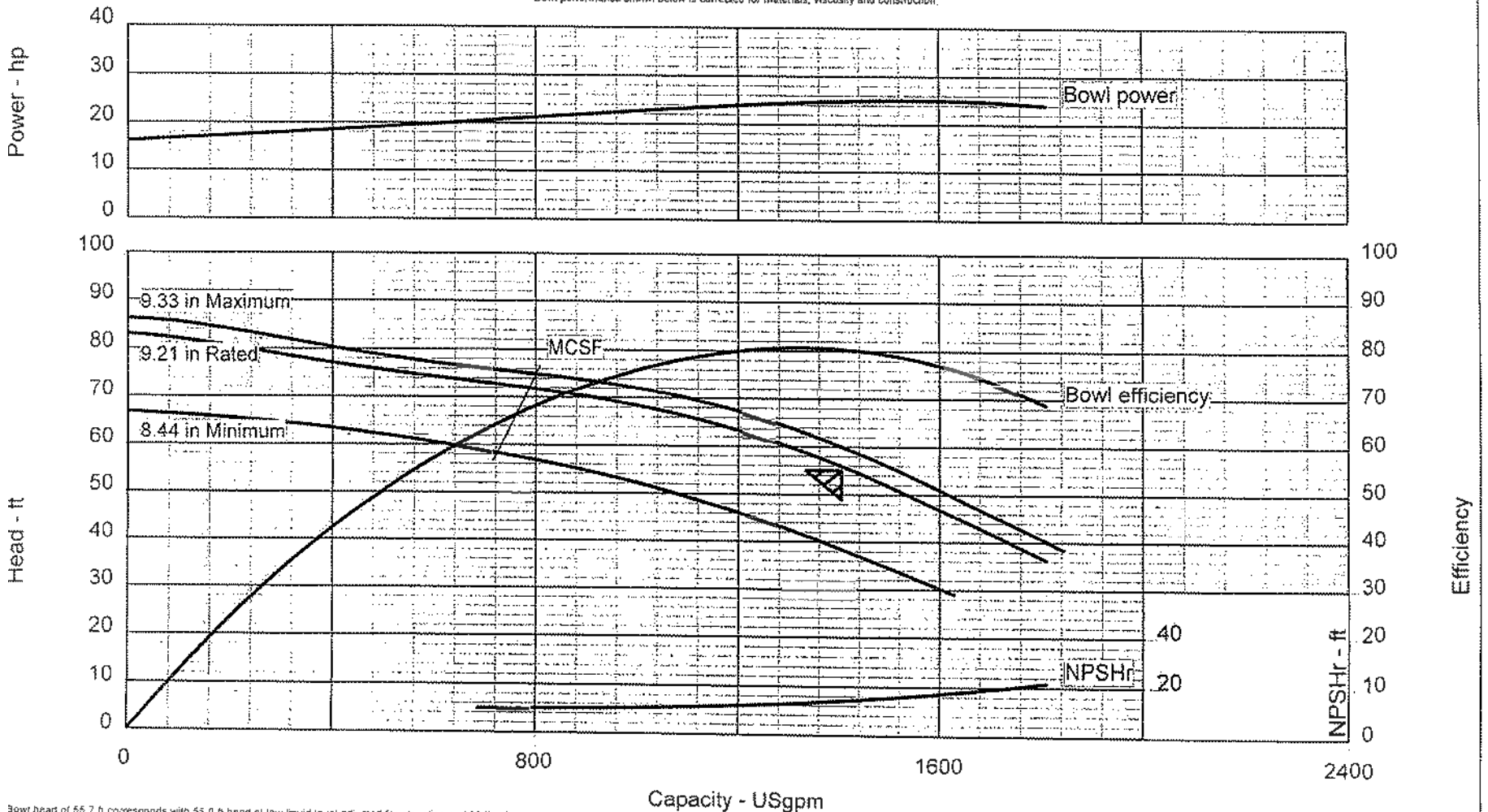


Capacity : 1405.0 USgpm
 Head : 55.00 ft
 Specific gravity : 1.000
 Pump speed : 1770 rpm

Pump size & type : 12EHM
 Based on curve no. : EC-2657
 Number of stages : 1

CURVES ARE APPROXIMATE. PUMP IS GUARANTEED FOR ONE SET OF CONDITIONS. CAPACITY, HEAD, AND EFFICIENCY.

Bowl performance shown below is corrected for materials, viscosity and construction.



Bowl head of 55.7 ft corresponds with 55.0 ft head at low liquid level adjusted for elevation and friction losses.

Customer :
 Customer reference :
 Item number : Arvada So. Pallet Reservo
 Service :

Pump / Stages : 12EHM / 1
 Based on curve no : EC-2657
 Vendor reference : 9999-W0000
 Date : December 8, 2003

Operating Conditions

Capacity : 1405.0 USgpm
 Water capacity (CQ=1.00) :
 Normal capacity :
 Total Developed Head : 55.00 ft
 Water head (CH=1.00) :
 NPSH available (NPSHa) : Ample
 NPSHa less NPSH margin :
 Maximum suction pressure : 0.0 psig

Materials / Specification

Material column code : B30
 Pump specification :

Other Requirements

Hydraulic selection : No specification
 Construction : No specification
 Test tolerance : Hydraulic Institute Level B
 Non-Drooping Curve Required
 Operating Speed Limit : 1770 rpm
 Driver Sizing : Max Power (SO to EOC) w/o SF

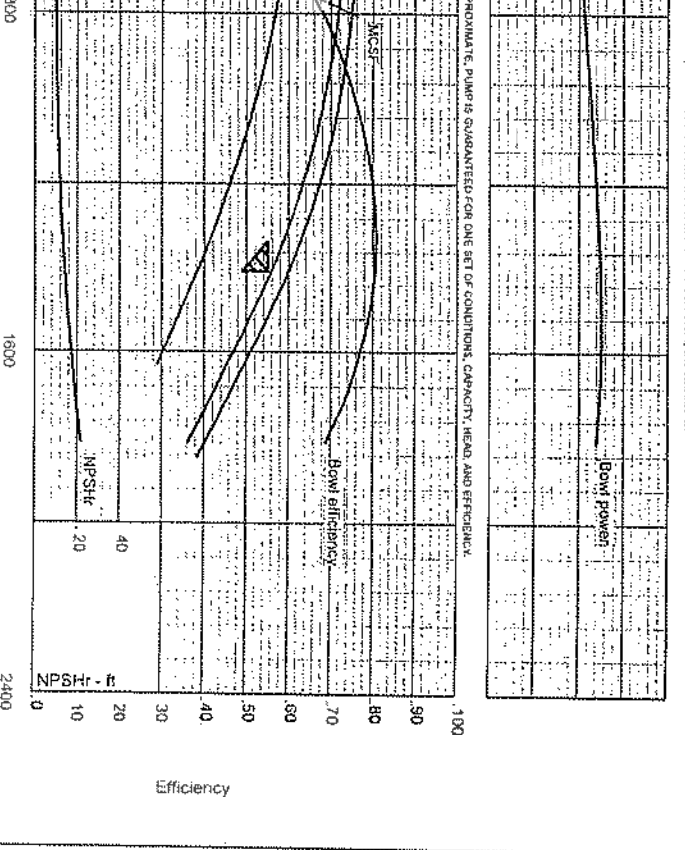
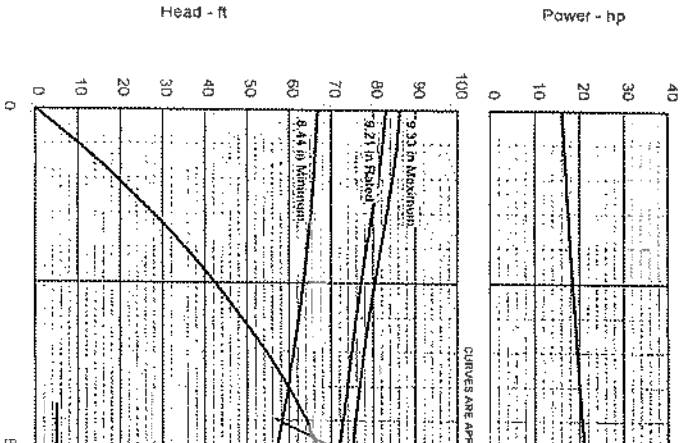
Liquid type : Water
 Liquid description :
 Temperature : 60 °F
 Specific gravity / Viscosity : 1.000 / 1.0 cSt

Performance

Hydraulic power : 18.5 hp
 Pump speed : 1770 rpm
 Efficiency (CE=1.00) : 78.5 %
 NPSH required (NPSHr) : 14.1 ft
 Rated power : 24.9 hp
 Maximum power : 25.0 hp / 18.6 kW
 Driver power : 35.9 psig
 Casing working pressure (based on shut off @ csl dia) : 35.9 psig
 Maximum allowable : 35.9 psig
 Bowl & column hydrotest : 44.9 psig
 Minimum submergence : 24.00 in
 Pump thrust at rated flow : 535.9 lbf

Impeller diameter :
 Rated : 9.21 in
 Maximum : 9.33 in
 Minimum : 9.44 in
 Suction specific speed : 9260 US units
 Minimum continuous flow : 788.7 USgpm
 Maximum head @ rated dia : 83.0 ft
 Flow at BEP : 1329.1 USgpm
 Flow as % of BEP : 105.7 %
 Efficiency at normal flow : -
 Impeller dia ratio (rated/max) : 98.7 %
 Head rise to shut off : 48.8 %
 Total head ratio (rated/max) : 93.1 %

Best performance shown below is corrected for altitude, density and construction.



Best head of 55.7 ft developed with 55.0 ft head. All flow liquid levels required for operation and factors listed.

Customer	Avada So. Platte Reserv	Pump / Stages	: 12EHM	/ 1
Customer reference		Based on curve no.	: EC-2657	
Item number		Vendor reference	: 9999-W0000	
Service		Date	: December 8, 2003	

Construction		Driver Information	
Bowl construction / lined	: Flanged / Lined bowls	Manufacturer	: Customer supplied
Impeller type	: Enclosed	Power / SF	: 25.0 hp / 18.6 kW
Impeller fastening	: Colletted	Vertical shaft type	: Hollow
Suction strainer	: Basket	Hollow shaft coupling	
Column construction	: Threaded	Driver Type	: Electric motor
Column flange specn	: Taneytown Specification	Frame size / Base dia	
Column dia (nominal)	: 10.00 in	Enclosure	
Column pipe length	: 35.58 ft	Duty type	
Column section length	: 120.00 in	Efficiency type	
lineshaft big spacing	: 120.00 in	Hazardous area class	
Lineshaft diameter	: 1.00 in	Explosion T rating	
Lineshaft coupling type	: Threaded coupling	Volts / Phase / Hz	: / - / -
Lineshaft bearings, qty	: 4	Amps-full load/locked rotor	: - / -
Lineshaft construction	: Open	Motor starting	: Direct on line (DOL)
Lineshaft lubrication	: Pumpage	Insulation	
Enclosing tube diameter	: N/A	Temperature rise	
Disch size/rating/face	: 10 inch / 125# ANSI / FF	Bearings / Lubrication	: / -
Pump/driver coupling	: -1	Motor mounted by	: Customer
"W" - Cast Above grade Discharge		Trust rating down/up	: / -

Materials		Seal Information	
Bowl	: Cast iron (A48 CL30)	Arrangement	: Packing
Impeller	: Bronze	Size	
Bowl bearing	: Bronze (C94400)	Manufacturer / Type	: / Packing
Bowl shaft	: 416SS (A582 Gr 416)	Material code (Man/API)	: / -
Bowl wear ring	: None supplied	Gland material	
Impeller wear ring	: None supplied	Auxiliary seal device	
Suction strainer		Seal flush plan	
Column	: Steel A53 Type E GrB	Seal flush construction	
Lineshaft	: 416 stainless steel	Paint and Package	
Enclosing tube		Pump paint	
Bearing retainer		Mounting plate paint	
Lineshaft bearing	: Rubber (Buna-N)	Shipment type	
Lineshaft sleeve			
Discharge head	: Cast iron (A48 CL30)		
Head shaft			
Mounting plate	: None supplied		

Weights (Approx.)		Additional Information	
Complete pump		PI / sump depth	: 36.70 ft
Mounting plate		Pump length (mounting surface to big hub/strainer)	: 38.48 ft
Driver(nell)		Available well diameter	: 100.00 in
		Max dia below mtg surface	: 15.50 in

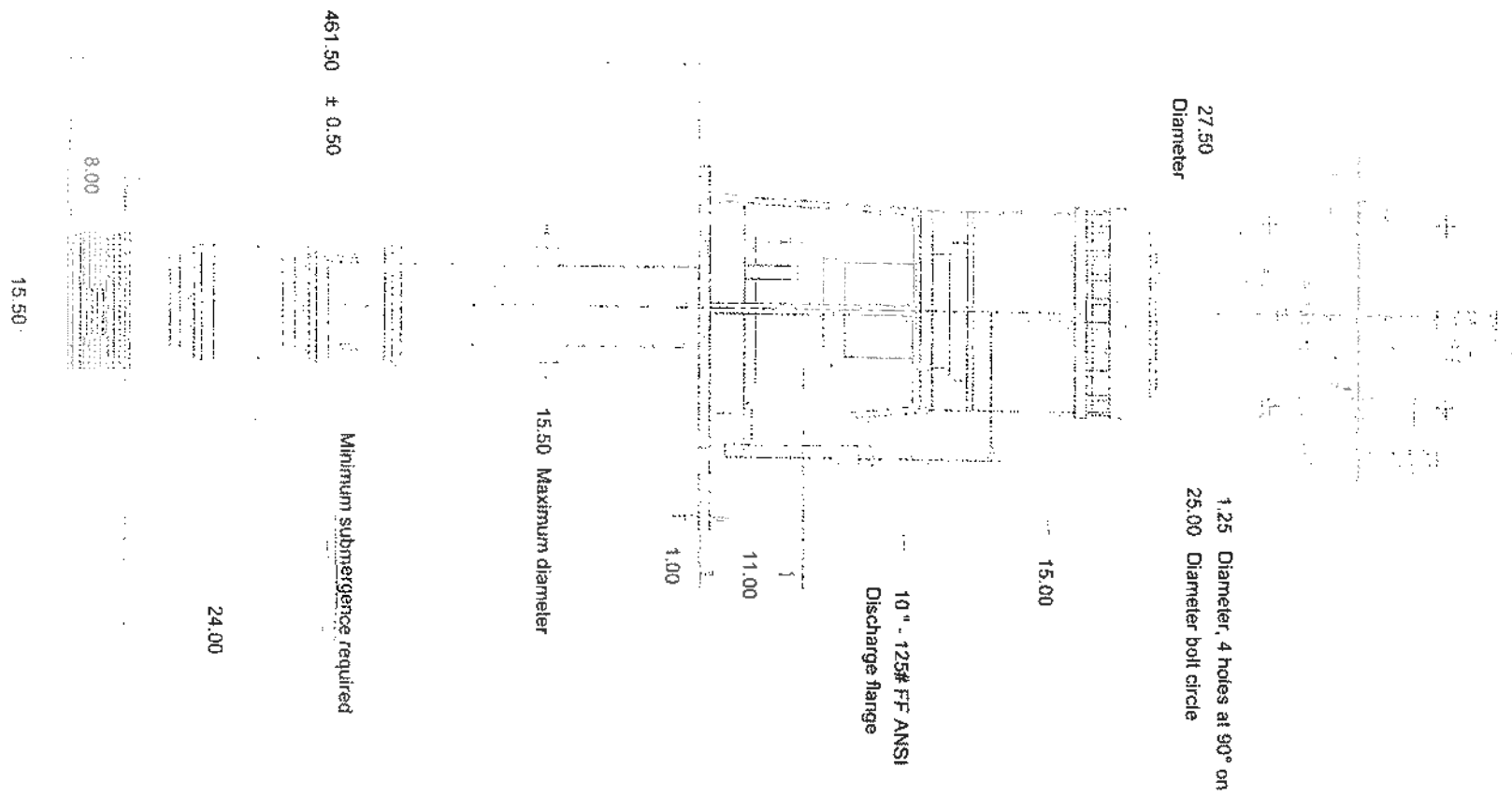
Testing	
Hydrostatic test	: None
Performance test	: None
NPSH test	: None

Notes

Discharge flange is designed only to bolt up to an ANSI 125# flange but is not fully ANSI compliant.

Top View

Not to scale



All dimensions are in inches unless otherwise specified

Customer	:	Arvada So. Platte Reservo	Pump size & type	:	12EHM	Drawing number	:	
Item number	:		Pump speed / Stages	:	1770 rpm / 1	Date	:	December 8, 2003
Service	:		Flow / Head	:	1405.0 USgpm / 55.00 ft	Certified by / Date:	:	
Customer PO #	:		Driver power / Frame	:	25.0 hp / 18.6 kW / -	Seal type	:	Packing
Vendor reference	:	9999-W0000 Rev. A	Volts / Phase / Hz	:	- / - / -	Seal flush plan	:	

PERFORMANCE CURVES

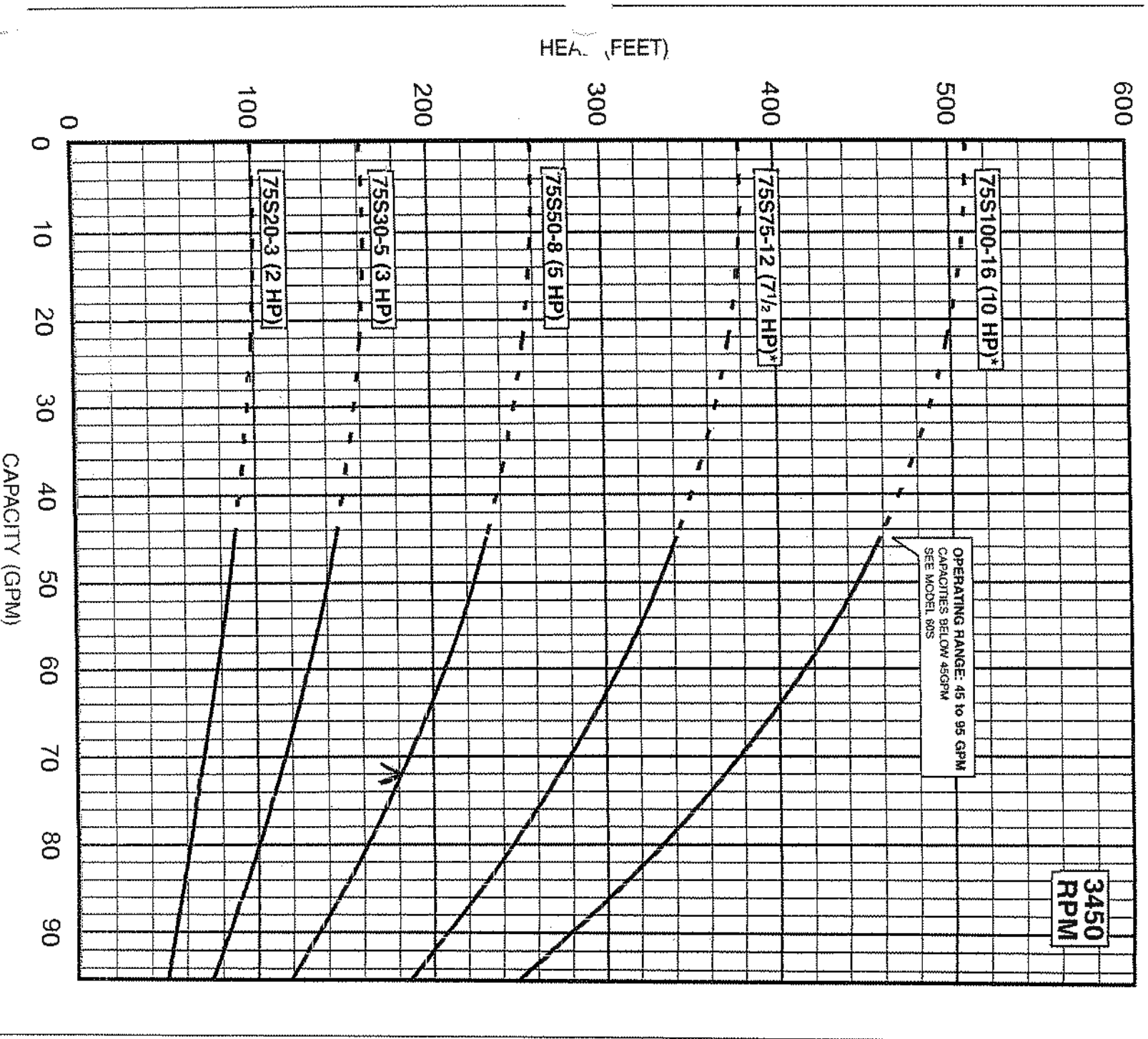
75 GPM

MODEL 75S

FLOW RANGE: 45 - 95 GPM

OUTLET SIZE: 2" NPT

NOMINAL DIA.: 4"



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

4" MOTOR STANDARD, 2-10 Hp 3450 RPM.

* Also available with 6" motor, performance is the same only at Best Efficiency point. Consult factory for actual performance.

Performance conforms to ISO 9906 Annex A @ 5 ft. min. submergence.

APPENDIX I

ARVADA PUMP STATION SKID DESIGN INFORMATION

PACKAGED PUMP SKID DATA SHEET - MECHANICAL

JOB NAME:	City of Arvada South Platte Reservoir	JOB NUMBER:	095990
SALES REPRESENTATIVE:	David Haynes	DATE:	12-31-03
STATION MODEL NUMBER:	VWP-VFD-25/25/25+5-4215/15	DESIGN FLOW RATE:	4215 gpm
STATION SERIAL NUMBER:	AGJ-03-095990-01	DESIGN DISCH. PRESSURE:	15-psi
		MAX SUCTION LIFT:	36-feet

MANUFACTURER:

MODEL NUMBER:

TOTAL PUMP LENGTH (INCHES):

INLET TO THE PMP (INCHES):

DESIGN FLOW (GPM):

DESIGN PRESSURE (FEET):

IMPELLER TRIM (INCHES):

SEAL TYPE:

HORSEPOWER (HP):

REVOLUTIONS PER MINUTE (RPM):

FRAME SIZE:

MOTOR ENCLOSURE IF NOT WP1:

MOTOR SERVICE FACTOR (SF):

STARTING METHOD IF NOT ATL:

NON REVERSING RATCHET:

FLOW RANGE (GPM):

PUMP No. 1	PUMP No. 2	PUMP No. 3	PUMP No. 4
Grundfos	Flowserve	Flowserve	Flowserve
75S50-8	12EHM-1 Stage	12EHM-1 Stage	12EHM-1 Stage
452-inches below bottom of the skid	452-inches below bottom of the skid	452-inches below bottom of the skid	452-inches below bottom of the skid
428.4 -inches below bottom of the skid	N/A	N/A	N/A
72 gpm	1405 gpm	1405 gpm	1405 gpm
180-feet	55-feet	55-feet	55-feet
Full	9.21-inches	9.21-inches	9.21-inches
N/A	Packing	Packing	Packing
5 hp	25 hp	25 hp	25 hp
3450	1770 rpm	1770 rpm	1770 rpm
N/A	284TP	284TP	284TP
Submersible	WP1	WP1	WP1
1.15	1.15	1.15	1.15
ATL	VFD	VFD	VFD
NA	Yes	Yes	Yes
0-72	0-1405	1406-2810	2811-4215

	MOTOR SHUTOFF	MOTOR RESTART	REFERENCE
LEVEL PROBE DEPTH:	34'-8" below bottom of skid	34'-8" below bottom of skid	N/A

OVERALL SIZE (L X W X H) INCHES FOOT PRINT DIMENSIONS:	See Metron Drawings	SKID SIZE L X W IN:	See Metron Drawings
PUMP LENGTH BELOW SKID (FEET):	37.667-feet		
WET WELL DEPTH (FEET):	38.667-feet		
WET WELL DIAMETER (INCHES):	96-inches		
DRY WEIGHT (POUNDS):	See Metron Drawings		
PIPE MATL IF NOT SCH. 40 CARBON STL:	Schedule 40 carbon steel pipe		

Metron, Inc.	Date: _____	Approved: _____	Doc No.: 487
Revision: A	Date: _____	Approved: _____	Page: 1 of 2

PACKAGED PUMP SKID DATA SHEET - MECHANICAL

	DIAMETER	CONNECTION
DISCHARGE CONNECTION:	10-inches	ANSI 150# Flange
SUCTION CONNECTION:	N/A	N/A

PRESSURE RELIEF VALVE HIGH PRESSURE SETTING: N/A

PRESSURE SWITCH GAUGE HIGH PRESSURE SETTING: N/A

PRESSURE SWITCH GAUGE LOW PRESSURE SETTING: N/A

ISOLATION VALVES

	MODEL	CLASS	SIZE	CONNECTION
LAKE SCREEN PUMP DISCHARGE:	Center Line Series 200 Butterfly Valve	150#	2-inches	Lug Style ANSI 150# Flange
LAKE SCREEN PUMP SUCTION:	N/A	N/A	N/A	N/A
MAIN PUMPS DISCHARGE:	Center Line Series 200 Butterfly Valve	150#	8-inches	Lug Style ANSI 150# Flange
MAIN PUMPS SUCTION:	N/A	N/A	N/A	N/A
PRESSURE REDUCING VALVE	Watts Series FBV-3 Ball Valve	150#	2"	2" FNPT
STATION SUCTION:	N/A	N/A	N/A	N/A
STATION DISCHARGE ISOLATION:	N/A	N/A	N/A	N/A

ADDITIONAL SYSTEM COMPONENTS:

- Two (2) Clemons Model CW2000 Self-Cleaning Lake Intake Screens with manifold assembly – shipped loose.

ADDITIONAL INFORMATION:

Metron, Inc.	Date: _____	Approved: _____	Doc No.: 487
Revision: A	Date: _____	Approved: _____	Page: 2 of 2

PACKAGED PUMP SKID DATA SHEET - ELECTRICAL

Customer Name: City of Arvada South Platte Reservoir Pumping Station Location: CO

Quote/ Job Number: 20030919 / 095990 REV. A Date: 11-17-03

Control Panel Serial Number: N/A (By Others)

Control Panel Model Number: VWP-VFD-25/25/25+5-460/3/60

Sales Representative: David Haynes

Enclosure NEMA Rating: 3R 4(STD) 4X 12

Cooling System Type: Heat Exchanger (STD) Air Conditioner Fan(s)

PRIMARY POWER INFORMATION:

Note: Optional mini power supply load not included in Full Load Amps

Voltage: 460 System Full Load Amps: 109.6 Single Phase 60 Hertz
 Three Phase 50 Hertz

Main Power Switch:

Note: The switching means listed below are not service entrance rated.

- _____ Amp, Non Fused Main Disconnect Switch w/ Through the Door Handle
- _____ Amp, Fused Main Disconnect Switch Externally Mounted
- _____ Amp, Circuit Breaker Main Disconnect Switch w/ Through the Door Handle

MOTOR CIRCUIT SPECS:

	Motor No.							
	No. 1	No. 2	No. 3	No. 4				
Horsepower:	5	25	25	25				
Full Load Amps:	7.6	34.0	34.0	34.0				
Motor Fuse Size (Amps):								
Motor Disc. Switch Size (Amps):								
Motor Breaker Size (Amps):								
Motor Thermo. Switch								

APPENDIX J

ARVADA PUMP STATION VENDOR PACKAGE INFORMATION

PACKAGED PUMP SKID DATA SHEET - MECHANICAL

JOB NAME: City of Arvada South Platte Reservoir **JOB NUMBER:** 095990
SALES REPRESENTATIVE: David Haynes **OATE:** 12-31-03
STATION MODEL NUMBER: VWP-VFD-25/25/25+5-4215/15 **DESIGN FLOW RATE:** 4215 gpm
STATION SERIAL NUMBER: AGJ-03-095990-01 **DESIGN DISCH. PRESSURE:** 15-psi
MAX SUCTION LIFT: 36-feet

	PUMP No. 1	PUMP No. 2	PUMP No. 3	PUMP No. 4
MANUFACTURER:	Grundfos	Flowserve	Flowserve	Flowserve
MOEEL NUMBER:	75S50-8	12EHM-1 Stage	12EHM-1 Stage	12EHM-1 Stage
TOTAL PUMP LENGTH (INCHES):	452-inches below bottom of the skid	452-inches below bottom of the skid	452-inches below bottom of the skid	452-inches below bottom of the skid
INLET TO THE PMP (INCHES)	428.4 -inches below bottom of the skid	N/A	N/A	N/A
DESIGN FLOW (GPM):	72 gpm	1405 gpm	1405 gpm	1405 gpm
DESIGN PRESSURE (FEET):	180-feet	55-feet	55-feet	55-feet
IMPELLER TRIM (INCHES):	Full	9.21-inches	9.21-inches	9.21-inches
SEAL TYPE:	N/A	Packing	Packing	Packing
HORSEPOWER (HP):	5 hp	25 hp	25 hp	25 hp
REVOLUTIONS PER MINUTE (RPM):	3450	1770 rpm	1770 rpm	1770 rpm
FRAME SIZE:	N/A	284TP	284TP	284TP
MOTOR ENCLOSURE IF NOT WP1:	Submersible	WP1	WP1	WP1
MOTOR SERVICE FACTOR (SF):	1.15	1.15	1.15	1.15
STARTING METHOD IF NOT ATL:	ATL	VFD	VFD	VFD
NON REVERSING RATCHET:	NA	Yes	Yes	Yes
FLOW RANGE (GPM):	0-72	0-1405	1406-2810	2811-4215

	MOTOR SHUTOFF	MOTOR RESTART	REFERENCE
LEVEL PROBE DEPTH:	34'-8" below bottom of skid	34'-8" below bottom of skid	N/A

OVERALL SIZE (L X W X H) INCHES See Metron Drawings **SKIO SIZE**
FOOT PRINT DIMENSIONS: See Metron Drawings **L X W IN:** See Metron Drawings
PUMP LENGTH BELOW SKID (FEET): 37.667-feet
WET WELL DEPTH (FEET): 38.667-feet
WET WELL DIAMETER (INCHES): 96-inches
DRY WEIGHT (POUNDS): See Metron Drawings
PIPE MATL IF NOT SCH. 40 CARBON STL: Schedule 40 carbon steel pipe

Metron, Inc.	Date: _____	Approved: _____	Doc No.: 487
Revision: A	Date: _____	Approved: _____	Page: 1 of 2

PACKAGED PUMP SKID DATA SHEET - MECHANICAL

	DIAMETER	CONNECTION
DISCHARGE CONNECTION:	10-inches	ANSI 150# Flange
SUCTION CONNECTION:	N/A	N/A

PRESSURE RELIEF VALVE HIGH PRESSURE SETTING: N/A

PRESSURE SWITCH GAUGE HIGH PRESSURE SETTING: N/A

PRESSURE SWITCH GAUGE LOW PRESSURE SETTING: N/A

ISOLATION VALVES

	MODEL	CLASS	SIZE	CONNECTION
LAKE SCREEN PUMP DISCHARGE:	Center Line Series 200 Butterfly Valve	150#	2-inches	Lug Style ANSI 150# Flange
LAKE SCREEN PUMP SUCTION:	N/A	N/A	N/A	N/A
MAIN PUMPS DISCHARGE:	Center Line Series 200 Butterfly Valve	150#	8-inches	Lug Style ANSI 150# Flange
MAIN PUMPS SUCTION:	N/A	N/A	N/A	N/A
PRESSURE REDUCING VALVE	Watts Series FBV-3 Ball Valve	150#	2"	2" FNPT
STATION SUCTION:	N/A	N/A	N/A	N/A
STATION DISCHARGE ISOLATION:	N/A	N/A	N/A	N/A

ADDITIONAL SYSTEM COMPONENTS:

- Two (2) Clemons Model CW2000 Self-Cleaning Lake Intake Screens with manifold assembly – shipped loose.

ADDITIONAL INFORMATION:

PACKAGED PUMP SKID DATA SHEET - ELECTRICAL

Customer Name: City of Arvada South Platte Reservoir Pumping Station Location: CO

Quote/ Job Number: 20030919 / 095990 REV. A Date: 11-17-03

Control Panel Serial Number: N/A (By Others)

Control Panel Model Number: VWP-VFD-25/25/25+5-460/3/60

Sales Representative: David Haynes

Enclosure NEMA Rating: 3R 4(STD) 4X 12
 Cooling System Type: Heat Exchanger (STD) Air Conditioner Fan(s)

PRIMARY POWER INFORMATION:

Note: Optional mini power supply load not included in Full Load Amps

Voltage: 460 System Full Load Amps: 109.6 Single Phase 60 Hertz
 Three Phase 50 Hertz

Main Power Switch:

Note: The switching means listed below are not service entrance rated.

- _____ Amp, Non Fused Main Disconnect Switch w/ Through the Door Handle
- _____ Amp, Fused Main Disconnect Switch Externally Mounted
- _____ Amp, Circuit Breaker Main Disconnect Switch w/ Through the Door Handle

MOTOR CIRCUIT SPECS:

	Motor No.							
	No. 1	No. 2	No. 3	No. 4				
Horsepower:	5	25	25	25				
Full Load Amps:	7.6	34.0	34.0	34.0				
Motor Fuse Size (Amps):								
Motor Disc. Switch Size (Amps):								
Motor Breaker Size (Amps):								
Motor Thermo. Switch								