

EXHIBIT F
TECHNICAL DOCUMENTS

CITY OF LOS ANGELES

CONTRACT DOCUMENTS

for the construction of the
BALBOA PUMP STATION IMPROVEMENTS

C-146599

JACOBS

Corvallis, Oregon

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SPECIFICATIONS

**SECTION 05 05 19BPS
POST-INSTALLED ANCHORS**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.
- C. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.
- B. Informational Submittals:
 - 1. Concrete Anchors:
 - a. Supplier's product description and installation instructions.
 - b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
 - 2. Passivation method for stainless steel members.

1.03 QUALITY ASSURANCE

- A. Qualifications: Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.

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PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel:	
Threaded Rods	F1554, Grade 36 A193/A193M, Grade B7
Flat and Beveled Washers (Hardened)	F436/F436M
Nuts*	A194/A194M, Grade 2H
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 POST-INSTALLED CONCRETE ANCHORS

- A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

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5. Acceptable for use in potable water structures by EPA and local health agencies or NSF 61.
- B. Torque-Controlled Expansion Anchors (Wedge Anchors):
1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; KWIK Bolt-TZ2 Expansion Anchor Safe Set System with hollow drill bit and vacuum and SI-AT-A22 tool with adaptive torque for applicable sizes (ESR-4266).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).
- C. Self-Tapping Concrete Screw Anchors:
1. Do not use for equipment anchorage unless specifically shown on the Drawings.
 2. Manufacturers and Products:
 - a. DeWalt/Powers Fasteners, Brewster, NY; Screw-Bolt+ (ESR-3889).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Hangermate+ Rod Hanger Screw Anchor (ESR-3889).
 - c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
 - d. Hilti, Inc., Tulsa, OK; Kwik HUS, KH-EZ, KH-EZ CRC, KH-EZ SS316, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ P Screw Anchor Safe Set System with hollow drill bit and vacuum (ESR-3027).
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713 and IAPMO UES-493).
- D. Adhesive Anchors:
1. Threaded Rod:
 - a. Diameter as shown on the Drawings.
 - b. Length as required to provide minimum depth of embedment indicated and thread projection required.
 - c. Clean and free of grease, oil, or other deleterious material.
 2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.

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3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - b. Store adhesive on pallets or shelving in a covered storage area.
 - c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
 - d. Dispose of When:
 - 1) Shelf life has expired.
 - 2) Stored other than in accordance with manufacturer's instructions.
4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT-HY 200 V3 Safe Set System with A: HIT-Z ROD (ESR-4868), or HAS threaded rod (ESR-3814), HIT RE 500 V3 Safe Set System with HAS threaded rod (ESR-3814), or HIT-RE 500 V3 Safe Set System with Hilti Roughening Tool (HIT RT) with HAS threaded rod (ESR-3814) for diamond cored holes.
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors. (ESR-4057).
 - c. DeWalt/Powers Fasteners, Brewster NY; Pure 220+ Epoxy adhesive anchor system with Dust X+ System (ESR-5144).

PART 3 EXECUTION

3.01 CONCRETE ANCHORS

- A. Begin installation only after concrete to receive anchors is a minimum of 21 days old or has attained design strength whichever requires a longer duration.
- B. Locate existing reinforcing with ground penetrating radar or other method approved by the Engineer prior to drilling. Coordinate with the Engineer to adjust anchor locations where installation would result in hitting reinforcing.
- C. Install in accordance with written supplier's instructions.
- D. Provide minimum embedment, edge distance, and spacing as indicated on the Drawings.
- E. Use only drill type, bit type, and diameter recommended by anchor manufacturer. Use rotary hammer drill unless otherwise approved by the Engineer. Core drilling may only be used if specifically allowed by the Engineer.

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- F. Clean hole of debris and dust per manufacturer's requirements.
- G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify the Engineer for direction on how to proceed.
- H. Adhesive Anchors:
 - 1. Unless otherwise approved by the Engineer and adhesive manufacturer:
 - a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
 - b. Do not install prior to concrete attaining an age of 21 days.
 - c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
 - d. Do not disturb anchor during recommended curing time.
 - e. Do not exceed maximum torque as specified in manufacturer's instructions.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Design-Builder-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33BPS, Special Inspection, Observation, and Testing. The Contractor responsibilities and related information are included in Section 01 45 33BPS, Special Inspection, Observation, and Testing.

3.03 FASTENER SCHEDULE

- A. Unless indicated otherwise on the Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment)		
Submerged, Exterior, Interior Wet, and Corrosive Areas	Type 316 stainless steel anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
2. All Others		
All service uses and locations	Type 316 stainless steel anchors	

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- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

**SECTION 26 05 02BPS
BASIC ELECTRICAL REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual specification sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 DESIGN REQUIREMENTS

- A. Provide anchorage and bracing design drawings, calculations, and related information where required under Section 01 88 15BPS, Anchorage and Bracing.
- B. Provide seismic certification per requirements of Section 01 45 33BPS, Special Inspection, Observation, and Testing, where required in that section for electrical equipment listed.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Electrical service components.
 - b. Nameplates, signs, and labels.
 - 2. Anchorage and bracing drawings and catalog information, as required by Section 01 88 15BPS, Anchorage and Bracing.
- B. Informational Submittals: Anchorage and bracing calculations, as required by Section 01 88 15BPS, Anchorage and Bracing.

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1.05 QUALITY ASSURANCE

- A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.
- C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.06 BUILD AMERICA, BUY AMERICA (BABA)

- A. Contractor shall provide pricing only for products that meet the requirements of this specification and are BABA compliant. Contractor shall be solely responsible for verifying and certifying BABA compliance of all products furnished. A manufacturer's or supplier's certification of BABA compliance shall be submitted for each product. Non-compliant products may be furnished only if a waiver is obtained from the applicable federal funding agency.

1.07 ENVIRONMENTAL CONDITIONS

- A. All areas are not classified.
 - 1. Use dust-tight and oil-tight NEMA 12 materials and methods.
- B. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas:
 - 1. Outdoor abovegrade areas.
- C. The following areas are classified as indoor and dry:
 - 1. Electrical Room:
 - a. Enclosure Rating: NEMA 1 minimum unless otherwise indicated.
- D. Temperature:
 - 1. Normal Operating Ambient Temperature Range: 40 degrees F to 104 degrees F (4 degrees C to 40 degrees C).

E. Humidity:

1. Relative Humidity Range: 5 percent to 95 percent noncondensing.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
- C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

2.02 EQUIPMENT FINISH

- A. Finish equipment in accordance with Section 09 90 00BPS, Painting and Coating, where applicable.
- B. Where Section 09 90 00BPS, Painting and Coating does not apply to the equipment or does not specify a finish, provide the manufacturer's standard finish color unless a specific color is indicated on the Drawings.

2.03 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws:
 1. Stainless steel.
 2. Adhesive: Single-part, room temperature vulcanizing adhesive suitable for the environment and materials installed. Use adhesive on NEMA 4 or NEMA 4X enclosures only.
- C. Color: Black, engraved to a white core.
- D. Letter Height:
 1. Pushbuttons/Selector Switches: 1/8 inch.
 2. Other Electrical Equipment: 1/4 inch.

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2.04 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Subcontractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Design-Builder.
- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Design-Builder in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Design-Builder. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 ANCHORING, BRACING, AND MOUNTING

- A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for Project design criteria provided in Section 01 61 00, Common Product Requirements, to meet the requirements of Section 01 88 15BPS, Anchorage and Bracing.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Homerun circuits shown on the Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:
1. Analog control circuits from devices in same general area to same destination.
 - a. No power or ac discrete control circuits shall be combined in same conduit with analog circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
 - c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Design-Builder.
 - d. Raceways shall be sized per Cable and Conduit Schedule and do not exceed 40 percent fill.
 - e. Changes shall be documented on Record Drawings.
 2. Discrete control circuits from devices in the same general area to the same destination.
 - a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
 - c. Raceways shall be sized per the Cable and Conduit Schedule and do not exceed 40 percent fill.
 - d. Changes shall be documented on Record Drawings.
 3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
 - a. Lighting Circuits: Subcontractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - b. Receptacle Circuits, 120 Volt Only: Combine no more than three circuits to a single raceway. Subcontractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - c. All Other Power Circuits: Do not combine power circuits without authorization of Design-Builder.

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3.04 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs:

1. Provide arc-flash warning labels on new or modified switchboards and panelboards to warn qualified persons of potential arc-flash hazards.
2. Locate labels so they are clearly visible to personnel prior to working on energized equipment.
3. Arc-flash labels shall be based on the results of the electrical systems analysis required in Section 26 05 70BPS, Electrical Systems Analysis.

B. Available Fault Current Signs:

1. Install label on service equipment and modified distribution equipment to indicate the maximum available fault current. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
 - a. Equipment name or identification.
 - b. Available fault current at the equipment.
 - c. Date the fault current calculations were performed.
2. Use bolted fault current and equipment name from study required in Section 26 05 70BPS, Electrical Systems Analysis, as basis for the label.
3. Where existing electrical systems are modified, completely remove existing fault current labels if present, and install new labels in accordance with the above requirements.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchboards, motor starters, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.05 LOAD BALANCE

- #### A.
- Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

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- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.06 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 - 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
 - 2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Design-Builder.

3.07 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Subcontractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Design-Builder.

END OF SECTION

SECTION 26 05 04BPS
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.
 - g. 943, Standard for Ground-Fault Circuit-Interrupters.

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- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.
 - f. Timers.
 - g. Fuses.
 - h. Magnetic contactors.
 - i. Intrinsic safety barriers.
 - j. Firestopping.
 - k. Enclosures: Include enclosure data for products having enclosures.
- 2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15BPS, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15BPS, Anchorage and Bracing.

1.03 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following special tools:

- 1. Fuses, 0 Volt to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

- 1. For existing panelboards match existing circuit breaker product and manufacturer.
- 2. Type: Molded case.
- 3. Trip Ratings: 15 amps to 800 amps.
- 4. Voltage Ratings: 120V ac, 240V ac, 277V ac, 480V ac, and 600V ac.

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5. Suitable for mounting and operating in any position.
6. UL 489.

B. Operating Mechanism:

1. Overcenter, trip-free, toggle type handle.
2. Quick-make, quick-break action.
3. Locking provisions for padlocking breaker in OPEN position.
4. ON/OFF and TRIPPED indicating positions of operating handle.
5. Operating handle to assume a CENTER position when tripped.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two-pole and three-pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.
7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

D. Short Circuit Interrupting Ratings:

1. Equal to, or greater than, available fault current or interrupting rating shown.
2. Equal to rating of existing equipment.
3. Series Connected Ratings: Do not apply series connected short circuit ratings, except where specifically shown. Where shown, provide UL listed series ratings for the specific breaker/breaker and fuse/breaker combinations.

E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).

1. Ground fault sensor shall be rated same as circuit breaker.
2. Push-to-test button.

F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30 mA ground fault (UL-listed for equipment ground fault protection).

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- G. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.
- H. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
- I. Connections:
 - 1. Supply (line side) at either end.
 - 2. Mechanical wire lugs, except crimp compression lugs where shown.
 - 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 - 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
 - 5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.
- J. Enclosures for Independent Mounting:
 - 1. See Article Enclosures.
 - 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 - 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 FUSE, 250-VOLT AND 600-VOLT

- A. Power Distribution, General:
 - 1. Current-limiting, with 200,000 ampere rms interrupting rating.
 - 2. Provide to fit mountings specified with switches.
 - 3. UL 248.
- B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:
 - 1. Class: RK-1.
 - 2. Type: Dual element, with time delay.
 - 3. Manufacturers and Products:
 - a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
 - b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).

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C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

1. Class: L.
2. Double O-rings and silver links.
3. Manufacturers and Products:
 - a. Bussmann; Type KRP-C.
 - b. Littelfuse, Inc.; Type KLPC.

D. Cable Limiters:

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

E. Ferrule:

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10 amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
 - a. Bussmann.
 - b. Littlefuse, Inc.

2.03 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Light: Transformer.

D. Pushbutton Color:

1. ON or START: Black.
2. OFF or STOP: Red.

E. Pushbutton and selector switch lockable in OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64 inch.

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G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
 - a. General Electric Co.; Type CR 104P.
 - b. Square D Co.; Type T.
 - c. Eaton/Cutler-Hammer; Type 10250T.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
 - a. Square D Co.; Type SK.
 - b. General Electric Co.; Type CR 104P.
 - c. Eaton/Cutler-Hammer; Type E34.
 - d. Crouse-Hinds; Type NCS.

2.04 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 1. Capable of wire connections without special preparation other than stripping.
 2. Capable of jumper installation with no loss of terminal or rail space.
 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 1. Weidmuller, Inc.
 2. Ideal.
 3. Electrovert USA Corp.

2.05 MAGNETIC CONTROL RELAY

- A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.
- B. NEMA ICS 2, Designation: A600 (600 volts).
- C. Time Delay Relay Attachment:
 - 1. Pneumatic type, timer adjustable from 0.2 second to 60 seconds (minimum) or as shown.
 - 2. Field convertible from ON delay to OFF delay and vice versa.
- D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.
- E. Manufacturers and Products:
 - 1. Eaton/Cutler-Hammer; D26 Type M.
 - 2. General Electric Co.; Type CR120B.
 - 3. Square D; Type X.

2.06 TIME DELAY RELAY

- A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.
- B. NEMA ICS 2 Designation: B150 (150 volts).
- C. Solid-state electronic, field convertible ON/OFF delay.
- D. One normally open and one normally closed contact (minimum).
- E. Repeat accuracy plus or minus 2 percent.
- F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on the Drawings.
- G. Manufacturers and Products:
 - 1. Eaton/Cutler-Hammer; Type D26MR.
 - 2. Square D Co.; Type XO.
 - 3. General Electric Co.; Type CR120.

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2.07 RESET TIMER

- A. Drive: Synchronous motor, solenoid-operated clutch.
- B. Mounting: Semiflush panel.
- C. Contacts: 10 amps, 120 volts.
- D. Manufacturers and Products:
 - 1. Eagle Signal Controls; Bulletin 125.
 - 2. Automatic Timing and Controls; Bulletin 305.

2.08 ELAPSED TIME METER

- A. Drive: Synchronous motor.
- B. Range: 0 hour to 99,999.9 hours, nonreset type.
- C. Mounting: Semiflush panel.
- D. Manufacturers and Products:
 - 1. General Electric Co.; Type 240, 2-1/2-inch Big Look.
 - 2. Eagle Signal Controls; Bulletin 705.

2.09 MAGNETIC CONTACTOR

- A. UL listed.
- B. Electrically operated, electrically held.
- C. Main Contacts:
 - 1. Power driven in one direction with mechanical spring dropout.
 - 2. Silver alloy with wiping action and arc quenchers.
 - 3. Continuous-duty, rated as shown.
 - 4. Poles: As shown.
- D. Control: Two-wire or as shown.
- E. Auxiliary Contacts: One normally open and one normally closed, or quantity as shown, rated 7200VA make, 720VA break, at 600V, A600 per NEMA ICS 5.
- F. Enclosures: See Article Enclosures.

G. Manufacturers and Products:

1. Eaton/Cutler-Hammer; Class A201.
2. General Electric Co.; CR 353.
3. Square D Co.; Class 8910.

2.10 PHASE MONITOR RELAY

A. Features:

1. Voltage and phase monitor relay shall drop out on low voltage, voltage unbalance, loss of phase, or phase reversal.
2. Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.
3. Adjustable trip and time delay settings.
4. Transient Protection: 1,000V ac.
5. Mounting: Multipin plug-in socket base.

B. Manufacturer and Product: Automatic Timing and Controls; SLD Series.

2.11 MAGNETIC LIGHTING CONTACTOR

A. Comply with NEMA ICS 2; provide UL 508 listing.

B. Electrically operated by dual-acting, single coil mechanism.

C. Inherently interlocked and electrically held in CLOSED position.

D. Main Contacts:

1. Double-break, continuous-duty, rated 20 amperes, 600 volts, withstand rating of 22,000 amps rms symmetrical at 250 volts or 14,000 amps rms symmetrical at 480 volts.
2. Marked for electric discharge lamps, tungsten, and general purpose loads.
3. Position not dependent on gravity, hooks, latches, or semi-permanent magnets.
4. Capable of operating in any position.
5. Visual indication for each contact.

E. Auxiliary contact relay for two-wire control.

F. One normally open and one normally closed auxiliary contact rated 10 amperes continuous, 7,200VA make, 720VA break with NEMA designation of A600 (600 volts).

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- G. Fully rated neutral terminal.
- H. Provision for remote pilot lamp with use of auxiliary contacts.
- I. Clamp type, self-rising terminal plates for solderless connections.
- J. Enclosures: See Article Enclosures.
- K. Manufacturers and Products:
 - 1. Eaton/Cutler-Hammer; Class A202.
 - 2. ASCO.
 - 3. ABB; CR360L (electrically held).
 - 4. Square D; Class 8903, Type L (electrically held).

2.12 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.
- C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.
- D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.
- E. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.
- F. Nonmetallic Framing Channel:
 - 1. Material: Fire retardant, fiber reinforced vinyl ester resin.
 - 2. Channel fitting of same material as channel.
 - 3. Nuts and bolts of long glass fiber reinforced polyurethane.

G. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Wesanco.

2.13 INTRINSIC SAFETY BARRIER

- A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.
- B. Rating: Power source shall be rated 24 volts dc, nominal, with not more than 250 volts available under fault conditions.
- C. Contact Rating: 5 amps, 250V ac.
- D. Mounting: Rail or surface.
- E. Manufacturers and Products:
 1. MTL, Inc.; Series 2000 or Series 3000.
 2. R. Stahl, Inc.

2.14 FIRESTOPS

- A. General:
 1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
 2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
 3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL or other testing and inspection agency acceptable to authorities having jurisdiction.

2.15 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

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- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.
- D. Enclosure Selections:
 - 1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures			
Location	Finish	Environment	NEMA 250 Type
Indoor	Any	Dry	12
Outdoor	Any	Wet	3R 316 stainless

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.
- B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 - 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Steel Raceway: Hot dipped rigid galvanized framing channel.
 - b. Aluminum Raceway: Extruded aluminum or carbon steel with neoprene material isolators.
 - c. PVC-Coated Conduit: PVC coated.
 - d. Steel Raceway and Other Systems Not Covered: Carbon steel or paint coated.

2. Interior, Corrosive (Wet or Dry) Locations:
 - a. Aluminum Raceway: Extruded aluminum.
 - b. Steel Raceway: Hot dipped rigid galvanized framing channel.
 - c. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - d. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel, nonmetallic, or PVC-coated steel.
3. Outdoor, Noncorrosive Locations:
 - a. Steel Raceway: Carbon steel or paint coated framing channel, except where mounted on aluminum handrail, then use aluminum framing channel.
 - b. Aluminum Raceway and Other Systems Not Covered: Aluminum framing channel or carbon steel with neoprene material isolators.
4. Outdoor Corrosive Locations:
 - a. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - b. Aluminum Raceway: Aluminum or carbon steel with neoprene material isolators.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel, nonmetallic, or PVC-coated steel.
5. Aluminum Railings: Devices mounted on aluminum railing shall use aluminum framing channel.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. Nonmetallic Channel: Epoxy resin sealer.
4. PVC-Coated Channel: PVC patch.

3.04 INTRINSIC SAFETY BARRIERS

- A. Install in compliance with ISA RP12.06.01.
- B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.
- C. Stencil "INTRINSICALLY SAFE CIRCUIT" on all boxes enclosing barriers.

3.05 SWITCHBOARD MATTING

- A. Install 36-inch width at switchgear, switchboard, motor control centers, and panelboards.
- B. Matting shall run full length of all sides of equipment that have operator controls or afford access to devices.

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3.06 FIRESTOPS

- A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

**SECTION 26 05 05BPS
CONDUCTORS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
 - b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
 4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
 5. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

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- d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
- e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 7. UL:
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
- 2. Manufactured Wire Systems:
 - a. Product data.
 - b. Rating information.
 - c. Dimensional drawings.
 - d. Special fittings.
- 3. If aluminum conductors are proposed, provide substitution schedule. Show conduit and aluminum conductor size for each circuit conduit and copper conductor size. Submit at least 14 days prior to conductor installation.

4. Cable Pulling Calculations:
 - a. Ensure submitted and reviewed before cable installation.
 - b. Provide for the following cable installations:
 - 1) Medium voltage cable runs that cannot be hand pulled.
 - 2) Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.
 - 3) Feeder circuits; single conductors #4/0 and larger.

B. Informational Submittals:

1. Journeyman lineman or electrician splicing credentials.
2. Factory Test Report for conductors 600 volts and below.
3. Certified Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

- B. Terminations and Splices for Conductors above 600 Volts: Work shall be done by journeyman lineman with splicing credentials or electrician certified to use materials approved for cable splices and terminations.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

- A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

- C. Insulation: THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

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D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

E. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 CONDUCTORS ABOVE 600 VOLTS

A. EPR Insulated Cable:

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
2. Type: 5 kV, shielded UL 1072, Type MV-105.
3. Conductors: Copper concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
4. Conductor Screen: Extruded, semiconducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 8.
5. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR) containing no polyethylene, in accordance with NEMA WC 71, and AEIC CS 8.
6. Insulation Thickness: 115-mil, 5 kV nominal.
7. Insulation Screen: Thermosetting, semiconducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74 and AEIC CS 8.
8. Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with 12-1/2 percent minimum overlap.
9. Jacket: Extruded polyvinyl chloride (PVC) compound applied in accordance with NEMA WC 71 or NEMA WC 74.
10. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
11. Manufacturers:
 - a. Okonite Co.
 - b. General Cable.
 - c. Southwire Co.

B. TR-XLP Insulated Cable:

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
2. Type: 5 kV, shielded, UL 1072, Type MV 105.
3. Conductors: Copper, concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
4. Strand Fill: Waterproof strand compound enclosing conductors.
5. Conductor Screen: Extruded, semiconducting thermosetting compound in accordance with NEMA WC 71 and AEIC CS 8.
6. Insulation: 133 percent insulation level, thermosetting, tree-resistant, cross-link polyethylene (TR-XLP), in accordance with NEMA WC 71 and AEIC CS 8.
7. Insulation Thickness: 115-mil, 5 kV nominal.
8. Insulation Screen: Thermosetting, semiconducting cross-link polyethylene, extruded directly over insulation.
9. Metallic Shield: Coated, 5-mil, copper shielding tape, helically applied with 12-1/2 percent minimum overlap.
10. Jacket: Extruded polyvinyl chloride PVC compound applied in accordance with NEMA WC 71 or NEMA WC 74 and AEIC CS 8.
11. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
12. Manufacturers:
 - a. Okonite Co.
 - b. Pirelli Wire and Cable.
 - c. General Cable.
 - d. Southwire Co.

2.03 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

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B. Type 1, Multiconductor Control Cable:

1. Conductors:
 - a. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
 - a. Belden.
 - b. Okonite Co.
 - c. Southwire.

C. Type 2, Multiconductor Power Cable:

1. General:
 - a. Meet or exceed UL 1581 for cable tray use.
 - b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
 - c. Overall Jacket: PVC.
2. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
 - c. UL rated VW-1 or listed Type XHHW-2.
 - d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.

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- 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.
3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2 3 4	0.42 0.45 0.49	45
10	10	2 3 4	0.54 0.58 0.63	60
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.
 - c. Encore.
 - d. General Cable.

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- D. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.
1. Outer Jacket: 45-mil nominal thickness.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
 3. Dimension: 0.31-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Encore.
 - d. General Cable.
 - e. Belden.
- E. Type 4, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.
1. Outer Jacket: 45-mil nominal.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.32-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and blue.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
 - d. Encore.
 - e. General Cable.

2.04 300-VOLT RATED CABLE

A. General:

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.
6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 10, 16 AWG, Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57.

1. Outer Jacket: 35-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.26-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil PVC.
 - d. Color Code: Pair conductors black and white.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Encore.

C. Type 11, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting requirements of NEMA WC 57.

1. Outer Jacket: 35-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.28-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.

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- c. Insulation: 15-mil PVC.
- d. Color Code: Triad conductors; black, red, and white.
- 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Encore.
- D. Type 12, 18 AWG, Multitwisted, Shielded Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.

- 1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.
 - f. Individual Pair Shield: 1.35-mil aluminum/mylar.
 - g. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
- 2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	50
8	0.66	60
12	0.79	60
16	0.91	60
24	1.13	70
36	1.31	70
50	1.55	80

- 3. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
 - d. Encore.

BALBOA PUMP STATION IMPROVEMENTS

- E. Type 13, 18 AWG, Multitwisted Pairs with Common Overall Shield
Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.

1. Conductors:

- a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
- b. Tinned copper.
- c. Group drain wire size AWG 20, minimum.
- d. Insulation: 15-mil PVC.
- e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.
- f. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	50
8	0.63	60
12	0.73	60
16	0.77	60
24	0.96	70
36	1.09	70
50	1.45	50

3. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.
- c. Belden.
- d. Encore.

- F. Type 14, Twisted Pair Fire Alarm Cable Shielded: Power limited fire protective signaling circuit cable meeting requirements of NFPA 70, Article 760.

1. Cable: Pass NFPA 262, 70,000 Btu flame test and listed by California State Fire Marshall.
2. Outer Jacket: Red in color, identified along its entire length as fire protective signaling circuit cable.

BALBOA PUMP STATION IMPROVEMENTS

3. Conductors:
 - a. Solid, tinned, or bare copper, shielded, with stranded tinned copper drain wire.
 - b. Insulation: 15-mil PVC.
 - c. Shield: Aluminum/mylar spiral wound along entire length.
4. Cable Sizes:

Wire Size	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Inches)
12	0.36	0.042
14	0.32	0.042
16	0.26	0.037
18	0.23	0.037

5. Manufacturers:
 - a. West Penn Wire.
 - b. Coleman Cable, Inc.
 - c. Encore.

2.05 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.06 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

BALBOA PUMP STATION IMPROVEMENTS

B. Identification Devices:

1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.
2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2 inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.

BALBOA PUMP STATION IMPROVEMENTS

4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.

2.07 ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS

A. Molded Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.

BALBOA PUMP STATION IMPROVEMENTS

2. Capable of making splices with a current rating equal to, or greater than cable ampacity, conforming to IEEE 404.
3. Class 5 kV, with compression connector, EPDM molded semiconductive insert, peroxide-cured EPDM insulation, and EPDM molded semiconductive outer shield.
4. Premolded splice shall be rejaacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal.
5. Manufacturers:
 - a. Elastimold.
 - b. Cooper Industries.

B. Heat Shrinkable Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than, cable ampacity, conforming to IEEE 404.
3. Class 5 kV, with compression connector, splice insulating and conducting sleeves, stress-relief materials, shielding braid and mesh, and abrasion-resistant heat shrinkable adhesive-lined rejaacketing sleeve to provide a waterproof seal.
4. Manufacturers:
 - a. Raychem.
 - b. 3M Co.

C. Termination Kits:

1. Capable of terminating 5 kV, single-conductor, polymeric-insulated shielded cables plus a shield ground clamp.
2. Capable of producing a termination with a current rating equal to, or greater than, cable ampacity meeting Class 1 requirements of IEEE 48.
3. Capable of accommodating cable shielding or construction without need for special adapters or accessories.
4. Manufacturers:
 - a. Raychem.
 - b. 3M Co.

D. Bus Connection Insulation:

1. Heat shrinkable tubing, tape, and sheets of flexible cross-linked polymeric material formulated for high dielectric strength.
2. Tape and sheet products to have coating to prevent adhesion to metal surfaces.
3. Insulating materials to be removable and reusable.
4. Manufacturer: Raychem.

BALBOA PUMP STATION IMPROVEMENTS

E. Elbow Connector Systems:

1. Molded, peroxide-cured, EPDM-insulated, Class 15 kV, 95 kV BIL, 200A, 10,000A rms load-break and 600A, 40,000 rms nonload-break elbows as shown, having copper current-carrying parts in accordance with IEEE 386.
2. Protective Caps: Class 15 kV, 95 kV BIL, 200 amperes or 600 amperes, with molded EPDM insulated body.
3. Insulated Standoff Bushings: Class 15 kV, 95 kV BIL, 200 amperes or 600 amperes, complete with EPDM rubber body, stainless steel eyebolt with brass pressure foot, and stainless steel base bracket.
4. Bushing Inserts: Class 15 kV, 95 kV BIL, with EPDM rubber body and all-copper, current-carrying parts.
5. Junctions: Class 15 kV, 95 kV having EPDM rubber body mounted on adjustable bracket.
6. Mounting Plates: ASTM A167 stainless steel, complete with universal mounting brackets, grounding lugs and two parking stands.
7. Manufacturers:
 - a. Cooper Industries.
 - b. Elastimold.

F. Cable Lugs:

1. In accordance with NEMA CC1.
2. Rated 5 kV of same material as conductor metal.
3. Manufacturers and Products, Uninsulated Compression Connectors and Terminators:
 - a. Burndy; Hydent.
 - b. Thomas & Betts; Color-Keyed.
 - c. ILSCO.
4. Manufacturers and Products, Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Thomas & Betts; Locketite.
 - b. ILSCO.

2.08 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.

- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- E. Manufacturers:
 - 1. Ideal Co.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.09 WARNING TAPE

- A. As specified in Section 26 05 33BPS, Raceway and Boxes.

2.10 SOURCE QUALITY CONTROL

- A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.
- B. Conductors Above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 8 partial discharge level test for EPR insulated cable.

PART 3 EXECUTION

3.01 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors and aluminum conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.

BALBOA PUMP STATION IMPROVEMENTS

- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

- 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
- 2. 8 AWG and Smaller: Provide colored conductors.
- 3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

- 4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

B. Conductors Above 600 Volts:

1. Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. Colors:
 - a. Grounded Neutral: White.
 - b. Phase A: Yellow.
 - c. Phase B: Red.
 - d. Phase C: Blue.

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.
- C. Circuits Not Appearing in Circuit Schedules:
 1. Assign circuit name based on device or equipment at load end of circuit.
 2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
- D. Method:
 1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
 2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
 3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Design-Builder.

BALBOA PUMP STATION IMPROVEMENTS

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Make connections of copper pigtail to aluminum conductor by means of compression type barrel connector and insulate with tape.
 - c. Install connectors designed for aluminum conductors utilizing compression barrel termination of conductor and terminating in dual rated lug.
 - d. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Insulate uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.

F. Cap spare conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 40 90 00BPS, Instrumentation and Control for Process Systems, leave pigtails of adequate length for bundled connections.
5. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.

- I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 CONDUCTORS ABOVE 600 VOLTS

- A. Do not splice unless specifically indicated or approved by Design-Builder.
- B. Make joints and terminations with splice and termination kits, in accordance with kit manufacturer's instructions.
- C. Install splices or terminations as continuous operation in accessible locations under clean, dry conditions.
- D. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer nontracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing plus a ground braid and clamp.

BALBOA PUMP STATION IMPROVEMENTS

- E. Install terminals or connectors acceptable for type of conductor material used.
- F. Provide outdoor rain skirts for riser pole and outdoor switchgear terminations.
- G. Provide shield termination and grounding for terminations.
- H. Provide necessary mounting hardware, covers, and connectors.
- I. Where elbow connectors are specified, install in accordance with manufacturer's instructions.
- J. Connections and Terminations:
 - 1. Install uninsulated crimp connectors and terminators for power circuit conductors 4 AWG and larger.
 - 2. Install uninsulated, bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 - 3. Insulate bus connections with heat shrinking tubing, tape, and sheets.
 - 4. Make bus connections removable and reusable in accordance with manufacturer's instructions.
- K. Give 2 working days' notice to Design-Builder prior to making splices or terminations.

3.06 CONDUCTOR ARC AND FIREPROOFING

- A. Install arc and fireproofing tape on 600-volt single conductors and cables, except those rated Type TC throughout entire exposed length at splices in manholes, handholes, vaults, cable trays, and other indicated locations.
- B. Install arc and fireproofing tape on 5 kV cables throughout entire exposed length at splices in manholes, handholes, vaults, cable trays, and other indicated locations.
- C. Wrap conductors of same circuit entering from separate conduit together as single cable.
- D. Follow tape manufacturer's installation instructions.
- E. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

BALBOA PUMP STATION IMPROVEMENTS

3.07 BUSWAY

- A. Install in strict accordance with manufacturer's recommendations and NFPA 70.
- B. Maximum Support Spacing: 10 feet.

END OF SECTION

**SECTION 26 05 26BPS
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).
3. UL.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Product data for the following:
 - 1) Ground rod.
 - 2) Grounding wells.
 - 3) Exothermic weld connectors.
 - 4) Mechanical connectors.
 - 5) Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL:
 - a. Confirm conformance with UL standards.
 - b. Supply with an applied UL listing mark.

BALBOA PUMP STATION IMPROVEMENTS

PART 2 PRODUCTS

2.01 GROUND ROD

- A. Material: Copper-clad steel.
- B. Diameter: Minimum 3/4 inch.
- C. Length: 10 feet.

2.02 GROUND CONDUCTORS

- A. As specified in Section 26 05 05BPS, Conductors.

2.03 CONNECTORS

- A. Exothermic Weld Type:
 - 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - 2. Indoor Weld: Use low-smoke, low-emission process.
 - 3. Manufacturers and Product:
 - a. NVent ERICO Products, Inc.
 - b. ThermOweld.
- B. Compression Type:
 - 1. Compress-deforming irreversible type; wrought copper extrusion material.
 - 2. Single indentation for conductors 6 AWG and smaller.
 - 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 - 4. Barrels prefilled with oxide-inhibiting and anti-seizing compound and sealed.
 - 5. Manufacturers and Products:
 - a. Burndy Corp.; Hyground Compression.
 - b. Thomas and Betts Co.; EZGround Compression.
 - c. NVent ILSCO.
- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 - 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. O-Z Gedney.

2.04 GROUNDING WELLS

- A. Precast Concrete: Ground rod box complete with cast-iron riser ring and H-20 rated cast iron traffic cover marked "GROUND ROD".
- B. Manufacturers and Products:
 - 1. Christy Co.
 - 2. Harger Lightning and Grounding Traffic Rated Series.
 - 3. Oldcastle Infrastructure.
 - 4. VFC, Inc.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Grounding in compliance with NFPA 70 and IEEE C2.
- B. Bond electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Bond each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- G. Shielded Instrumentation Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

BALBOA PUMP STATION IMPROVEMENTS

- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Motors Less than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.
- C. Space multiple ground rods by one rod length.
- D. Install to 8 feet below local frost depth.

3.05 GROUNDING WELLS

- A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on the Drawings.
- B. Install riser ring and cover flush with surface.
- C. Place 6 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Design-Builder prior to backfilling ground connections.
- B. Exothermic Weld Type:
 - 1. Wire brush or file contact point to bare metal surface.
 - 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
 - 3. Avoid using badly worn molds.
 - 4. Mold to be completely filled with metal when making welds.
 - 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

BALBOA PUMP STATION IMPROVEMENTS

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

- A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 MANHOLE AND HANDHOLE GROUNDING

- A. Install one ground rod inside each manhole and handhole larger than 24-inch by 24-inch inside dimensions.
- B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.
- C. Make connections of grounding conductors fully visible and accessible.
- D. Connect all noncurrent-carrying metal parts and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.09 TRANSFORMER GROUNDING

- A. Bond neutrals of transformers within buildings to system ground network and to any additional indicated grounding electrodes.
- B. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 LIGHTNING PROTECTION SYSTEMS

- A. Bond lightning protection system ground terminals to building or structure grounding electrode system.

3.11 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

**SECTION 26 05 33BPS
RACEWAY AND BOXES**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
 2. ASTM International (ASTM):
 - a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 3. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
 4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C80.1, Electrical Rigid Steel Conduit (ERSC).
 - c. C80.3, Steel Electrical Metallic Tubing (EMT).
 - d. C80.6, Electrical Intermediate Metal Conduit (EIMC).
 - e. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - f. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
 - g. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - h. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
 - i. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - j. VE 1, Metallic Cable Tray Systems.
 5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

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6. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
7. UL:
 - a. 1, Standard for Safety for Flexible Metal Conduit.
 - b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
 - c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
 - d. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
 - e. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
 - f. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
 - g. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - h. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
 - i. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
 - j. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
 - k. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
 - l. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - m. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's Literature:
 - a. Rigid galvanized steel conduit.
 - b. Electric metallic tubing.
 - c. PVC Schedule 40 conduit.
 - d. PVC Schedule 80 conduit.
 - e. PVC-coated rigid galvanized steel conduit.
 - f. Flexible metal, liquid-tight conduit.
 - g. Conduit fittings.
 - h. Wireways.
 - i. Surface metal raceway.
 - j. Device boxes for use in hazardous areas.
 - k. Junction and pull boxes used at or below grade.
 - l. Large junction and pull boxes.
 - m. Terminal junction boxes.

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2. Precast Manholes and Handholes:
 - a. Dimensional drawings and descriptive literature.
 - b. Traffic loading calculations.
 - c. Accessory information.
3. Equipment and machinery proposed for bending metal conduit.
4. Method for bending PVC conduit less than 30 degrees.
5. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15BPS, Anchorage and Bracing.
6. Conduit Layout:
 - a. Provide drawings for conduit installations, underground and concealed conduits including, but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls.
 - b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
 - 1) Low and medium voltage feeder and branch circuits.
 - 2) Instrumentation and control systems.
 - 3) Communications systems.
 - 4) Empty conduit for future use.
 - c. Scale not greater than 1 inch equals 20 feet.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15BPS, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33BPS, Special Inspection and Testing.
3. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

- ### B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

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PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Meet requirements of NEMA C80.1 and UL 6.
 - 2. Material: Hot-dip galvanized with chromated protective layer.
- B. Electric Metallic Tubing (EMT):
 - 1. Meet requirements of NEMA C80.3 and UL 797.
 - 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- C. PVC Schedule 40 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.
 - 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- D. PVC Schedule 80 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.
 - 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- E. PVC-Coated Rigid Galvanized Steel Conduit:
 - 1. Meet requirements of NEMA RN 1.
 - 2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2-mil nominal thickness.
 - 3. Threads: Hot-dipped galvanized and factory coated with urethane.
 - 4. Bendable without damage to interior or exterior coating.
- F. Flexible Metal, Liquid-Tight Conduit:
 - 1. UL 360 listed for 105 degrees C insulated conductors.
 - 2. Material: Galvanized steel with extruded PVC jacket.
- G. Flexible Metal, Nonliquid-Tight Conduit:
 - 1. Meet requirements of UL 1.
 - 2. Material: Galvanized steel.

H. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers and Products:
 - a. Carlon; Carflex or X-Flex.
 - b. T & B; Xtraflex LTC or EFC.

I. Innerduct: Resistant to spread of fire, per requirements of UL 2024.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-I.
 - 2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers and Products:
 - 1) Appleton; Series GIB.
 - 2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat with bonding screw.
 - b. UL listed for use in wet locations.
 - c. Manufacturers and Products:
 - 1) Appleton, Series HUB-B.
 - 2) O-Z/Gedney; Series CH.
 - 3) Meyers; ST Series.
5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Conditions):
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.

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- 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
 - c. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Unions:
 - a. Concrete tight, hot-dip galvanized malleable iron.
 - b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
 - 2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
8. Conduit Sealing Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYF, EYM, or ESU.
 - 2) Crouse-Hinds; Type EYS or EZS.
 - 3) Killark; Type EY or Type EYS.
9. Drain Seal:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYD.
 - 2) Crouse-Hinds; Type EYD or Type EZD.
10. Drain/Breather Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; ECD.
11. Expansion Fitting:
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement:
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.
 - 2) Expansion Movement Only:
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
12. Cable Sealing Fitting:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products:
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.

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B. Electric Metallic Tubing:

1. Meet requirements of UL 514B.
2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
3. Electro zinc-plated inside and out.
4. Raintight.
5. Coupling Manufacturers and Products:
 - a. Appleton; Type 95T.
 - b. Crouse-Hinds.
 - c. Thomas & Betts.
6. Connector Manufacturers and Products:
 - a. Appleton; Type ETP.
 - b. Crouse-Hinds.
 - c. Thomas & Betts.

C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC 3.
2. Type: PVC, slip-on.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
8. Expansion Fitting:
 - a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.

E. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
 - a. Thomas & Betts; Series 5331.
 - b. O-Z/Gedney; Series 4Q.

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F. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Body: Galvanized steel.
3. Throat: Nylon insulated.
4. 1-1/4-Inch Conduit and Smaller: One screw body.
5. 1-1/2-Inch Conduit and Larger: Two screw body.
6. Manufacturer and Product: Appleton; Series 7400.

G. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
4. Manufacturers and Products:
 - a. Carlon; Type LT.
 - b. O-Z/Gedney; Type 4Q-P.
 - c. Thomas & Betts; Series 6300.

H. Watertight Entrance Seal Device:

1. New Construction:
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
2. Cored-Hole Application:
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.

B. Cast Metal:

1. Box: Cast ferrous metal.
2. Cover: Gasketed, weatherproof, cast ferrous metal, with stainless steel screws.
3. Hubs: Threaded.
4. Lugs: Cast mounting.

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5. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS or Type FD.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 6. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA or Type EAJ.
 - b. Appleton; Type GR.
- C. Cast Aluminum:
1. Material:
 - a. Box: Cast, copper-free aluminum.
 - b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
 2. Hubs: Threaded.
 3. Lugs: Cast mounting.
 4. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS-SA or Type FD-SA.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 5. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA-SA.
 - b. Appleton; Type GR.
- D. PVC-Coated Cast Metal:
1. Type: One-piece.
 2. Material: Malleable iron, cast ferrous metal, or cast aluminum.
 3. Coating:
 - a. Exterior Surfaces: 40-mil PVC.
 - b. Interior Surfaces: 2-mil urethane.
 4. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
- E. Nonmetallic:
1. Box: PVC.
 2. Cover: PVC, weatherproof, with stainless steel screws.
 3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers.

2.04 JUNCTION AND PULL BOXES

- A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

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- B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.
- C. Large Sheet Steel Box:
 - 1. NEMA 250, Type 1.
 - 2. Box: Code-gauge, galvanized steel.
 - 3. Cover: Full access, screw type.
 - 4. Machine Screws: Corrosion-resistant.
- D. Large Cast Metal Box:
 - 1. NEMA 250, Type 4X.
 - 2. Box: Cast malleable iron or ferrous metal, electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
 - 3. Cover: Hinged with screws.
 - 4. Gasket: Neoprene.
 - 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 6. Manufacturers and Products, Surface Mounted Nonhinged Type:
 - a. Crouse-Hinds; Series W.
 - b. O-Z/Gedney; Series Y.
 - 7. Manufacturer and Product, Surface Mounted, Hinged Type:
O-Z/Gedney; Series YW.
 - 8. Manufacturers and Products, Recessed Type:
 - a. Crouse-Hinds; Type WJBF.
 - b. O-Z/Gedney; Series YR.
- E. Large Cast Aluminum Box:
 - 1. NEMA 250 Type 4.
 - 2. Box: Cast copper-free aluminum, with drilled and tapped conduit entrances and exterior mounting lugs.
 - 3. Cover: Nonhinged.
 - 4. Gasket: Neoprene.
 - 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 6. Manufacturers and Products, Surface Mounted Type:
 - a. Crouse-Hinds; Series W-SA.
 - b. O-Z/Gedney; Series YS-A, YL-A.
 - c. Killark.
- F. Large Stainless Steel Box:
 - 1. NEMA 250 Type 4X.
 - 2. Box: 14-gauge, ASTM A240/A240M, Type 316 stainless steel.
 - 3. Cover: Hinged with screws.
 - 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

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5. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Wiegman.
- G. Large Steel Box:
 1. NEMA 250 Type 3R.
 2. Box: code-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by Owner/Design-Builder.
 3. Cover: Hinged with screws.
 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 5. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Wiegman.
- H. Large Nonmetallic Box:
 1. NEMA 250 Type 4X.
 2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.
 3. Cover: Hinged with screws.
 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 5. Conduit hubs and mounting lugs.
 6. Manufacturers and Products:
 - a. Crouse-Hinds; Type NJB.
 - b. Carlon; Series N, C, or H.
 - c. Robroy Industries.
- I. Concrete Box, Nontraffic Areas:
 1. Box: Reinforced, cast concrete with extension.
 2. Cover: Steel diamond plate with locking bolts.
 3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
 4. Size: 10 inches by 17 inches, minimum.
 5. Manufacturers and Products:
 - a. Utility Vault Co.; Series 36-1017.
 - b. Christy, Concrete Products, Inc.; N9.
 - c. Quazite; "PG" Style.
- J. Concrete Box, Traffic Areas:
 1. Box: Reinforced, cast concrete with extension and bottom slab.
 2. Cover: Steel checked plate; H/20 loading with screw down.

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3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Manufacturers and Products:
 - a. Christy, Concrete Products, Inc.; B1017BOX.
 - b. Utility Vault Co.; 3030 SB.

2.05 TERMINAL JUNCTION BOX

- A. Cover: Hinged, unless otherwise shown.
- B. Interior Finish: Paint with white enamel or lacquer.
- C. Terminal Blocks:
 1. Separate connection point for each conductor entering or leaving box.
 2. Spare Terminal Points: 25 percent, minimum.

2.06 SURFACE METAL RACEWAY

- A. General:
 1. Meet requirements of UL 5.
 2. Material: Two-piece, code-gauge steel.
 3. Finish: Factory applied rust inhibiting primer and gray semi-gloss finish suitable for field painting.
 4. Configuration: Single, 1-17/32-inch by 2-3/4-inch section, unless otherwise indicated.
- B. Fittings and Accessories:
 1. Wire clips at 30 inches on center.
 2. Couplings, cover clips, supporting clips, ground clamps, and elbows as required; to comply with manufacturer's recommendations.
- C. Outlets:
 1. Provide bracket or device covers as required to support wiring devices indicated.
 2. Wiring Devices and Device Plates: In accordance with Section 26 27 26, Wiring Devices.
 3. Manufacturers:
 - a. The Wiremold Co.
 - b. Walker.

2.07 METAL WIREWAYS

- A. Meet requirements of UL 870.
- B. Type: Steel-enclosed, lay-in type.
- C. Cover: Removable, screw type.
- D. Rating: Indoor or outdoor raintight.
- E. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.
- F. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.
- G. Knockouts: Without knockouts, unless otherwise indicated.
- H. Manufacturers:
 - 1. Circle AW.
 - 2. Hoffman.
 - 3. Square D.

2.08 NONMETALLIC WIREWAY

- A. Rating: Outdoor, corrosion resistant, raintight, NEMA Type 12 and Type 3R.
- B. Type: Fiberglass-enclosed, with removable cover.
- C. Captivated, corrosion-resistant cover screws.
- D. Oil-resistant gaskets.
- E. Meet UL cold impact test to minus 35 degrees C.
- F. Manufacturer: Hoffman.

2.09 CABLE TRAYS

- A. Meet requirements of NEMA VE 1.
- B. Type: Ladder, or as indicated of welded construction.
- C. Material: Copper-free aluminum alloy 6063-T6 finish.

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- D. Dimensions: 36 inches wide, with 4-inch NEMA nominal inside fill depth and fittings with 12-inch bending radius.
- E. Barrier Strip: Vertical, solid type, with horizontal fittings and strip clamps.
- F. Fittings of same material as cross-sectional tray area and hardware of same material as cable tray.
- G. Tray Grounding: Conform to NFPA 70 and NEMA VE 1.
- H. Provide next higher NEMA VE 1 class designation than required for support of designed span length.
- I. Design Loads: Use working load adequate for actual cable installed plus 20 percent additional weight allowance for future cables with safety factor of 2 in accordance with NEMA VE 1, Table 3-1.
- J. Expansion Joints: NEMA VE 1 for 50 degrees F maximum temperature variation.
- K. Furnish cable tray with no sharp edges, burrs, or weld projections.
- L. Warning Signs: 1-1/2-inch high black lettering on yellow background with legend, "WARNING, NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- M. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Square-D.
 - 3. P. W. Industries.
 - 4. T. J. Cope, Inc.

2.10 PRECAST MANHOLES AND HANDHOLES

- A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.
- B. Loading: AASHTO, H-20 in accordance with ASTM C857.
- C. Access: Provide cast concrete 6-inch or 12-inch risers and access hole adapters between top of manhole and finished grade at required elevations.
- D. Drainage:
 - 1. Slope floors toward drain points, leaving no pockets or other nondraining areas.

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2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.

E. Raceway Entrances:

1. Provide on all four sides.
2. Provide knockout panels or precast individual raceway openings.
3. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.

F. Embedded Pulling Iron:

1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.
2. Location:
 - a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
 - b. Floor: Centered below manhole or handhole cover.

G. Cable Racks:

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.
2. Wall Attachment:
 - a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
 - b. Insert Spacing: Maximum 3 feet on center for inside perimeter of manhole.
 - c. Arrange in order that spare raceway ends are clear for future cable installation.

H. Manhole Frames and Covers:

1. Material: Machined cast iron.
2. Diameter: 36-1/2 inch.
3. Cover Type: Indented, solid top design, with two drop handles each.
4. Cover Loading: AASHTO H-20.
5. Cover Designation: Cast, on upper side, in integral letters, minimum 2 inches in height, appropriate titles.
 - a. Above 600 Volts: ELECTRIC HV.
 - b. 600 Volts and Below: ELECTRIC LV.
 - c. TELEPHONE.

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I. Handhole Frames and Covers:

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, bolt-on of checkered design.
3. Cover Loading: AASHTO H-20.
4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
 - a. 600 Volts and Below: ELECTRIC LV.
 - b. TELEPHONE.

J. Hardware: Steel, hot-dip galvanized.

K. Furnish knockout for ground rod in each handhole and manhole.

L. Manufacturers:

1. Utility Vault Co.
2. Penn-Cast Products, Inc.
3. Concrete Conduit Co.
4. Associated Concrete Products, Inc.
5. Pipe, Inc.

2.11 ACCESSORIES

A. Duct Bank Spacers:

1. Modular Type:
 - a. Nonmetallic, interlocking, for multiple conduit sizes.
 - b. Suitable for all types of conduit.
 - c. Manufacturers:
 - 1) Underground Device, Inc.
 - 2) Carlon.
2. Template Type:
 - a. Nonmetallic, custom made one-piece spacers.
 - b. Suitable for all types of conduit.
 - c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
 - d. Conduit openings cut 1 inch larger than conduit outside diameter.
 - e. Additional openings for stake-down, rebar, and concrete flow through as required.
 - f. Manufacturer and Product: SP Products; Quik Duct.

B. Identification Devices:

1. Raceway Tags:
 - a. Material: Permanent, nonferrous metal.
 - b. Shape: Round.

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- c. Raceway Designation: Pressure stamped, embossed, or engraved.
 - d. Tags relying on adhesives or taped-on markers not permitted.
- 2. Warning Tape:
 - a. Material: Polyethylene, 4-mil gauge with detectable strip.
 - b. Color: Red.
 - c. Width: Minimum 3 inches.
 - d. Designation: Warning on tape that electric circuit is located below tape.
 - e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
 - f. Manufacturers and Products:
 - 1) Panduit; Type HTDU.
 - 2) Reef Industries; Terra Tape.
 - 3) Brady.
 - 4) Marking Services Inc.
 - 5) Seton.
- 3. Buried Raceway Marker:
 - a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
 - b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
 - c. Minimum Dimension: 1/4 inch thick, 10 inches long, and 3/4 inch wide.
- C. Raceway Coating: Clean and paint in accordance with Section 09 90 00BPS, Painting and Coating.
- D. Heat Shrinkable Tubing:
 - 1. Material: Heat-shrinkable, cross-linked polyolefin.
 - 2. Semi-flexible with meltable adhesive inner liner.
 - 3. Color: Black.
 - 4. Manufacturers:
 - a. Raychem.
 - b. 3M.
- E. Wraparound Duct Band:
 - 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
 - 2. Width: 50 mm minimum.
 - 3. Manufacturer and Product: Raychem, Type TWDB.

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PART 3 EXECUTION

3.01 GENERAL

- A. Conduit and tubing sizes shown are based on use of copper conductors. Reference Section 26 05 05BPS, Conductors.
- B. Comply with NECA Installation Standards.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs over 100 feet, provide junction box and drain fitting at conduit low point.
- H. Group raceways installed in same area.
- I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.
- M. Install watertight fittings in outdoor, underground, or wet locations.
- N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- P. Do not install raceways in concrete equipment pads, foundations, or beams without the Design-Builder approval.

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- Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 REUSE OF EXISTING CONDUITS

- A. Where Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria:
 - 1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
 - 2. Conduit is sized per the NEC.
 - 3. Conduit is of the type specified in Contract Documents.
 - 4. Conduit is supported as specified in Contract Documents.
- B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4 inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.

3.03 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum Cover: 2 inches, including fittings.
- B. Conduit placement shall not require changes in reinforcing steel location or configuration.
- C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
- D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by the Design-Builder.
- E. Slabs and Walls (Requires Design-Builder Approval):
 - 1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
 - 2. Install within middle two-fourths of slab or wall.
 - 3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
 - 4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.

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5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

F. Columns and Beams (Requires Design-Builder Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.04 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed: PVC-coated rigid galvanized steel.

C. Interior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.
3. Electric metallic tubing for ceiling portion of lighting circuits.
4. PVC-coated rigid galvanized steel.

D. Interior, Concealed (Not Embedded in Concrete):

1. Rigid galvanized steel.
2. Intermediate metal.
3. Electric metallic tubing.
4. PVC-coated rigid galvanized steel.

E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:

1. Rigid galvanized steel.
2. PVC Schedule 40.
3. Electric metallic tubing.

F. Direct Earth Burial:

1. PVC Schedule 40.
2. PVC Schedule 80.
3. PVC-coated rigid galvanized steel.

G. Concrete-Encased Ductbank:

1. Rigid galvanized steel.
2. PVC Schedule 40.
3. PVC Schedule 80.

H. Under Slabs-On-Grade:

1. Rigid galvanized steel.
2. PVC Schedule 40.
3. PVC Schedule 80.
4. PVC-coated rigid galvanized steel.

I. Transition from Underground or Concrete Embedded to Exposed: Rigid galvanized steel PVC-coated rigid steel, or PVC Schedule 40 conduit.

1. Transitions at 12 inches below top of slab.

J. Under Equipment Mounting Pads: PVC-coated rigid steel or PVC Schedule 40 conduit.

3.05 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by the Design-Builder where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: Flexible, nonmetallic liquid-tight.
4. Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

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3.06 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as specified in Section 07 92 00, Joint Sealants, and as specified in Section 07 84 00, Firestopping, and as specified in Section 26 05 04BPS, Basic Electrical Materials and Methods.
- D. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface. Does not apply to PVC coated metallic conduit.
- E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack or use watertight seal device.
- F. Entering Structures:
 - 1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
 - 2. Concrete Roof or Membrane Waterproofed Wall or Floor:
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
 - 3. Heating, Ventilating, and Air Conditioning Equipment:
 - a. Penetrate equipment in area established by manufacturer.
 - b. Terminate conduit with flexible conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
 - c. Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
 - 4. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.

5. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
6. Manholes and Handholes:
 - a. Metallic Raceways: Provide insulated grounding bushings.
 - b. Nonmetallic Raceways: Provide bell ends flush with wall.
 - c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.07 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze.
- C. Application/Type of Conduit Strap:
 1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
 2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 3. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 1. Wood: Wood screws.
 2. Hollow Masonry Units: Toggle bolts.
 3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 4. Steelwork: Machine screws.
 5. Location/Type of Hardware: Per Area Classification Table.
- E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

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3.08 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
 - 1. Bends 30 Degrees and Larger: Provide factory-made elbows.
 - 2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
 - 3. Use manufacturer's recommended method for forming smaller bends.
- H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.09 EXPANSION/DEFLECTION FITTINGS

- A. Provide on raceways at structural expansion joints and in long tangential runs.
- B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.
- C. Install in accordance with manufacturer's instructions.

3.10 PVC CONDUIT

- A. Solvent Welding:
 - 1. Apply manufacturer recommended solvent to joints.
 - 2. Install in order that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

3.11 PVC-COATED RIGID STEEL CONDUIT

A. Install in accordance with manufacturer's instructions.

B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.

C. Provide PVC boot to cover exposed threading.

3.12 WIREWAYS

A. Install in accordance with manufacturer's instructions.

B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

C. Applications:

1. Metal wireway in indoor dry locations.
2. Nonmetallic wireway in indoor wet, outdoor, and corrosive locations.

3.13 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:

- a. Install insulated bushing on ends of conduit where grounding is not required.
- b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.

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- c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
 - d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
 - e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
 2. Rigid Galvanized Conduit:
 - a. Provide one lock nut each on inside and outside of enclosure.
 - b. Install grounding bushing at source enclosure.
 - c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
 3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
 4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
 5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
 6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
 7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.
- D. Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures:
 1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
 2. Terminate PVC conduit entering bottom with bell end fittings.

3.14 UNDERGROUND RACEWAYS

- A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
- B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.
- C. Make routing changes as necessary to avoid obstructions or conflicts.
- D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
- E. Union type fittings not permitted.

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- F. Spacers:
 - 1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
 - 2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
- G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.
- H. Transition from Underground to Exposed: Rigid galvanized steel, PVC-coated rigid steel conduit.
- I. Installation with Other Piping Systems:
 - 1. Crossings: Maintain minimum 12-inch vertical separation.
 - 2. Parallel Runs: Maintain minimum 12-inch separation.
 - 3. Installation over valves or couplings not permitted.
- J. Metallic Raceway Coating: At couplings and joints, along entire length, clean and paint in accordance with Section 09 90 00BPS, Painting and Coating. Apply wraparound duct band with one-half tape width overlap to obtain two complete layers.
- K. Concrete Encasement:
 - 1. As specified in Section 03 30 00, Cast-in-Place Concrete.
 - 2. Concrete Color: Red.
- L. Backfill:
 - 1. As specified in Section 31 23 23.15, Trench Backfill.
 - 2. Do not backfill until inspected by the Design-Builder and Inspector.

3.15 UNDER SLAB RACEWAYS

- A. Make routing changes as necessary to avoid obstructions or conflicts.
- B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.
- C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.

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- D. Raceway spacing, in a single layer or multiple layers:
 - 1. 3 inches clear between adjacent 2-inch or larger raceway.
 - 2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.
- E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified in Section 31 23 23.15, Trench Backfill.
- F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.
- G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.
- H. Fittings:
 - 1. Union type fittings are not permitted.
 - 2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel. Does not apply to concrete encased conduits.
 - 3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.16 OUTLET AND DEVICE BOXES

- A. General:
 - 1. Install plumb and level.
 - 2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
 - 3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
 - 4. Install galvanized mounting hardware in industrial areas.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.

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2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by the Design-Builder.
3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
 - a. Ensure all mounting heights to address CBC Chapter 11B for accessibility.
 - b. Dimensions given to centerline of box.
 - c. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
 - d. Do not straddle CMU block or other construction joints.
2. Light Switch:
 - a. 48 inches maximum above finished floor.
 - b. When located next to door, install on lock side of door.
3. Thermostat: 48 inches maximum above finished floor.
4. Telephone Outlet:
 - a. 15 inches above floor.
 - b. 6 inches above counter tops.
 - c. Wall Mounted: 52 inches above finished floor.
5. Convenience Receptacle:
 - a. General Interior Areas: 15 inches maximum above finished floor.
 - b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash within 24-inch of depth.
 - c. Industrial Areas, Workshops: 48 inches maximum above finished floor.
 - d. Outdoor Areas: 24 inches above finished grade.
6. Special-Purpose Receptacle: As shown.
7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on the Drawings.

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E. Flush Mounted:

1. Install with concealed conduit.
2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
3. Holes in surrounding surface shall be no larger than required to receive box.

F. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Provide plaster rings where necessary.
5. Boxes embedded in concrete or masonry need not be additionally supported.

G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.17 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

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8. Install in exposed conduit runs at least every 150 feet or after the equivalent of four right-angle bends.
- B. Flush Mounted:
1. Install with concealed conduit.
 2. Holes in surrounding surface shall be no larger than required to receive box.
 3. Make edges of boxes flush with final surface.
- C. Mounting Hardware:
1. Noncorrosive Dry Areas: Galvanized.
 2. Noncorrosive Wet Areas: Stainless steel.
 3. Corrosive Areas: Stainless steel.
- D. Supports:
1. Support boxes independently of conduit by attachment to building structure or structural member.
 2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
 3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
 4. Boxes embedded in concrete or masonry need not be additionally supported.
- E. At or Below Grade:
1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
 2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
 3. Obtain Design-Builder's written acceptance prior to installation in paved areas, roadways, or walkways.
 4. Use boxes and covers suitable to support anticipated weights.
- F. Install Drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

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3.18 MANHOLES AND HANDHOLES

- A. Excavate, shore, brace, backfill, and final grade in accordance with Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.
- B. Do not install until final raceway grading has been determined.
- C. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.
- D. Grounding: As specified in Section 26 05 26BPS, Grounding and Bonding for Electrical Systems, for Electrical Systems.
- E. Identification: Field stamp covers with manhole or handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.19 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull tab for underground raceways with end bells.
- C. Provide nylon pull cord.
- D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.20 IDENTIFICATION DEVICES

- A. Raceway Tags:
 - 1. Identify Raceway Schedule designation.
 - 2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
 - 3. Install tags at each terminus for concealed raceways.
 - 4. Provide noncorrosive wire for attachment.
- B. Warning Tape: Install approximately 8 inches below grade and above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.
- C. Buried Raceway Marker:
 - 1. Install at grade to indicate direction of underground raceway.
 - 2. Install at bends and at intervals not exceeding 100 feet in straight runs.

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3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.21 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

**SECTION 40 05 15BPS
PIPING SUPPORT SYSTEMS**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. American Society of Mechanical Engineers (ASME): B31.3, Process Piping.
3. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
4. International Code Council (ICC).
5. International Mechanical Code (IMC).
6. Manufacturers' Standardization Society (MSS):
 - a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
 - b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.02 SUBMITTALS

A. Action Submittals:

1. Catalog information for manufactured pipe support components and drawings of piping support systems, general arrangement drawings locating each support, sway brace, seismic brace, hanger, restraint, guide, component, and anchor for piping of all sizes. Identify support, hanger, restraint, guide, and anchor type by catalog number and Shop Drawing detail number.
2. Calculations for each type of pipe support, attachment and anchor as required by Section 01 88 15BPS, Anchorage and Bracing.
3. Identify revisions to piping system and anchorage and bracing layouts or addition of flexible joints.
4. Anchorage and bracing drawings and catalog information, as required by Section 01 88 15BPS, Anchorage and Bracing.

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B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15BPS, Anchorage and Bracing.
2. Calculations for wind load effects on piping systems, where applicable.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 36, Equipment Seismic.
4. Maintenance information on piping support system.

1.03 QUALIFICATIONS

- A. Piping support systems shall be analyzed for support configurations and pipe supports shall be designed and Shop Drawings prepared and sealed by Registered Professional Engineers in the state where the Work is to be installed.
- B. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire protection bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

1.04 DESIGN REQUIREMENTS

A. General:

1. Subcontractor is responsible for determining final pipe routing and pipe support locations per the layout requirements of this specification and the Drawings. Subcontractor will coordinate their work with the Design-Builder and other trade Subcontractors during the development of the Field Layout Submittal.
2. Subcontractor will identify all locations where the specified layout requirements could not be met, and additional design may be required.
3. Design-Builder will provide the detailed design of the complete pipe and support system. The Design-Builder will assemble and submit the Pipe Support Deferred Design Submittal to the AHJ.
4. Subcontractor must account for the time required for AHJ review and approval prior to installation of pipe support systems in their schedule and review with Design-Builder.
5. Design, size, and locate piping support systems throughout facility, whether shown or not.
6. Design shall meet requirements of Section 01 88 15BPS, Anchorage and Bracing.

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7. Supports are shown only where specific types and locations are required; additional pipe supports may be required.
8. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.
9. Modifying process piping, equipment, and structural element design configuration to facilitate pipe support without explicit review and approval by Design Builder is not permitted.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Coordinate design criteria, including design for seismic loads and wind loads as applicable, with Section 01 61 00, Common Product Requirements, and with criteria provided on the General Structural Note Sheets on the Drawings.
3. Design anchors, guides, and restraints with consideration for thermal movements and thrust forces.
4. Consider relative deflections of supports and structural framing systems, including roof supports and floor supports and their deflections under loads, when selecting pipe support details.
5. Seismic loads in accordance with governing codes and as shown on Structural General Drawings.
6. Wind loads in accordance with governing codes and as shown on Structural General Drawings.
7. Coordinate pipe support locations and configurations with the building structural system and with other building systems.
8. Do not attach pipe supports to ladders, stairs, or railing systems.
9. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 4.
 - a. Spacing shown in MSS SP 58 is for straight pipe. Reduce span by 30 percent for each elbow in span.
 - b. MSS SP 58 tables are for standard weight pipe. Reduce spans by 25 percent if pipe is less than standard weight.
 - c. Reduce allowable spans if piping includes valves or other inline components. Span shall be reduced by the length of pipe and fluid equal to the weight of the components.
 - d. Temperature to be used to determine support spacing for plastic pipe based on manufacturer's recommendations.

- ### C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by all loadings and actual spacing on each particular support.

BALBOA PUMP STATION IMPROVEMENTS

- D. Vertical Sway Bracing: 10-foot maximum centers or as required by submitted calculations or as indicated on the Drawings.
- E. Existing Support Systems: Use existing supports systems to support new piping only if approved by Design-Builder.

PART 2 PRODUCTS

2.01 GENERAL

- A. Special support and hanger details may be required for cases where standard catalog supports are not applicable.
- B. Materials: Carbon steel. Coatings, factory or field applied, refer to Section 09 90 00BPS, Painting and Coating.

2.02 SOURCE QUALITY CONTROL

- A. Factory, shop and field inspection and testing is required in accordance with Section 01 45 30 Sampling, Testing, and Fabrication Inspection.

2.03 PIPE SADDLES

- A. Saddle Supports, Pedestal Type:
 - 1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
 - 2. Nonadjustable Saddle: MSS SP 58, Type 37 with U-bolt.
 - a. Anvil; Figure 259, sizes 4 inches through 24 inches with Figure 63C base.
 - b. B-Line; Figure B3090, sizes 1 inch through 24 inches with B3088S base.

2.04 FLANGE SUPPORTS

- A. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.05 PIPE ANCHORS

- A. Type: Anchor chair with U-bolt strap.
- B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.06 LATERAL FORCE RESTRAINTS

- A. Anchoring and bracing shall meet requirements of Section 01 88 15BPS, Anchorage and Bracing and Section 01 61 00, Common Product Requirements.
- B. Where other restraints are not provided, provide lateral and longitudinal restraints for seismic, wind, thrust, thermal and other lateral forces.

2.07 ACCESSORIES

- A. Anchor Bolts:
 - 1. Size and Material: As specified in Section 05 50 00BPS, Metal Fabrications and Section 05 05 19BPS, Post-Installed Anchors.
 - 2. Bolt Length (Extension Above Top of Nut):
 - a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
 - b. Maximum Length: No more than a full nut depth above top of nut.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install support systems in accordance with MSS SP 58, unless shown otherwise and/or where required by Design-Builder's design.
 - 2. Support piping connections to equipment by pipe support and not by equipment.
 - 3. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
 - 4. Support no pipe from pipe above or below it.
 - 5. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown and/or required by Design-Builder's design.
 - 6. Anchors for all concrete and masonry shall be as specified in Section 05 50 00BPS, Metal Fabrications.
 - 7. Do not install pipe supports and hangers in equipment access areas.
 - 8. Install lateral supports for seismic loads where shown and/or where required by Design-Builder's design.
 - 9. Install pipe supports where required to withstand expansion thrust loads and to direct and control thermal expansion.
 - 10. Repair mounting surfaces to original condition after attachments are completed.

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B. Standard Pipe Supports:

1. Horizontal Piping Supported from Walls:
 - a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
 - b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
 - c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
2. Horizontal Piping Supported from Floors:
 - a. Saddle Supports:
 - 1) Pedestal type, elbow, and flange.
 - 2) Provide minimum 1-1/2-inch grout beneath baseplate.
3. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. New Concrete Elevated Slabs:
 - a. Embedded inserts, concrete attachment plates, or concrete anchors as limited below:
 - 1) Single point attachment to slab allowed only for maximum 3/4-inch rod (8 inches and smaller pipe), unless shown otherwise and/or where otherwise required by design.
 - 2) Where there is vibration or deflection considerations, do not connect a single pipe support hanger rod directly to a concrete anchor (single point attachment) regardless of size.
 - 3) Provide dielectric separation between stainless steel and galvanized embeds and rebar within concrete framework.
 - 4) Coat galvanized and aluminum embeds for protection of contact with concrete with coating as specified in Section 09 90 00BPS, Painting and Coating.
2. Existing Concrete Elevated Slab:
 - a. Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
 - 1) Single point attachment to ceiling is allowed only for maximum 3/4-inch rod (8 inches and smaller pipe).
 - 2) Where there is vibration or deflection considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.

- D. Saddles for Steel, Ductile Iron, or Concrete Pipe: Provide 90-degree to 120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.

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3.02 FIELD FINISHING

- A. Paint components as specified in Section 09 90 00BPS, Painting and Coating.

END OF SECTION

**SECTION 40 80 01BPS
PROCESS PIPING LEAKAGE TESTING**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Testing Plan:
 - a. Submit prior to testing and include at least the information that follows for each piping system and section of pipe to be tested.
 - 1) Testing dates.
 - 2) Test type.
 - 3) Method(s) of isolating from adjacent piping and equipment not included in the test.
 - 4) Calculation of maximum allowable leakage for piping section(s) to be tested for which leakage is allowed.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify Design-Builder in writing 5 days in advance of testing. Perform testing in presence of Design-Builder.
- B. Pressure Piping:
 1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping for filling and draining each section tested prior to testing.
 2. Wait 7 days minimum after concrete thrust blocking is installed until the concrete has attained sufficient strength to resist the thrust loading to perform the testing.
 3. Remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

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4. New Piping Connected to Existing Piping:
 - a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Design-Builder. Include details of each isolation and each closure after successful completion of testing in the test plan if not shown on the Drawings.
 - b. Subject each closure to an initial service leak test and conduct visual inspection for leakage.
 5. Items that do not require testing include: Equipment seal drains, and atmospheric vents.
 6. Test Pressure: As indicated on Piping Schedule as shown on the Drawings.
- C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

- A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
- B. Exposed Piping:
1. Perform testing on installed piping prior to application of insulation.
 2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
 3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
 4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 5. Examine joints and connections for leakage.
 6. Correct visible leakage and retest as specified.
- C. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

3.03 FIELD QUALITY CONTROL

- A. Test Report Documentation:
1. Test date.
 2. Description and identification of piping tested.
 3. Test fluid.
 4. Test pressure.
 5. Test duration.

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6. Remarks, including:
 - a. Leaks (type, location).
 - b. Repair/replacement performed to remedy excessive leakage.
7. Signed by Design-Builder to represent that test has been satisfactorily completed.

END OF SECTION

**SECTION 40 96 00BPS
APPLICATIONS SOFTWARE**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. General: Work performed by PCSI includes design, furnishing, testing, documenting, training and starting up the Process Control and Integration (PCI) Applications software for the Balboa Pump Station control system, including the PLC and local HMI.
- B. Major applications software work items include:
 - 1. Work sequence and schedule.
 - 2. Applications software workshops.
 - 3. Applications software submittals.
 - 4. Applications software development.
 - 5. Software testing.
 - 6. Software installation.
 - 7. O&M development.
 - 8. Owner Training.
 - 9. Startup.
- C. Work Guidelines:
 - 1. ISA 18.2, Management of Alarm Systems for the Process Industries.
 - 2. ISA 95, Enterprise-Control System Integration.
 - 3. ISA 101, Human Machine Interface.
 - 4. Reference LASAN Automation Guidelines for additional requirements related to PLC hardware and software programming including communications, display and data format, display, and pop-up colors and controls, display navigation, tag point numbering and descriptions, and PLC functionality.

1.02 DIVISION OF WORK

- A. PCSI: the Process Control System Integrator will provide application software for changes to the existing PLC and HMI functions required for the Balboa Pump Station except for the remote LAWSDAC SCADA functions. The Owner will provide modifications to all remote LAWSDAC SCADA functions.
- B. Design-Builder: The Design-Builder shall have overall system responsibility.

BALBOA PUMP STATION IMPROVEMENTS

1.03 DEFINITIONS

A. Abbreviations:

1. DCS: Distributed Control System.
2. FSAT: Functional Software Acceptance Test.
3. HMI: Human Machine Interface.
4. I&C: Instrumentation and Control.
5. I/O: Inputs and Outputs.
6. O&M: Operation and Maintenance.
7. ORT: Operational Readiness Test.
8. P&ID: Process and Instrument Diagram.
9. PC: Personal Computer.
10. PCI: Process Control and Integration.
11. PLC: Programmable Logic Controller.
12. PMCS: Process Monitoring and Control Software.
13. PT: Performance Testing.
14. SCADA: Supervisory Control and Data Acquisition.
15. SDT: Software Demonstration Test.
16. SLC: Single Loop Controller.
17. VFD: Variable Frequency Drive.

B. Instructor Day: 8 hours of actual instruction time.

C. Loop Specifications: Lists and descriptions in Section 40 90 00BPS, Instrumentation and Control for Process Systems, giving additional requirements for individual control loops.

D. Software:

1. Programming of digital devices using all types of programming language.
2. Configuring of digital devices using all types of configuring process.
3. Programs or configuration data stored in read only memory, programmable read only memory, read/write memory, or other storage device.

E. Types of Software:

1. Standard Software: Software packages that are independent of project on which they are used. Standard software includes system software and process monitoring and control software.
 - a. System Software: Application independent software developed by Microsoft.

- b. Process Monitoring and Control Software (PMCS): Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing capability for, data acquisition, monitoring, alarming, man-machine interface, data collection, data retrieval, trending, report generation, control, and diagnostics.
- 2. Application Software:
 - a. Software to provide functions unique to this Project and that are not provided by standard software alone.
 - b. Configuring databases, tables, displays, reports, parameter lists ladder logic, and control strategies required to implement functions unique to this Project.

1.04 WORK SEQUENCE AND SCHEDULE

- A. General: All work provided under this section shall be in accordance with a Milestone Breakdown and System Delivery Plan.
- B. Milestone Breakdown (MB): Summarize the major milestones for work provided along with the major milestones of the Project.
- C. System Delivery Plan (SDP):
 - 1. The intent of the SDP is to:
 - a. Coordinate and communicate applications software design and testing activities.
 - b. Coordinate interactions with the Owner regarding workshops, submittal reviews, Design-Builder(s) progress, test witnessing, training, etc.
 - c. Communicate and clarify required work sequences and major milestone.
 - 2. Minimum Content:
 - a. Work sequence and schedule.
 - b. Applications software workshops.
 - c. Applications software submittals.
 - d. Applications software development.
 - e. Software testing.
 - f. Software installation.
 - g. Startup and commissioning.
 - h. Troubleshooting of PLC-related issues.
 - i. O&M development.
 - j. Owner training.
 - k. Startup.

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1.05 SOFTWARE DESIGN WORKSHOPS

- A. Location: Owner's facility during the course of the Project.
- B. Objective: To provide a vehicle for the Owner to oversee the applications software development.
- C. Documentation: Software Supplier summarize resolutions reached in each workshop, including cost and schedule impacts and distribute copies to Owner and Design-Builder.
- D. Order and minimum topics to be covered in each Software Design Workshop.
 - 1. Applications Software Design Workshop (kick off) that establishes project processes, including:
 - a. Software Supplier and Design-Builder organization and reporting procedures.
 - b. Workshop objectives.
 - c. Submittal process.
 - d. Review work sequence and schedule.
 - 2. PLC and HMI Standards Workshop:
 - a. Objective: To review PLC and HMI standards in a participative workshop with Owner prior to beginning of development of Application Software.
 - b. Design products and topics to be finalized:
 - 1) Tag Group naming convention.
 - 2) PLC Tag naming conventions.
 - 3) HMI Tag naming conventions.
 - 4) Overview display design.
 - 5) Process graphics.
 - 6) Display paging and navigation.
 - 7) Dynamic Objects: Pumps, valves, gates, compressors, etc.
 - 8) Equipment control through pop-up windows.
 - 9) Loop control through pop-up windows.
 - 10) Display philosophy, organization, and operation.
 - 11) General data entry through the HMI.
 - 12) Use of tool tips.
 - 13) Color graphic standards, symbol standards, etc.
 - 14) Dynamic Objects: Pumps, compressors, valves, gates, controller faceplates, process indicators, indicators with alarms, data entry, controller face plate, dampers, aerator, chemical feed pump, mixers.
 - 15) Security.
 - 16) Alarm Management: Operation of the alarms, alarm areas, alarm filtering.

- 17) Trending.
- 18) Historical data storage and retrieval.
- 19) Variable naming conventions.
- 20) Scripting.
- 21) Tag Group file naming convention.
- 22) Display file naming convention.
3. 30 Percent Workshop:
 - a. Software Supplier use PFDs, P&IDs, I/O List, Functional Description, initial PLC program with I/O mapping, and HMI static graphics to present how the proposed control system design and Applications Software will meet the functional requirements specified herein and the Owner's standards.
 - b. Describe the software structures and anticipated software tags for all types of process functions (i.e. per VFD motor, OC valve, MOD valve, Analog instrument, Discrete instrument, Power Monitor, etc.).
 - c. At the completion of workshop Applications Software Supplier updates Functional Description and associated programming documentation with changes, additions and clarifications, using revision mode, that document the changes.
 - d. Submit finalized Functional Description along with an outline of any application software cost and schedule impacts.
4. Process Control Network Configuration Workshop:
 - a. Coordination of network address assignments with existing process control network.
 - b. Identify all new network nodes. Include PCI elements added to existing PLC and HMI.
 - c. Coordinate requirements for separate network used for PLC I/O and networked VFDs.
5. 60 Percent Development Workshops:
 - a. Objective: To present to Design-Builder and Owner how Applications Software Supplier will implement functional requirements of this section.
 - b. Present Information on:
 - 1) Updated Functional Description, per 30% workshop comments.
 - 2) PLC I/O Database listing.
 - a) Provide updated software tag structures for all process functions, as identified during Loop Specifications Workshop.
 - b) Listing should include all software tags with designations for control, monitoring, alarming, historization, and trending.

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- 3) HMI Screen previews that illustrate dynamic objects, how control functions are controlled and monitored, how equipment is controlled and HMI screen navigation, including automatic control modes.
 - 4) Communications Strategy for Conveying:
 - a) Data-linked I/O.
 - b) Alarm management/acknowledgement.
 - c) Communications heartbeat between the HMI and PLC.
 - 5) Program Flow Diagram(s) showing all software sections, sub sections, function blocks, subprograms, and their interrelationships.
 - a) Finalize standards for commonly used functions, including the following:
 - (1) Objective: Develop Application Software Function Standards. Standards for commonly used functions, including, but not limited to, the following:
 - (a) User-Defined Tag structures and plant standards.
 - (b) Function Block Templates.
 - (c) Software tag format.
 - (d) HIGH and LOW process variable alarm checking.
 - (e) Instrument failure alarm detection.
 - (f) Equipment control.
 - (g) ON/OFF pump control.
 - (h) START/STOP pump control.
 - (i) OPEN/CLOSE Valve and Gate control.
 - (j) Modulating valve control.
 - (k) Equipment failure detection.
 - (l) Equipment run time.
 - (m) Signal filtering.
 - (n) Flow totalization.
 - (o) Process values.
 - (p) Setpoint ramping.
 - (q) Discrete alarm.
 - (r) Interface with plant PLC.
6. 90 Percent Development Workshops:
 - a. Objective: To present to Design-Builder and Owner how Applications Software Supplier will implement functional requirements of this section, prior to Commissioning.

- b. Present Information on:
 - 1) Final version of functional description.
 - 2) PLC I/O Database Listing:
 - a) Provide updated software tag structures for all process functions, as identified during Loop Specifications Workshop.
 - b) Listing should include all software tags with designations for control, monitoring, alarming, historization, and trending.
 - 3) HMI screen previews that illustrate dynamic objects, how control functions are controlled and monitored, how equipment is controlled and HMI screen navigation, including automatic control modes.
 - 4) Communications Strategy for Conveying:
 - a) Data-linked I/O.
 - b) Alarm management/acknowledgement.
 - c) Communications heartbeat between the HMI and PLC.
 - 5) Program flow diagram(s) showing all software sections, subsections, function blocks, subprograms, and their interrelationships.
 - 6) Functional Test Plan: Provide the initial commissioning test plan to validate functional descriptions.
- c. Process Reporting:
 - 1) Objective: Developed and document number and types of reports.
 - 2) Identify and define each type of process report including:
 - a) Daily flow and energy totals.
 - b) Weekly flow and energy totals.
 - c) Monthly flow and energy totals.
 - d) Yearly flow and energy totals.

1.06 SUBMITTALS

A. Action Submittals:

- 1. Functional Description:
 - a. Submittal Objective(s): Provide updated Functional Description (FD) for the control system. This should take the FD provided with the design and updates it per Owner coordination, software workshops, and field commissioning.
 - b. Scope of document:
 - 1) Description of operation of the facility and approach for control for engineering, operations and maintenance staff.
 - 2) Listing of major equipment and instrumentation.

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- 3) Operator interfaces.
- 4) Modes of Operations.
- 5) Software functions.
2. Application Software Standards:
 - a. Submittal Objective(s): Provide standard used for control system software. This should align with the Owner's.
 - b. Provide for each of the following:
 - 1) All software being supplied.
 - c. Special Submittal Instruction(s):
 - 1) Submit in PDF.
 - 2) Complete configuration documentation.
 - 3) Submit standard used and how it aligns with the Owner's standard for all created function blocks and graphical objects.
 - 4) Submit any deviations to the Owner's Standard.
 - a) Submit details of changes required to PLC monitoring and control resulting from installation of alternative or upgraded process equipment and instrumentation, and other causes.
 - b) Submit changes at 30-day intervals.
 - 5) Provide function block programming and operator interface graphics for basic objects but not limited to motor/pumps, valves, alarming, process values, and navigation.
 - 6) Complete configuration documentation for microprocessor based programmable devices.
 - a) For each device, include program listings and function block diagrams, as appropriate, showing:
 - (1) Functional blocks or modules used.
 - (2) Configuration, calibration, and tuning parameters.
 - (3) Descriptive annotations.
3. Application Workshops:
 - a. Submittal Objective(s): Provide a means for Design-Builder and Owner to participate in discussions of how control system should be built, and standards applied.
 - b. Provide for each of the following:
 - 1) All software being supplied.
 - c. Special Submittal Instruction(s):
 - 1) Submit schedule and agenda for the two main software workshops.
 - a) Pre-software Development Workshop:
 - (1) Review Standards.
 - (2) Show how Owner standard is applied.

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- b) Software Design Workshop:
 - (1) Review of Application Software.
 - (2) Review Functional Descriptions.
 - (3) Update and details to Loop Specifications.
 - (4) Document and submit reporting criteria and functional requirements.

B. Informational Submittals:

- 1. Factory Software Demonstration Test:
 - a. Submittal Objective(s): Provide overview of factory test procedures and results, prior to and after successful factory testing.
 - b. Special Submittal Instructions:
 - 1) Submit Procedures, Forms, Checklists, and Results in PDF file format.
 - 2) Submit Preliminary Test Procedures: Provide outline of proposed tests, forms, and checklists.
 - 3) Submit Final Test Procedures:
 - a) Provide outline of proposed tests, forms, and checklists.
 - b) Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
 - 4) Submit copy of signed-off test results.
- 2. Software Application:
 - a. Submittal Objective(s): Provide an overview of software development.
 - b. Provide for each of the following:
 - 1) All configurable hardware and software being supplied.
 - c. Special Submittal Instruction(s):
 - 1) Submit in PDF.
 - 2) Submit within 30 days after first Preconstruction Conference: Schedule of work with milestones including but not limited to software workshops, testing, Design-Builder witness testing, start-up.
 - 3) Testing Related Submittals:
 - a) Test Forms:
 - (1) Proposed test procedures, forms, and check lists:
 - (a) Software Demonstration Tests (SDT).
 - (b) Operational Readiness Test1 (ORTI).
 - (c) Operational Readiness Test II (ORT II).
 - (d) Operational Readiness Test III (ORT III).
 - (e) Operational Readiness Test IV (ORT IV).
 - (f) Software Performance Test (PT).

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- b) Test Procedures: Conduct tests using Design-Builder accepted test procedures, forms, and checklists.
- c) Test Documentation: Copy of signed of test procedures when tests are completed.
- 4) Operations and Maintenance Manuals:
 - a) In accordance with Section 01 78 23, Operation and Maintenance Data, unless otherwise specified in this section.
 - (1) User's manuals for Standard Software packages.
 - (2) Licensed copies of Standard Software packages.
 - (3) Updated versions of material provided under Shop Drawing Submittals for Applications Software Design and Development.
 - (4) Applications software source files.

PART 2 PRODUCTS

2.01 PLC APPLICATION SOFTWARE DESIGN REQUIREMENTS

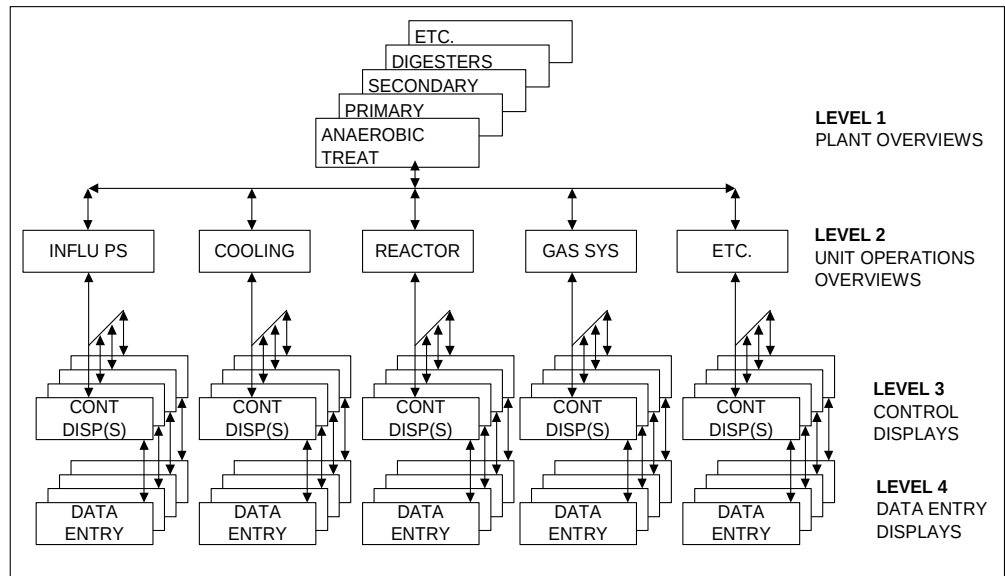
A. General:

1. The PCSI shall develop the PLC software design to convey accurate information to the plant operations staff so they can make informed process control decisions and execute the control decisions.
2. The following outlines key objectives in designing the HMI graphics displays:
 - a. Easily navigated menus.
 - b. Provide no more than three mouse actions to navigate to any control display.
 - c. Maintain consistency in graphic display and controls design. (Consistency reduces the chances of misunderstanding, significantly reduces learning time, anxiety and stress.)
 - d. Maintain consistent and predictable window operations.
 - e. Accurate representation of the plant and its operations.
 - f. Represent control options in an easily understood fashion.
 - g. Develop help screens to provide additional information to help the operations staff understand the control options where complex operations are required.
 - h. A pleasant and engaging interface that conforms to the operators "Mental Model."
 - i. Where possible, design overview displays similar to the physical layout of the facility. The perspective to the physical layout should be from the local main control room.

- j. Provide operator access to process and alarm setpoints, including the following:
 - 1) Process alarms (HIGH HIGH, HIGH, LOW, and LOW LOW).
 - 2) Pump and equipment control setpoints.
 - 3) Process timer setpoints.
 - 4) Sequence setpoints for volume, level, time etc.

B. General Display Organizational Philosophy:

1. Graphic displays provide the vehicle for the operations to accomplish supervisory control over the entire treatment process. Organization of these graphics displays into a consistent homogeneous hierarchy that permits fast, easy and intuitive navigation between the displays is essential for plant operations. The following figure illustrates an overview of a typical graphic display hierarchy.

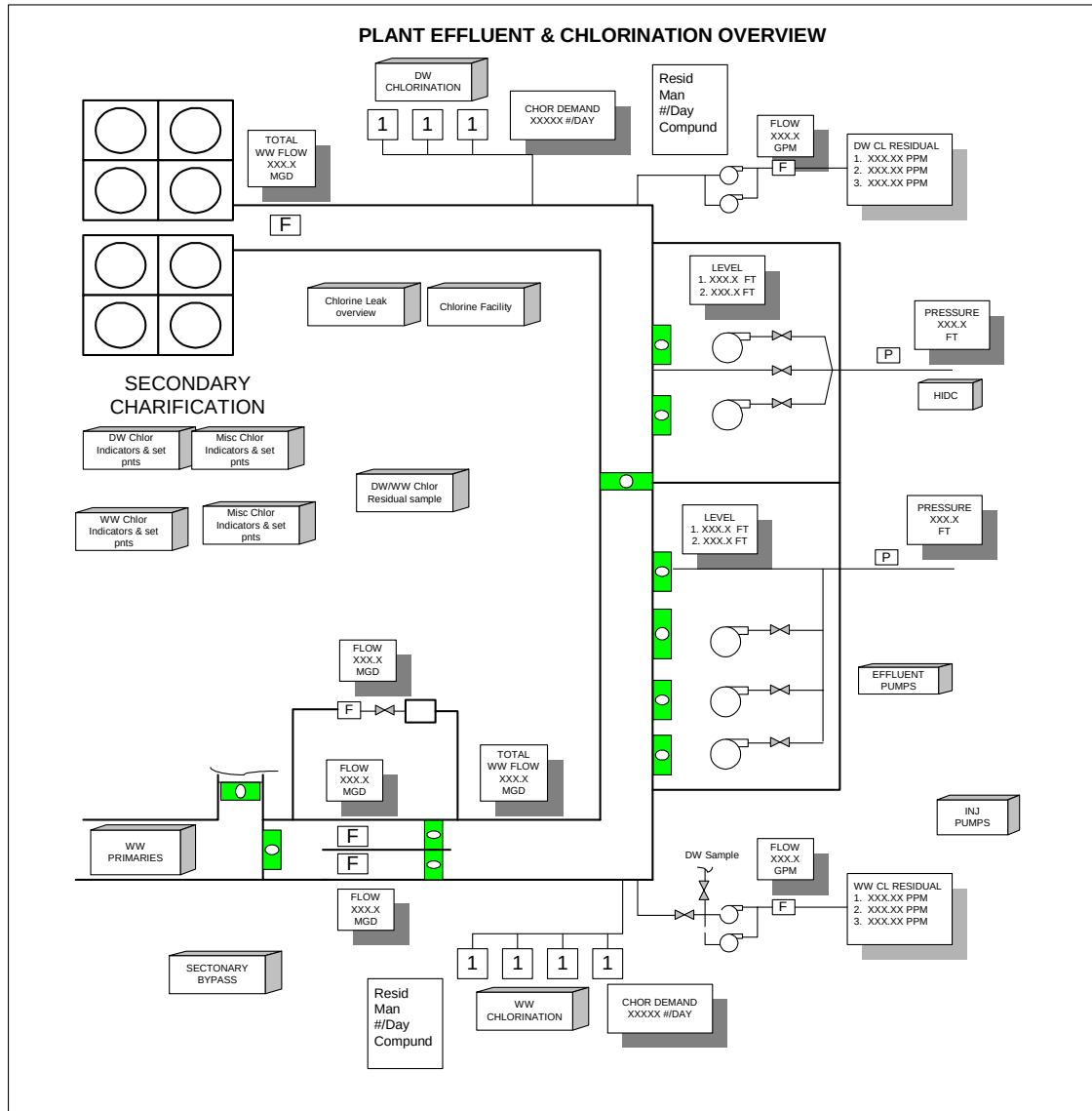


2. As shown, the process and control graphic display hierarchy consists of four levels of displays. The following briefly describes the intent of each of the four levels of displays:
 - a. Level 1—Plant Overview(s):
 - 1) The Plant Overview(s) show major processes such as Primary, Secondary, Anaerobic Treatment, etc. These overview displays show the most important (essential) process data and major equipment status on a plant wide basis, but provide no equipment or system control.

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- 2) The Plant Overview(s) display provide the means to page (i.e., go to) to other Plant Overviews or Unit Process overviews, or in some cases directly to Control Displays.
 - 3) As a general rule, the Plant overviews show the most critical status and system data that give the operations staff a good general feel on how the plant, is currently operating. A Plant Overview is going to be the opening display whenever the HMI is started.
- b. Level 2—Unit Process Overviews:
- 1) Unit Process Overviews are full sized screens.
 - 2) The Unit Process Overviews show primary process data on unit processes, unit operations, equipment status, or system status, etc. As a general rule no control strategies are implemented through the Unit Operations Overviews. The unit operations overview provides the means to page to Control Displays.
 - 3) The general rule is to show enough status and system data information that gives operations staff a good general feel on how the individual processes are currently operating. It also provides a launching pad to access control information associated with the individual processes.
 - 4) Examples of Unit Process Overviews are Influent Pump Station, Influent Cooling, Reactor and associated Chemical system, Bio Gas System, Sulfide Oxidation, Odor Control, Utilities. The following illustrate the level of detail on a Unit Process Overview display.

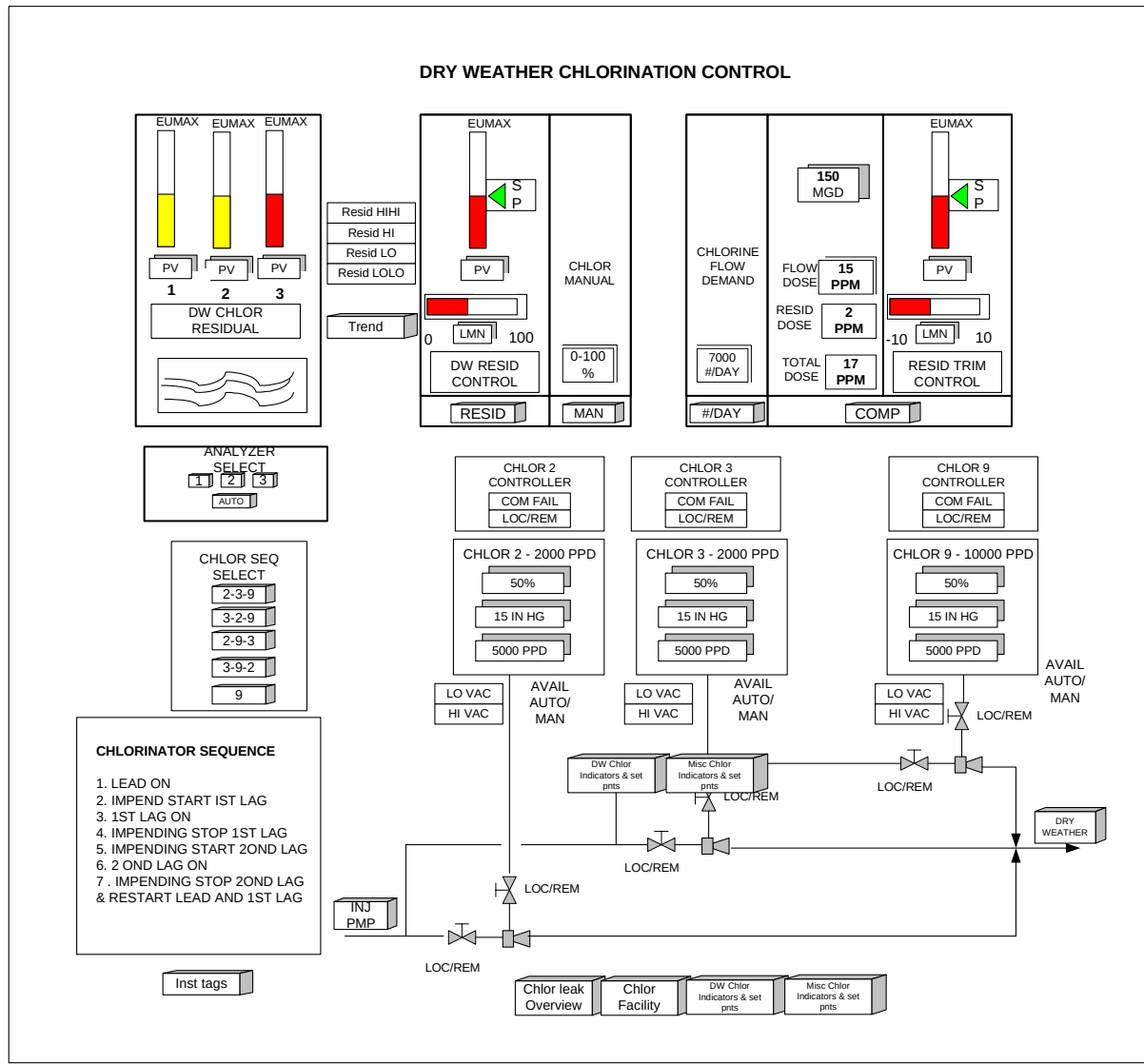
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Example Level 2 Display Graphic for “Plant Effluent and Chlorination.”

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- c. Level 3—Control Displays:
 - 1) Control Displays can be Full screen or popup windows.
 - 2) Control Displays provide the means to monitor and provide Supervisory Control of specific process operations such as pump stations, specific pumps, heat exchangers, pH control, Pre-Acidification, chemical systems, etc. Depending on the complexity of the specific process there may be several levels of displays. For example, some unit operations will have a special display for each phase of a startup sequence. Control of each piece of equipment on individual unit operation control displays is possible. The following figure illustrates a typical control Display.
 - a) The Level display provides the capability to control specific equipment, system and to navigate directly to related displays.



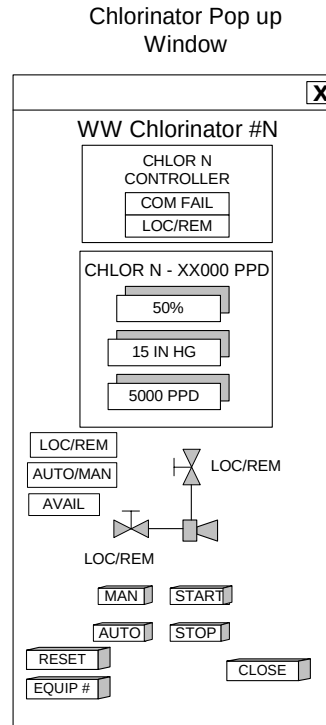
Example Level 3 Display of the “Dry Weather Chlorination Control.”

3) Supervisory Control:

- a) The objective of the HMI design approach is to implement all Supervisory Control of the plant and its process and control strategies from the control displays. The control strategies include the following functions:
 - (1) System level control, such as control loops, and sequences, etc.
 - (2) Equipment level control, such as a pump start/stop control.
 - (3) Detailed monitoring of sequence steps and general information messages for status.

BALBOA PUMP STATION IMPROVEMENTS

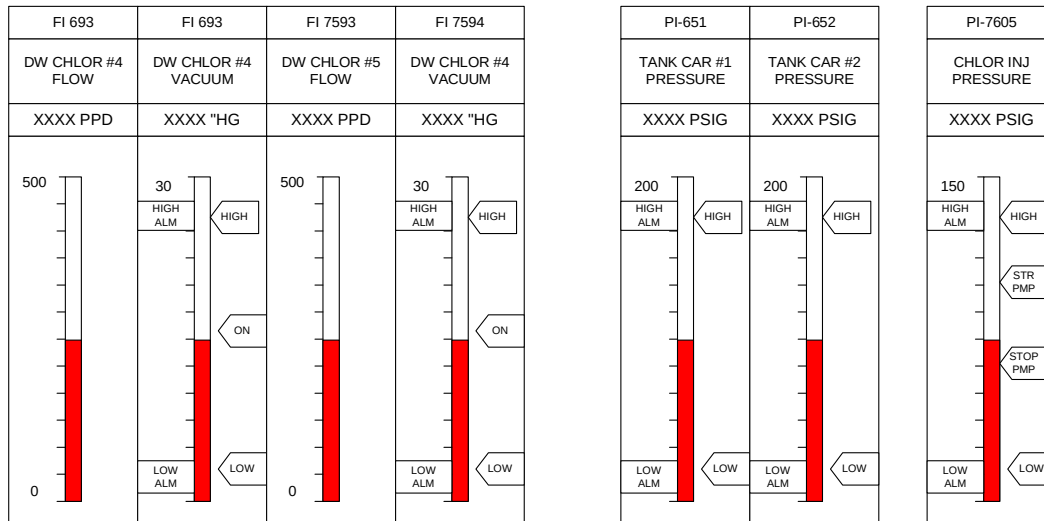
- (4) Important alarm messages.
 - (5) Paging between related displays.
 - (6) Paging between related processes.
- 4) Pop-Up Windows:
- a) Pop-up windows provide the capability to control systems and equipment without cluttering the overview or control display. The following illustrates the configuration of a typical pop-up window:



- b) The typical pop-up window provides the following functions:
 - (1) Status monitoring of equipment being controlled.
 - (2) Operating mode.
 - (3) Manual mode selection.
 - (4) Start/Stop Control in Manual.
 - (5) Auto mode selection.
 - (6) Failure Reset.
 - (7) Equipment description.
 - (8) Control for displaying the equipment number.
- d. Level 4—Data Entry and Trend Displays:
- 1) Data Entry displays are designed especially for data entry purpose. Operators enter process setpoints, equipment

control setpoints (such as lead-lag pump start/stop setpoints), alarm setpoints, etc. The following figure illustrates a typical data entry display:

CHLORINATION MISCELLANEOUS INDICATORS AND SETPOINTS



Example Data Entry Display. The operator clicks on a setpoint pointer then enters the setpoint. The pointer is then scaled the same as the process variable.

- e. Display Navigation: To provide fast and effective screen navigation shall be provided. The following outlines the type of screen navigation functionality to be provided. The final display navigation process shall be developed in the software workshops.
- f. Main Directory:
 - 1) A Main Directory can be a list of Displays that shows the hierarchy of Plant Overviews, Unit Process Overviews, Control Displays and Data Entry Displays.
 - 2) The Main Directory provides a way to catalog and access all displays, however, is does not provide an effective navigation tool for plant operations.
 - 3) The Plant Overview Display is another type of Main Directory Display that has active areas (poke points) to call up Unit Process Displays based on physical location in the plant. The Main Directory Display lends itself to fast navigation from display to display.
- g. Main Navigation Menu Bar: The Main Navigation Menu Bar is series of buttons on the bottom of each display that provides the user with the capability to go to (navigate to) any unit operation.
 - 1) The Main Navigation Menu Bar takes up graphic screen area on each full size screen but does provide a consistent, fast way to navigate between unit operation screens.

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- h. Previous and Next Display Controls:
 - 1) Previous and next display configurations shall be provided.
 - 2) The next and previous displays will be configured to operate within the same level. For example, if an operator is on a Level 2 unit process overview, the previous and next displays configuration will be set up to cycle between all the Level 2 unit process overview displays.
 - 3) If the user was in the Level 3 displays for a specific unit process the next and previous displays will be configured to cycle between all the Level 3 and Level 4 displays associated with the unit process overview.
 - i. System/Control Displays:
 - 1) Each unit process display will have soft keys that call up System/Control displays. If possible, develop soft keys that call up system/control displays that use a transparent button over the unit. For example on the thickening overview a transparent button over a specific gravity belt will call up the respective gravity belt control display.
 - 2) A transparent button is a control that has an outline of a button but is transparent. When placed over an object on a display, the object is still visible by clearly identifies navigation to another display or access to a pop-up window.
- C. Alarm Group Display: The alarm group window gives operators a first-level indication of an alarm occurrence by group and allows operators to filter the alarm list. It indicates by solid color that an active (acknowledged) alarm exists in the alarm group and by blinking that an unacknowledged alarm exists in the alarm group.
- D. Alarm Summary (Filtered): The filtered alarm summary window is dedicated to the presentation and acknowledgment of alarms. It provides alarm details, such as date and time of alarm, recurring alarm signal, alarm group, description of the alarm, alarm priority, current value, engineering unit, etc., for all alarms, acknowledged or unacknowledged. Once the alarms occur, they can be taken off the alarm list only if they have been acknowledged and the alarm conditions are no longer true.

2.02 PROCESS CONTROL I/O DATABASE

- A. Process Control I/O Database:
- 1. The PCSI shall update the existing Master Engineering Database (MEDB) tool that has the following functions:
 - a. Coordinate, manage and document all process control database points including those communicated to SCADA.

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- b. The database shall contain all the field necessary to configure the various points including the following per point type:
- 1) Discrete Point Configuration: The Software Supplier shall provide a PLC Input/Output (I/O) database of all discrete points that are communicated to and from the PLC. The list shall be configured on a Microsoft Excel or Access database. The I/O list includes the following fields:
 - a) Loop Number.
 - b) Block Tag Number.
 - c) Block type.
 - d) PLC node the point is assigned to.
 - e) Attribute: Further definition of the function of the point. The following is a list of definitions:
 - (1) A(X): PLC alarm read, where X designates the alarm priority: 1,2,3.
 - (2) W: PLC write.
 - (3) R: PLC read.
 - (4) RW: SCC read and write.
 - f) Point description.
 - g) Alarm Description 1.
 - h) Alarm Description 2.
 - i) Closed Condition (INPUT): Description of the state of the input parameter of device when the field or internal contacts are in the CLOSED position.
 - j) Open Condition.
 - k) Closed Condition (OUTPUT): Description of the output signal in the energized position.
 - l) Alarm area.
 - m) PLC I/O address.
 - 2) Analog Point Configuration: The Software Supplier shall provide a PLC Input/Output (I/O) Database of all analog points that are communicated to and from the PLC. The list shall be configured on a Microsoft Excel or Access database. The Analog I/O database includes the following fields:
 - a) Loop Number.
 - b) Block Tag Number.
 - c) Block Type.
 - d) Point description.
 - e) Alarm Description 1.
 - f) Alarm Description 2.
 - g) Engineering units.
 - h) Scale range.

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- i) Alarms functions to be configured in FIX analog block configuration.
 - (1) HIGH HIGH.
 - (2) HIGH.
 - (3) LOW.
 - (4) LOW LOW.
 - (5) SIGNAL FAIL.
 - (6) Other.
- j) PLC I/O address.
- 3) PLC Database: The Software Supplier shall provide a database of all PLC database points that are not included in the analog or discrete I/O Databases in the that are communicated to and from the PLC. The database shall be configured in a Microsoft EXCEL or ACCESS database. PLC database includes the following fields:
 - a) Loop number.
 - b) Block tag number.
 - c) Block type.
 - d) PLC the point is assigned to.
 - e) Point description.
 - f) Alarm Description 1.
 - g) Alarm Description 2.
 - h) Engineering units.
 - i) Scale range.
 - j) Alarms functions to be configured in FIX block configuration:
 - (1) HIGH HIGH.
 - (2) HIGH.
 - (3) LOW.
 - (4) LOW LOW.
 - (5) SIGNAL FAIL.
 - (6) Other.

2.03 STANDARD PLC BLOCKS

- A. General: The following Standard functions blocks specify the standard PLC functions block to be developed and used to implement the Functional Requirements. Follow Owner PLC programming standards. For functions not covered in standards, provide functions described below or submit proposed blocks for Design-Builder and Owner review and approval.
- B. Discrete PLC Mode Command and Feedback Status: When the PLC commands a specific mode such as AUTO or MANUAL, the PLC shall be configured with an AUTO write command database point and a in AUTO mode database status.

- C. Analog PLC Read-Write Process: When an analog value such as setpoint or controller output is specified to be accessible to the operator, the PLC shall be configured to write to a register through one database tag and then read back the variable written through a second database tag.
- D. General Control Functions: Refer to Functional Description, for the standardized control functions to be implemented at the PLC. The standardized blocks/functions will be used consistently to implement the process specific control strategies.

PART 3 EXECUTION

3.01 ONSITE TESTING

A. General:

- 1. Test software to demonstrate that the applications software satisfies requirements outlined in the Loop specifications, and described in submittals, and workshops.
- 2. Test Format:
 - a. Cause and Effect:
 - 1) Person conducting test initiates input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect), occurs.
- 3. Procedures, Forms, and Checklists:
 - a. The Test will be completed on a unit operation and loop basis that is designed to coordinate with the PCI testing and startup.
 - b. The Software Supplier shall generate testing forms, and checklists from the PLC database.
 - c. Have space after each test item description for sign off by appropriate party after satisfactory completion.

B. Software Demonstration Tests (SDT):

- 1. Scope: Test entire PLC to demonstrate that it is operational. The SDT shall be successfully completed to the satisfaction of the Design-Builder and Owner before the software is loaded on to the Plant PLC.
- 2. Location: Software Supplier's facility.
- 3. Prerequisites: PCSI shall complete a witnessed SFAT on the entire system and submit results as part of the Pre-software Design Submittal.
- 4. HMI Display Navigation Test: The Objective of the test is to verify all the display navigation controls.
- 5. Loop-Specific Functions: Demonstrate functions shown on P&IDs, specified in the Loop Specifications, described in submittals, and workshops. This test shall not be started until the Display and Display navigation tests have been successfully completed. This test shall verify

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- all PLC functions through indications on the HMI software. The PCSI shall develop a test form on and unit Operation and loop basis. The form shall list all controlled equipment, control routines, alarm points, status points, setpoints, controllers, sequences that are specified in the Loop Specifications. The test shall demonstrate all manual and automatic functions are operating as specified and verify that the outputs and inputs are configured to the correct PLC I/O point.
6. Make following documentation available to Owner at Test Site both before and during SDT:
 - a. Loop specifications.
 - b. Software design submittal.
 - c. O&M material.
 - d. Master copy of SDT sign off sheets.
 - e. Applications software documentation.
 - C. ORT Test I (ORT I). Performed by the Design-Builder and PCIS (as required): Prior to ORTII, startup test period and PT, inspect, test, and document that entire PCI and PLC is ready for operation; excluding Software Supplier provided PLC applications software.
 - D. ORT Test II (ORT II): Combined effort between Systems Integrator Subcontractor, Design-Builder, and Software Supplier to confirm that PCI, including applications software, is ready for operation.
 1. Prerequisite: Completion of ORT I.
 2. Joint test with PCSI. Repeat of PCSI SDT, except using real field sensors and equipment. Plant interlocking and communications with the PLC shall be tested on loop-by-loop basis.
 3. Test procedures provided by PCSI based on Loop specifications.
 - E. Software Performance Tests (PT): These are the activities that Section 01 91 14, Equipment Testing and Facility Startup, refers to as performance testing. Design-Builder will lead this test with participation from PCSI, PCIS, and package system vendors, as necessary.
 1. Once ORT I and ORT II has been completed and facility has been started up, perform a witnessed PT on complete PCI and software to demonstrate that it is operating as required by the Contract Documents and software loop descriptions. Demonstrate each required function on a paragraph-by-paragraph, loop-by-loop basis.
 2. Loop-specific and non-loop-specific tests same as required for SDT except that entire installed PCI tested using actual process variables and all functions demonstrated.
 3. Perform local and manual tests for each loop before proceeding to REMOTE and AUTOMATIC modes.

4. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
5. Make updated versions of documentation required for PT available to Owner at Site, both before and during tests.
6. Make one copy of all software O&M manuals available to the Owner at the Site both before and during testing.

3.02 OWNER TRAINING

A. General:

1. Design-Builder to lead this training. All PLC specific functions will be provided by PCSI.
 - a. Provide an integrated training program for Owner's personnel.
 - b. Perform training to meet specific needs of Owner's personnel.
 - c. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
 - d. Provide instruction on all working shift(s) as needed to accommodate the Owner's personnel schedule.
 - e. Owner reserves the right to make and reuse videotapes of all training sessions.

B. Management Seminar:

1. Length: 1 day.
2. Location: Owner's facility.
3. Objective: Provide an overview for non-operations and maintenance personnel for understanding the applications software.
4. Attended by management, engineering, and other non-operations and non-maintenance personnel.
5. Primary Topics:
 - a. Applications Software Overview: How software is used for operation and control of facilities.
 - b. Block Diagram Presentation of the PLC: How and what information flows within system and what is done by each functional unit.
 - c. Process/Operator Interface: Explanation and demonstration of how to use an operator's CRT to access displays, reports, and controls.

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- d. Management-oriented explanation of data management displays and printouts.
- e. Walk-through of installed systems.

C. Operations:

1. Provide a minimum of 10 days of training at the Site indicated by the Owner for Owner's personnel in the operation of the PLC and HMI. Training shall include:
 - a. Standard operational features of PLC equipment provided.
 - b. Specific features provided for this project including:
 - 1) General Loop functions.
 - 2) Operation of Each Loop: For example, AUTO/MANUAL control, control setpoint settings, control mode selection, alarm acknowledgment.
 - 3) Operation of Each HMI display, dynamic objects, and controls on that display. The information shall be presented in an electronic format similar to the following Microsoft Power Point slide that illustrates the function of a compound mode in a chlorination control routine.

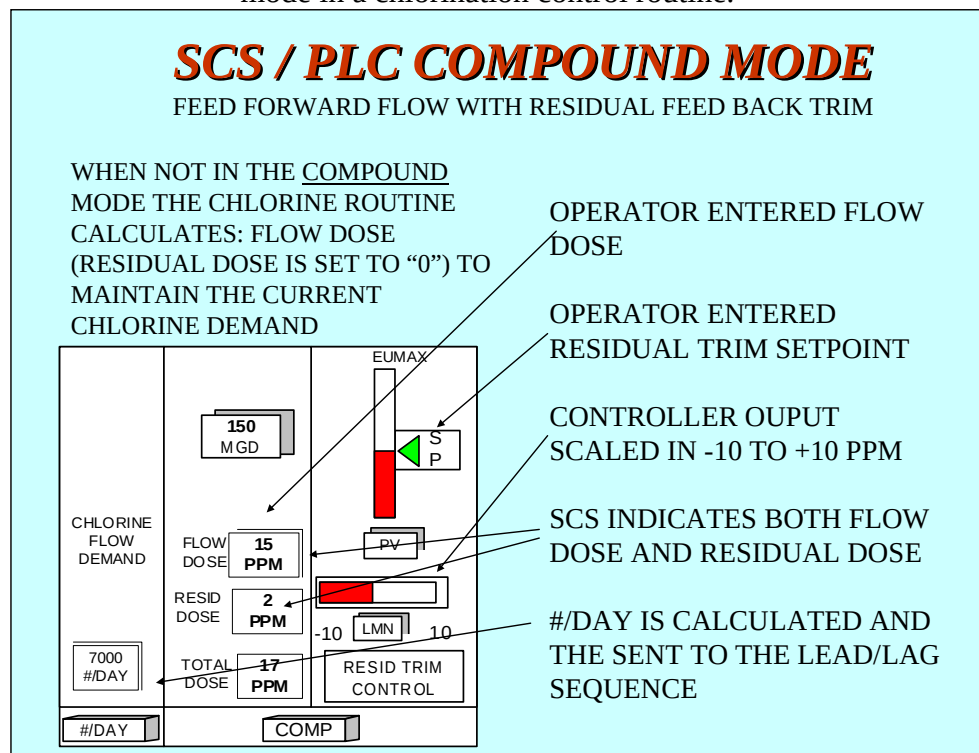


Figure Illustrating a specific control section on a graphic display.

2. Operations Startup Suggestions:
 - a. Suggested unit operations startup suggestions shall be developed and presented to the operations staff. The suggested unit operation

shall consist of two sections, field setup and startup through the PLC.

- 1) The field setup shall list the field devices such as pumps, valves, chemical feeders, etc., and the position of their local control switches to transfer control to the PLC.
- 2) The startup sequence through the PLC shall list each equipment control, its display where located and the control action to be taken and the expected response to be seen on the PLC.
- b. The following is a list of Unit Operations to be developed:
 - 1) Influent cooling.
 - 2) Pre-acidification and associated chemical systems.
 - 3) Reactors and associated chemical systems.
 - 4) Solids transfer.
 - 5) Gas system.
 - 6) Sulfide oxidation.
 - 7) Utilities.
3. Alarm Summary:
 - a. Describe each PLC alarm, including PLC tag name, detailed description of the alarm, probable cause, suggested operator action(s).
 - b. The Alarm summary shall be configured in Microsoft Excel.

D. Software Maintenance:

1. Provide a minimum of 5 days of training at the Site indicated by the Owner's for personnel in the maintenance of the PLC software.
2. Software functional Block diagrams.

3.03 O&M MANUALS

A. General:

1. Provide the following:
 - a. Suggested startup procedures.
 - b. Training material.
 - c. Alarm summaries.

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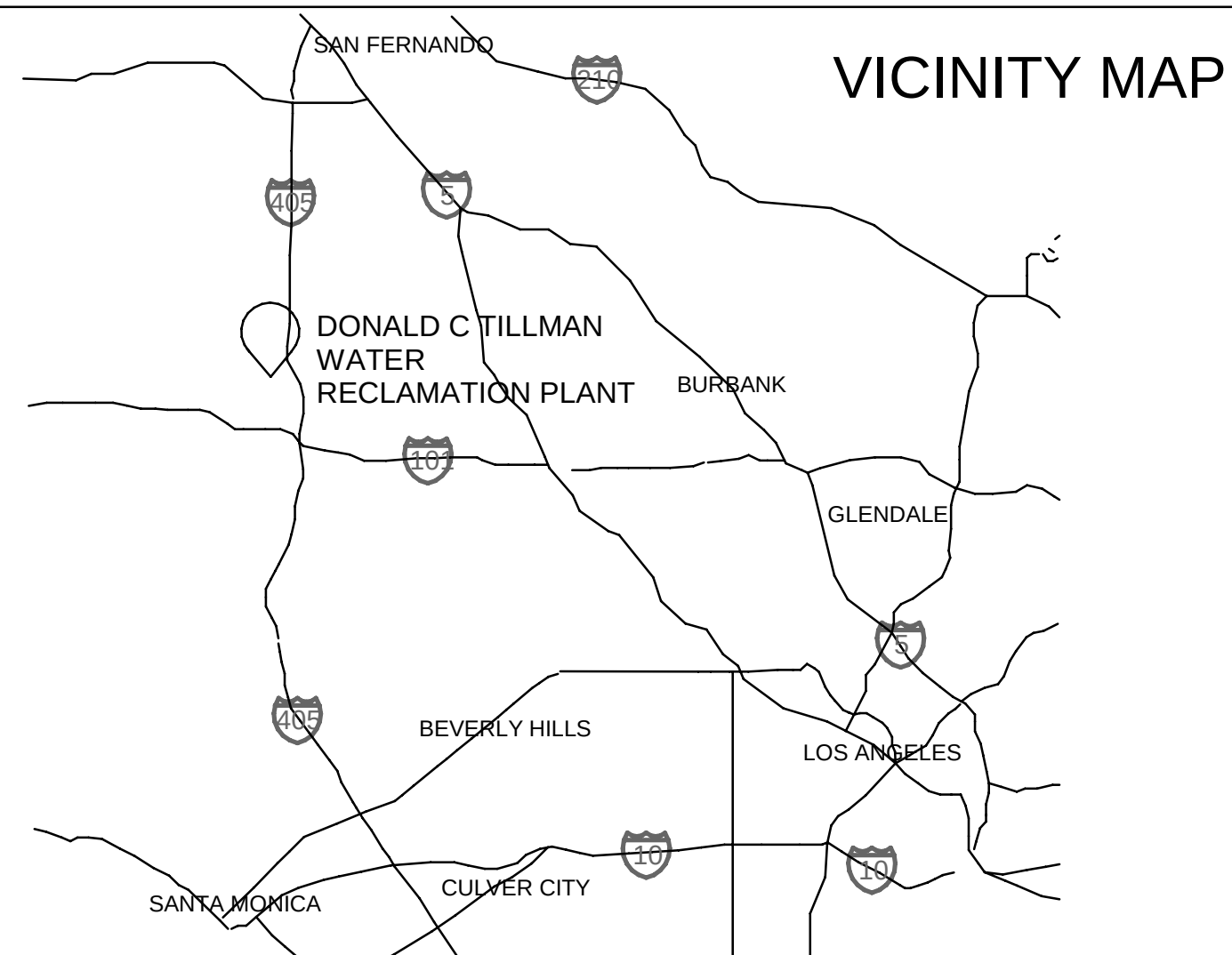
B. Software:

1. Provide the following:
 - a. Finalized loop specifications.
 - b. Program flow diagrams.
 - c. Documented ladder programs.
 - d. PLC I/O database, forms, queries, and reports.

END OF SECTION

The site plan for the Balboa Pump Station is a detailed technical drawing showing the layout of various facilities. Key components include:

- Buildings:** Administration Building, Services Building, Compressor Building, Headworks, Blower Building, Chlorination Building, Existing Tertiary Filters (Phase I and II), Chlorine Contact Basins (Phase I and II), Electrical Building, and End Lab.
- Tanks and Basins:** Primary Sedimentation Tank (with Phase I, II, and III sections), Aeration Tanks (Phase I and II), Secondary Sedimentation Tanks (Phase I and II), Influent Storage Basins No. 1 and 2, and a Surge Tank.
- Infrastructure:** Niles Road, Substation, Secondary Road, Final Road, Keightley Way, Tibbo Drive, and Park Service Road. A 1500mm water main is also indicated.
- Other Features:** Future Excess Sol Stockpile Area, Construction Staging Area (Site DND CB1007), and a Haff Site.
- Legend:** A hatched rectangular symbol represents the 'BALBOA PUMP STATION'.



CHIEF OPERATING OFFICER AND SENIOR ASSISTANT GENERAL MANAGER - WATER SYSTEM:	Anselmo Collins 111 N Hope St Los Angeles, CA 90012
CITY OF LOS ANGELES:	Los Angeles Department of Water and Power Contact: Jesus Gonzalez 111 N Hope St Los Angeles, CA 90012 Telephone: (213) 367-4048 Email: jesus.gonzalez@ladwp.com
OWNER:	Los Angeles Department of Water and Power 111 N Hope St Los Angeles, CA 90012

**PROCESS, MECHANICAL,
PLUMBING
AND INSTRUMENTATION AND
CONTROLS ENGINEER:**

Jacobs
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ELECTRICAL ENGINEER:

Lee and Ro
Contact: Eric Lovering, P.E.
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SPECIFICATIONS:

Jacobs
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Email: sean.goris@jacobs.com

**RESPONSIBLE OWNERS
AGENT:**

Contact: Paul Vranesic
Telephone: (702) 279-2944

PIN NUMBER	177B141 4	177B141 59	177B141 21
LOT/PARCEL AREA	3,539,212.8 (SQ FT)	401,327.0 (SQ FT)	5,442,032.9 (SQ FT)
ASSESSOR PARCEL NO.	(APN)2251002906	(APN)2251007900	(APN)2251007900
TRACT	RANCHO ENCINO	RANCHO ENCINO	RANCHO ENCINO
MAP REFERENCE	DM 4232-118/125	DM 4232-118/125	DM 4232-118/125
BLOCK	NONE	NONE	NONE
LOT	PT LT B	PT LT B	PT LT B
ARB (LOT CUT REFERENCE)	21	31	17

90%DESIGN
NOT FOR CONSTRUCTION

Jacobs

[illegible]

REFERENCES	Scale	AS SHOWN	DATE	APPROVED	DATE
	Designer	SGRIEBEL	09/02/2026	As to Design	
	Stamp	RSTEGER	09/02/2026	As to Operation	
	Drawn By	SGRIEBEL	09/02/2026		
	Checked By	RSTEGER	09/02/2026	As to Distribution	
	Last Update	SGRIEBEL	09/02/2026		
				Senior Assistant GM of Water	
File Name	BPS BORDER DWG				

GROUNDWATER REPLENISHMENT PROJECT BALBOA PUMP STATION IMPROVEMENTS TITLE, LOCATION AND INFORMATION

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-Z-001

Jacobs

GROUND WATER REPLENISHMENT PROJECT

BALBOA PUMP STATION IMPROVEMENTS

DRAWING INDEX

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-Z-002

90%DESIGN NOT FOR CONSTRUCTION	Jacobs			REVISIONS			REFERENCES	Scale AS SHOWN		DATE	APPROVED		DATE	GROUNDWATER REPLENISHMENT PROJECT BALBOA PUMP STATION IMPROVEMENTS ABBREVIATIONS 1					
				Number	Date			Initials	Description		Approved	Designer				SGRIEBEL	09/02/2026	As to Design	
												Stamp				RSTEGE	09/02/2026	As to Operation	
												Drawn By				SGRIEBEL	09/02/2026		
												Checked By				RSTEGE	09/02/2026	As to Distribution	
												Last Update				SGRIEBEL	09/02/2026		
														Senior Assistant GM of Water					
											File Name	BPS BORDER.DWG	Recommended				DEPARTMENT OF WATER AND POWER	DRAWING NUMBER	
																	WATER SYSTEM	CITY OF LOS ANGELES	D-06100-Z-010

D-06100-Z-011

FILENAME: AutodesK Docs\US CA_DB\DCTEQ2_City of LA_Tillman AWE\BGEN_DB\DCTEQ1.vt
PLOT DATE/TIME: 8/11/2026 9:46:47 AM

GSP	GALVANIZED STEEL PIPE	LALL	LEVEL ALARM LOW LOW	MWS	MAXIMUM WATER SURFACE	POC	POINT OF CONNECTION, POINT ON CURVE										
GT	GATE, GRAVITY THICKENER	LAM	LAMINATE			POE	POWER OVER ETHERNET, POINT OF ENDING										
GV	GATE VALVE	LAR	LA RIVER MASTERPLAN		N	POLY	POLYETHYLENE, POLYMER										
GW	GROUNDWATER	LAS	LIQUID AMMONIUM SULFATE	N	NORTH, NORTHING, NEW	PP	POWER POLE										
GWB	GYPSUM WALL BOARD	LB	POUND	N2	NITROGEN GAS	PPD	PUMPED PROCESS DRAIN, POUNDS PER DAY										
G&W	GENESEE & WYOMING RAILROAD	LC	LIGHTING CONTROLLER	N/A	NOT APPLICABLE	PR	PAIR										
		LCL	LONG CONTINUOUS LOAD	NAC	NOTIFICATION APPLIANCE CIRCUIT (AUDIBLE OR VISIBLE)	PRC	POINT OF REVERSE CURVATURE										
	H	LCP	LOCAL CONTROL PANEL	NAD	NORTH AMERICA DATUM	PRCST	PRECAST										
H	HORIZONTAL, HYDROSTATIC	LCV	LEVEL CONTROL VALVE	NAOH	SODIUM HYDROXIDE	PREFAB	PREFABRICATION										
H2S	HYDROGEN SULFIDE	LE	LEVEL ELEMENT	NAS	NETWORK ATTACHED STORAGE	PRT	PRINTER										
H.A.S.	HEADED ANCHOR STUDS	LF	LINEAR FEET	NAT	NATURAL	PRV	PRESSURE REDUCING VALVE, PRESSURE REGULATING VALVE										
HB	HEADBOARD	LG	LONG	NAVD	NORTH AMERICA VERTICAL DATUM	PS	POINT OF SWITCH, PUMP STATION										
HC	HOLLOW CORE WOOD	LIT	LEVEL INDICATOR, LEVEL INDICATING TRANSMITTER	NC	NORMALLY CLOSED	PSF	POUNDS PER SQUARE FOOT										
HCG	HIGH-CAPACITY GRILLE	LL	LIVE LOAD	NCIPW	NEUTRALIZED CLEAN IN PLACE WASTE	PSH	PRESSURE SWITCH HIGH										
HCL	HYDROCHLORIC ACID	LLV	LONG LEG VERTICAL	NEC	NATIONAL ELECTRIC CODE	PSI	POUNDS PER SQUARE INCH										
HCP	HVAC CONTROL PANEL	LNDG	LANDING	NELDI	NOVOLAC EPOXY LINED DUCTILE IRON PIPE	PSIG	POUND PER SQUARE INCH GAUGE										
HD	HUB DRAIN	LONG	LONGITUDINAL	NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION	PSL	PRESSURE SWITCH LOW										
HDG	HOT-DIPPED GALVANIZED	LOR	LOCAL-OFF-REMOTE	NESC	NATIONAL ELECTRICAL SAFETY CODE	PSS	PRESSURE SUSTAINING STATION										
HDMI	HIGH-DEFINITION MULTIMEDIA INTERFACE	LOW	LIMIT OF WORK	NF	NON-FUSED	PSV	PRESSURE SAFETY VALVE										
HDPE	HIGH DENSITY POLYETHYLENE	LP	LOW VOLTAGE PANEL, LIGHTING PANEL, LOW POINT, LOW PRESSURE	NFPA	NATIONAL FIRE PROTECTION ASSOCIATION	PT	PRESSURE TREATED, POINT OF TANGENCY, PRETENSIONED, POINT										
HEX	HEXAGONAL	LPE	LOW PRESSURE EFFLUENT	NGVD	NATIONAL GEODETIC VERTICAL DATUM	PTD	PAPER TOWEL DISPENSER										
HGL	HYDRAULIC GRADELINE	LPT	LOW POINT	NG/L	NANOGRAMS PER LITER	PTN	PARTITION										
HH	HANDHOLE	LS	LEVEL SWITCH	NIC	NOT IN CONTRACT	PTZ	PAN TILT ZOOM										
HID	HIGH INTENSITY DISCHARGE	LSH	LEVEL SWITCH HIGH	NIP	NETWORK INTERFACE PANEL	PUE	PUBLIC UTILITY EASEMENTS										
HIM	HUMAN INTERFACE MODULE	LSHH	LEVEL SWITCH HIGH HIGH	NPW	NON-POTABLE WATER (RECLAIMED EFFLUENT)	PV	PLUG VALVE										
HM	HOLLOW METAL	LSIG	LONG TIME/SHORT TIME/INSTANTANEOUS GROUND FAULT	NO.	NUMBER (#), NORMALLY OPEN	PVC	POLYVINYL CHLORIDE, POINT OF VERTICAL CURVATURE										
HMI	HUMAN MACHINE INTERFACE	LSL	LEVEL SWITCH LOW	NO/NC	NORMALLY OPEN/CLOSED	PVDF	POLYVINYLDENE FLUORIDE										
HMWPE	HIGH MOLECULAR WEIGHT POLYETHYLENE	LSLL	LEVEL SWITCH LOW LOW	NOI	NOTICE OF INTENT	PVI	POINT OF VERTICAL INTERSECTION										
HORIZ	HORIZONTAL	LT	LEFT	NOM	NOMINAL	PVMT	PAVEMENT										
HOA	HAND-OFF-AUTO	LTG	LIGHTING	NO3N	NITRATE AS NITROGEN	PVRV	PRESSURE AND VACUUM RELIEF VALVE										
HP	HORSEPOWER, HEAT PUMP, HIGH POINT			NS	NEAR SIDE	PVT	POINT OF VERTICAL TANGENCY										
HPE	HIGH PRESSURE EFFLUENT		M	NP	NAMEPLATE	PW	POTABLE WATER										
HPS	HIGH PRESSURE SODIUM	MA	MILLIAMPERE	NTP	NETWORK TIME PROTOCOL	PWR	POWER										
HPT	HIGH POINT	MANUF	MANUFACTURER	NTS	NOT TO SCALE												
HPU	HYDRAULIC POWER UNIT	MATL	MATERIAL	NTU	NEPHELOMETRIC TURBIDITY UNITS		Q										
HPW	HOT PROCESS WATER	MAU	MAKE-UP AIR UNIT	NVR	NETWORK VIDEO RECORDER	QT	QUARRY TILE										
HR	HOUR, HANDRAIL	MAX	MAXIMUM														
HRT	HYDRAULIC RETENTION TIME	MB	MACHINE BOLT		O		R										
HRU	HEAT RECOVERY UNIT	MBH	1000 BTU/HR	OA	OUTSIDE AIR		R										
HS	HAND SWITCH	MBS	MAINTENANCE BYPASS SWITCH	OC	ON CENTER	R	RISER, RADIUS										
HSS	HOLLOW STRUCTURAL STEEL / SECTION	MBW	MEMBRANE BACKWASH WASTE	OCR	OVERCURRENT RELAY	RA	RETURN AIR										
HT	HEIGHT	MC	MODULATE-CLOSE	OD	OUTSIDE DIAMETER	RAD	RADIUS, RADIO										
HV	HOSE VALVE	MCC	MOTOR CONTROL CENTER	ODU	OUTDOOR UNIT	RB	RETENTION BASIN										
HVAC	HEATING VENTILATING AND AIR CONDITIONING	MCCX	MOTOR CONTROL CENTER NO.X	OF	OVERFLOW, OUTSIDE FACE	RC	REINFORCED CONCRETE										
HVLS	HIGH VOLUME LOW SPEED	MCP	MOTOR CIRCUIT PROTECTION	O.F.	OUTSIDE FACE	RCB	REINFORCED CONCRETE BOX, ROOT CONTROL BARRIER										
HW	HIGH WATER	MD	MOTORIZED DAMPER	OF/CI	OWNER FURNISHED / CONTRACTOR INSTALLED	RCP	REINFORCED CONCRETE PIPE										
HWP	HEATING WATER PUMP	MDC	MOTORIZED DAMPER CONTROL	OIU	OPERATOR INTERFACE UNIT	RCPT	RECEPTACLE										
HZ	HERTZ	MDM	MODEM	OL	OVERLOAD RELAY	RCY	RECYCLE										
		MDO	MEDIUM DENSITY OVERLAY	OP	OPEN	RD	ROAD, ROOF DRAIN										
	I	MECH	MECHANICAL	OP	OPENING	RDCR	REDUCER										
IA	INSTRUMENT AIR	MED	MEDIUM	OPNG	OPENING	RE	REUSE EFFLUENT										
IBC	INTERNATIONAL BUILDING CODE	MET	METAL	OPP	OPPOSITE	RED	REDUCTION EQUIVALENT DOSE										
I&C	INSTRUMENTATION & CONTROL	MEP	MECHANICAL, ELECTRICAL, PLUMBING	OPP HD	OPPOSITE HAND	REF	REFERENCE										
ID	INSIDE DIAMETER	MF	MEMBRANE FILTRATION, MICROFILTRATION	ORG	ORANGE	REFRIG.	REFRIGERATOR										
IDU	INDOOR UNIT	MBWAS	MEMBRANE FILTRATION BACKWASH AIR SCOUR	ORP	OXIDATION REDUCTION POTENTIAL	REG	REGULAR										
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS	MBWAS/V	MEMBRANE FILTRATION BACKWASH AIR SCOUR VENT	OSC	OPEN-STOP-CLOSE	REINF	REINFORCE (ING)										
IE	INVERT ELEVATION	MBWS	MEMBRANE FILTRATION BACKWASH SUPPLY	OZ	OUNCE, OZONE	REQD	REQUIRED										
IF	INSIDE FACE	MBWVW	MEMBRANE FILTRATION BACKWASH WASTE			REP	REPRESENTATIVE										
IH	INTAKE HOOD	MFCIPF	MEMBRANE FILTRATION CLEAN IN PLACE TANK FILL		P	RET	RETAINING, RETURN										
IN	INCH	MFCIPR	MEMBRANE FILTRATION CLEAN IN PLACE RETURN	P	PNEUMATIC, PILOT LIGHT	RGS	RIGID GALVANIZED STEEL										
INSUL	INSULATION	MFCIPS	MEMBRANE FILTRATION CLEAN IN PLACE SUPPLY	PA	PLANTING AREA	RHF	RESIDUALS HANDLING FACILITY										
INT	INTERIOR, INTERNAL, INTERMEDIATE	MFF	MEMBRANE FILTRATION FACILITY	PAH	PRESSURE ALARM HIGH	RIO	REMOTE I/O UNIT										
INV	INVERT	MFR	MANUFACTURER	PB	PULL BOX, PRECAST BUILDING	RM	ROOM										
IP	INTERNET PROTOCOL	MG	MILLION GALLONS	P&ID	PROCESS AND INSTRUMENTATION DIAGRAM	RM-X	REMOTE MULTIPLEXING MODULE NO.X										
IRRIG	IRRIGATION	MGD	MILLION GALLONS PER DAY	PC	POINT OF CURVATURE, PLUMBING CODE	RO	ROUGH OPENING, REVERSE OSMOSIS										
IU	INTAKE UNIT	MG/L	MILLIGRAM PER LITER	PCB	POWER CIRCUIT BREAKER	ROC	REVERSE OSMOSIS CONCENTRATE										
		MH	MANHOLE	PCV	PRESSURE CONTROL VALVE	ROF	REVERSE OSMOSIS FEED, REVERSE OSMOSIS FACILITY										
	J	MIC	MANUFACTURER'S INTERCONNECTING CABLE	PCM	PROCESS CONTROL MODULE	ROFL	REVERSE OSMOSIS FLUSH										
JB	JUNCTION BOX	MIN	MINIMUM, MINUTE	PD	PROCESS DRAIN, PLANT DRAIN PUMP STATION	ROP	REVERSE OSMOSIS PERMEATE										
JAN	JANITOR	MISC	MISCELLANEOUS	PE	PRESSURE ELEMENT, PRIMARY EFFLUENT	ROPW	REVERSE OSMOSIS PERMEATE WASTE										
J1	POWER INDICATOR	MITA	MEMBRANE INTEGRITY TEST AIR	PEA	ANIONIC POLYMER	ROW	RIGHT OF WAY										
JIT	POWER INDICATOR TRANSMITTER	MIX	MIXER	PEN	NONIONIC POLYMER	RPM	REVOLUTIONS PER MINUTE										
JT	JOINT	MJ	MECHANICAL JOINT	PF	POWER FACTOR	RS	RIGID STEEL, REFRIGERANT SUCTION										
		MJ/CM2	MILLIJOULES PER SQUARE CENTIMETER	PFM	PREFORMED MONOCHLORAMINE	RSHGC	RELATIVE SOLAR HEAT GAIN COEFFICIENT										
	K	MM	MILLIMETER	PFR	POWER FAIL RELAY	RSP	ROCK SLOPE PROTECTION										
K	KEY OPERATED	MO	MASONRY OPENING	PG	PRESSURE GAUGE	RST	REINFORCING STEEL										
KA	KILOAMPERES	MPM	METERING PUMP	PH	PHASE	RT	RIGHT										
KAIC	KILOAMPERES INTERRUPTING CAPACITY	MPOE	MAIN POINT OF ENTRY	pH	HYDROGEN ION CONCENTRATION	RTU	ROOF TOP UNIT, REMOTE TELEMETRY UNIT										
KM	KEYBOARD MOUSE	MPR	MOTOR PROTECTION RELAY	PI	PRESSURE INDICATOR, POINT OF INTERSECTION	RVNR	REDUCED VOLTAGE NON-REVERSING										
KV	KILOVOLTS	MPS	METERING PUMP SKID	PIT	PRESSURE INDICATOR TRANSMITTER	RVR	REDUCED VOLTAGE REVERSING										
KVA	KILOVOLTS AMPERES	MRCT	MULTI RADIO CURRENT TRANSFORMER	PITO	POINT OF INTERSECTION TURNOUT	RW	RAW WATER										
KVM	KEYBOARD VIDEO MOUSE	MS	MOP SINK, MOTOR STARTER, MAGNETIC STARTER	PIV	POST INDICATOR VALVE	RWPS	RAW WATER PUMP STATION										
KW	KILOWATT	MSB	MAIN SWITCHBOARD	PJF	PREFORMED JOINT FILLER												
		MSC	MANUFACTURER SUPPLIED CABLE	PL	PROPERTY LINE, PLATE		S										
	L	MS/CM	MILLISIEMENS PER CENTIMETER	PLAM	PLASTIC LAMINATE	S	SOUTH, SLOPE										
L	LENGTH	MTD	MOUNTED	PLC	PROGRAMMABLE LOGIC CONTROLLER	SA	SULFURIC ACID, SUPPLY AIR, SURGE ARRESTOR										
LA	LEVEL ALARM	MTS	MANUAL TRANSFER SWITCH	PM	POWER MONITOR	SAM	SAMPLE										
LAH	LEVEL ALARM HIGH	MUTCD	MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES	PMP	PUMP	SBC	SAND BALLASTED CLARIFICATION										
LAHH	LEVEL ALARM HIGH HIGH	MV	MEDIUM VOLTAGE	PNL	PANEL	SBS	SODIUM BISULFITE										
LAL	LEVEL ALARM LOW	MVA	MEGA-VOLT AMPERES	PO4	PHOSPHATE	SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION										

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REVISIONS			Description	Approved
Number	Date	Initials		

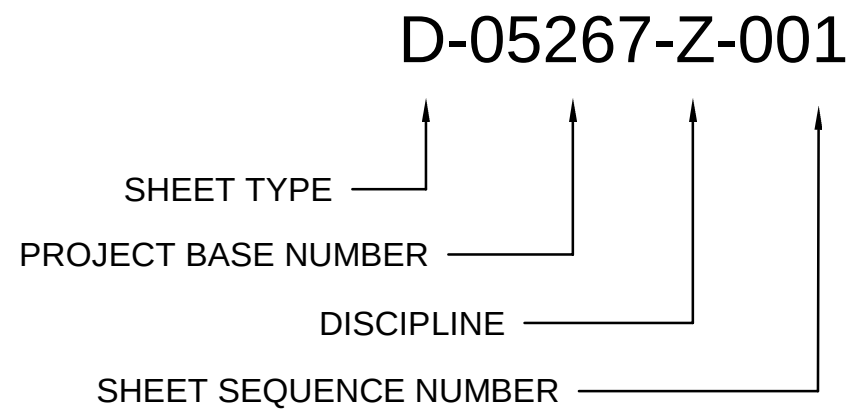
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		Stamp	RSTEGER	09/02/2026	As to Operation		
		Drawn By	SGRIEBEL	09/02/2026			
		Checked By	RSTEGER	09/02/2026	As to Distribution		
		Last Update	SGRIEBEL	09/02/2026			
					Senior Assistant GM of Water		
		File Name	BPS BORDER.DWG				

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
ABBREVIATIONS 2

DEPARTMENT OF WATER AND POWER
CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-Z-011

SHEET IDENTIFICATION



ENLARGED PLAN IDENTIFICATION

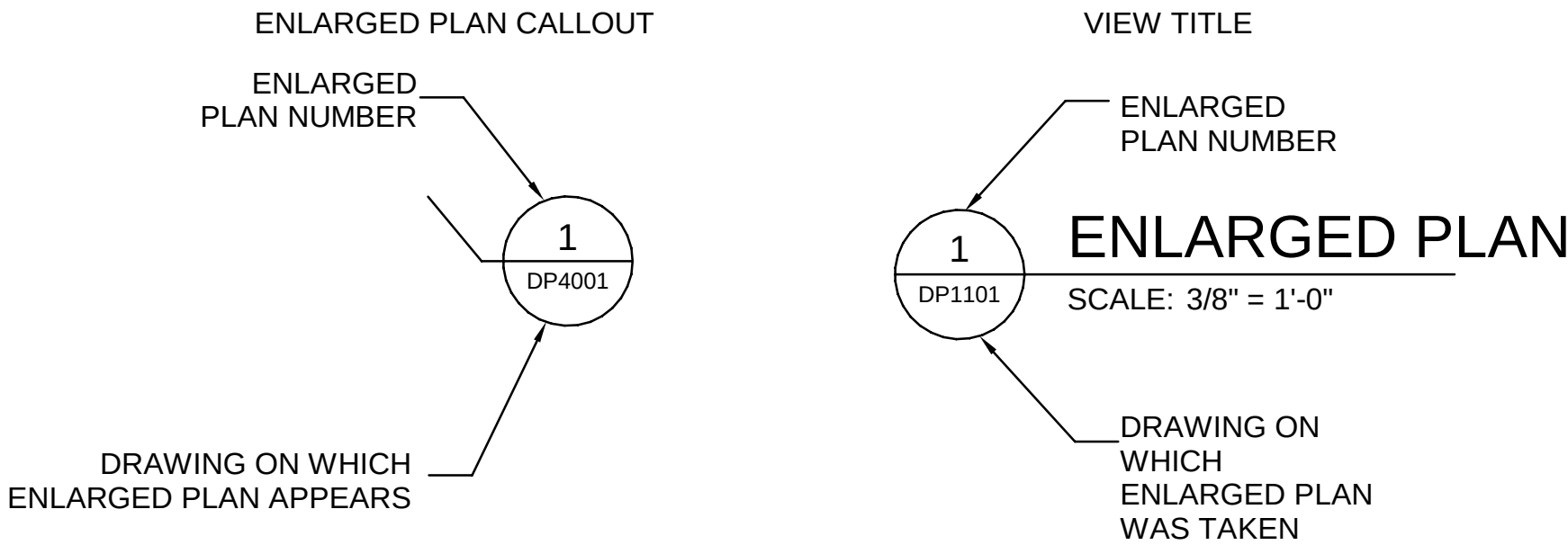
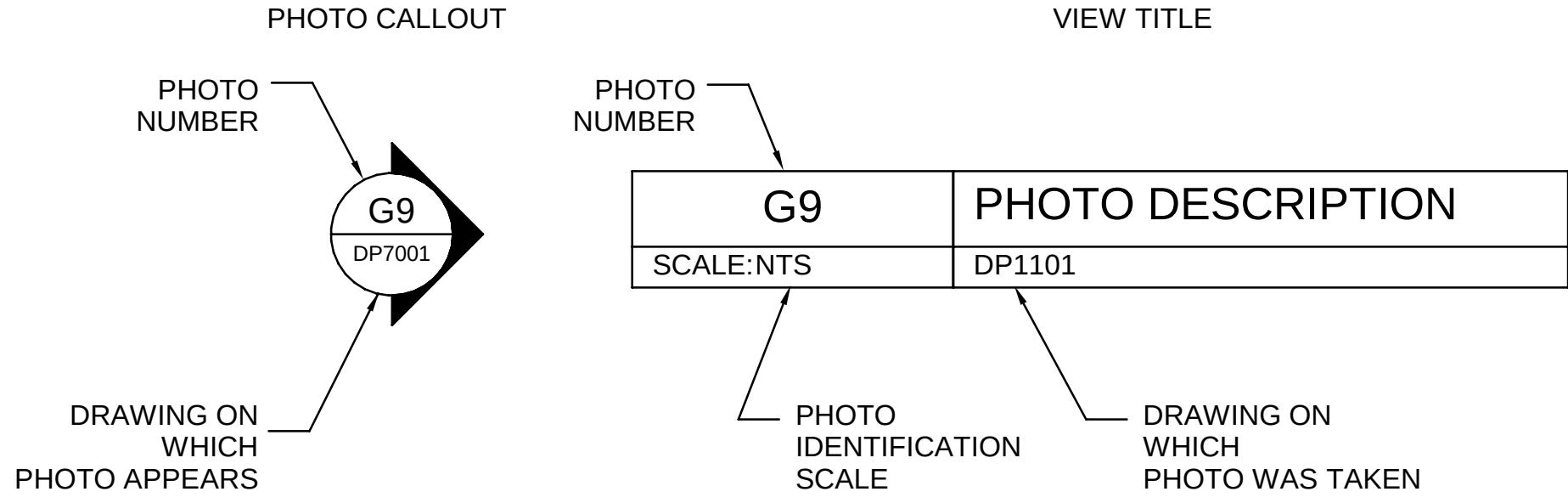
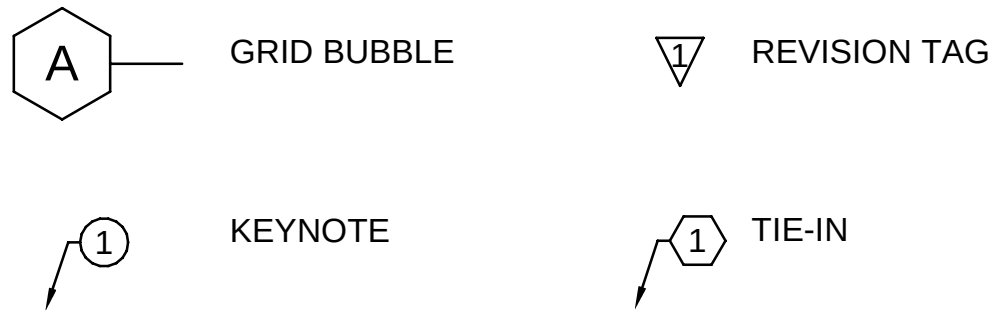


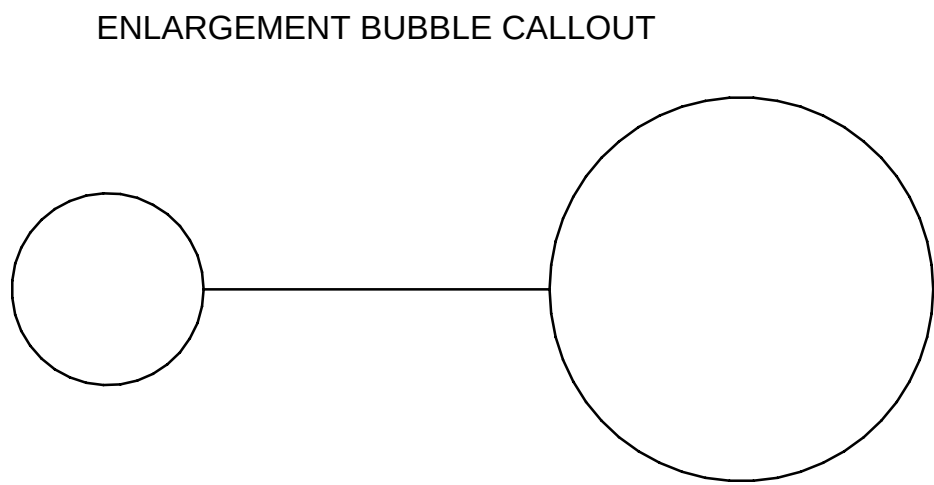
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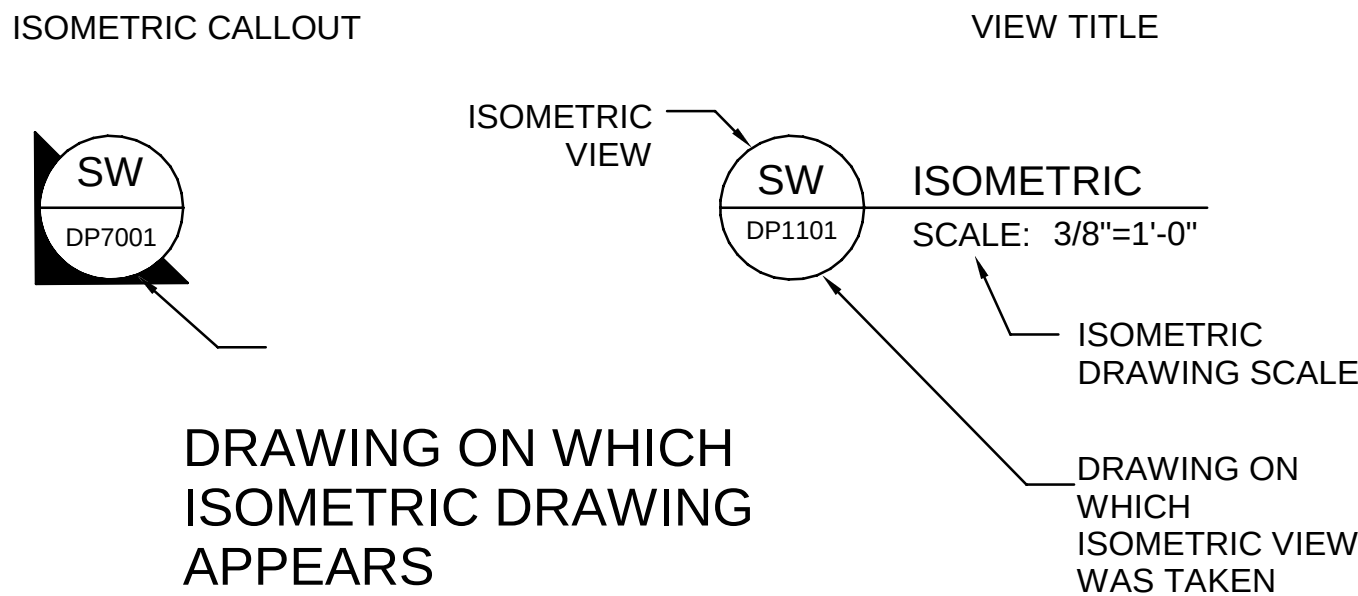
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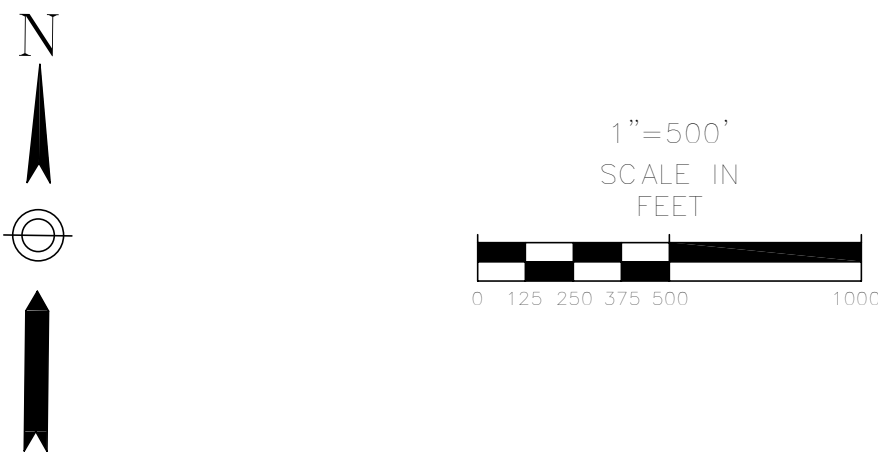
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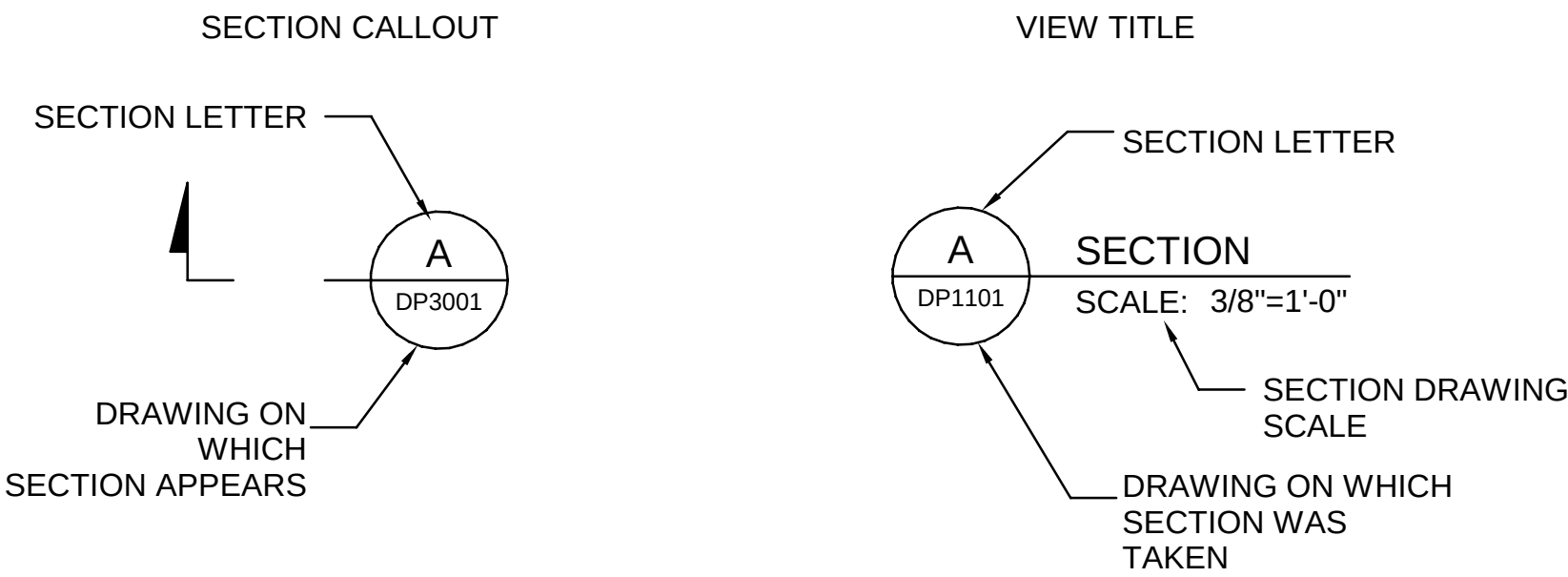
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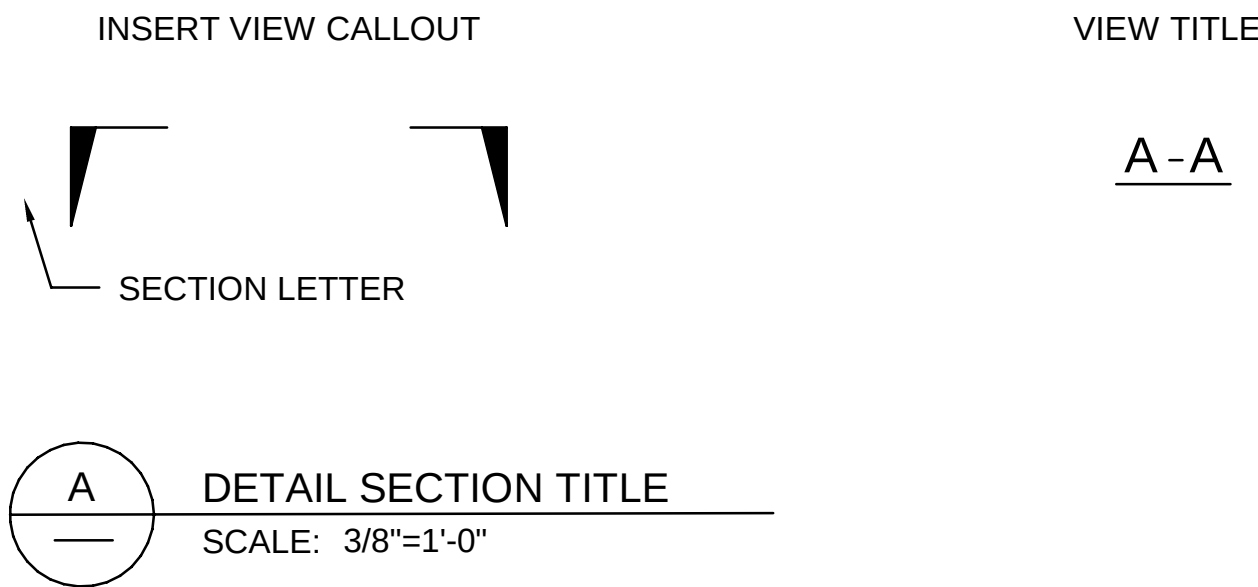
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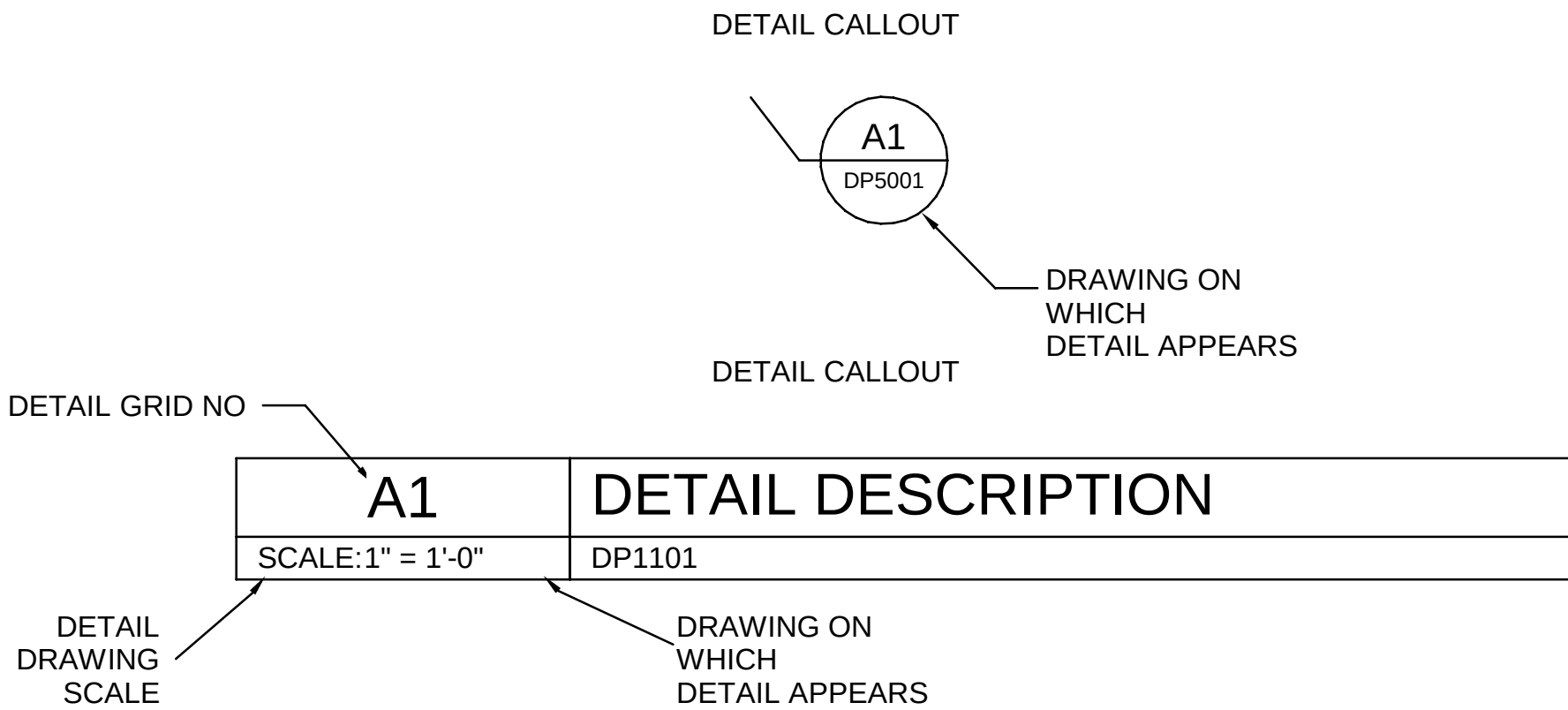
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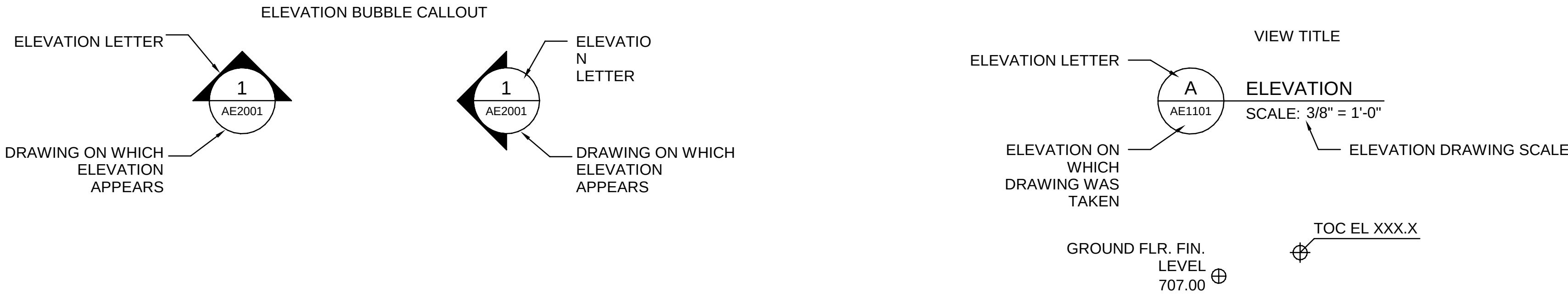
INSERT-VIEW IDENTIFICATION



DETAIL VIEW IDENTIFICATION



ELEVATION IDENTIFICATION



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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES		Scale	AS SHOWN	DATE	APPROVED	DATE
	Designer	SGRIEBEL		09/02/2026	As to Design	
	Stamp	RSTEGER		09/02/2026	As to Operation	
	Drawn By	SGRIEBEL		09/02/2026		
	Checked By	RSTEGER		09/02/2026	As to Distribution	
	Last Update	SGRIEBEL		09/02/2026		
					Senior Assistant GM of Water	
File Name	BPS BORDER.DWG	Recommended				

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
LEGEND

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-Z-025

GENERAL

1. DETAILS NOTED AS "TYPICAL" OR "TYP" SHALL APPLY IN ALL CASES WHETHER OR NOT THEY ARE SPECIFICALLY REFERENCED ON INDIVIDUAL PLANS, DETAILS OR SECTIONS.
2. ALL DESIGN, CONSTRUCTION, AND MATERIALS SHALL COMPLY WITH THE FOLLOWING BUILDING AND DESIGN CODES:

A. CALIFORNIA BUILDING CODE (CBC), 2025

B. CITY OF LOS ANGELES BUILDING CODE, (LABC) 2026

C. ASCE 7, MINIMUM DESIGN LOADS AND ASSOCIATED CRITERIA FOR BUILDINGS AND OTHER STRUCTURES, 2022

D. ACI 318, BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE, 2019

E. ACI 350, CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE, 2020

F. AISC 341, SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS, 2022

G. AISC 360, SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, 2022
3. STRUCTURAL PLANS SHOW APPROXIMATE LOCATION OF MECHANICAL, ELECTRICAL, AND OTHER EQUIPMENT, AS WELL AS RELATED AUXILIARY FRAMING. THE FINAL POSITIONING OF THESE ITEMS IS DEPENDENT ON THE EQUIPMENT SELECTED.
4. MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES, AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS, SHALL BE PROVIDED FOR BY THE CONTRACTOR PRIOR TO PLACING CONCRETE.

DEMOLITION

1. NOTIFY UNDERGROUND SERVICES ALERT, (800) 422-4133, AT LEAST 48 HOURS PRIOR TO COMMENCING WITH DEMOLITION OR DIGGING. DEMOLITION MAY BEGIN ONLY AFTER A SERVICE ALERT LOCATOR HAS PHYSICALLY MARKED OR STAKED UNDERGROUND SERVICES IN THE AREAS OF WORK.

LOADING CRITERIA:

1. BUILDING DESIGN IS BASED ON THE FOLLOWING DESIGN SEISMIC PARAMETERS:

SEISMIC DESIGN CATEGORY: E

SITE CLASS: D

S1: 0.86g

S_s: 2.6g

SMS: 2.57g

SM1: 1.91g

SDS: 1.72g

SD1: 1.27g

PGA: 0.98g

RISK CATEGORY IV

IMPORTANCE FACTOR = 1.5

2. BUILDING WIND DESIGN IS BASED ON THE FOLLOWING FORCES:

INTERNAL PRESSURE COEFFICIENT - GC_{pi} = +/- 0.18 (ENCLOSED BUILDING)

BASIC WIND SPEED (3 SEC GUST) - 101 MPH; NOMINAL WIND SPEED

WIND EXPOSURE C

STEEL FRAMING:

1. STEEL FRAMING SHALL BE IN ACCORDANCE WITH LENGTHS, DEPTH, AND MATERIALS INDICATED ON THESE DRAWINGS. DETAILED FRAMING FABRICATION DRAWINGS SHALL BE OBTAINED BY THE CONTRACTOR.

WELDING

1. WELDS SHALL CONFORM TO AMERICAN WELDING SOCIETY (AWS):

D1.6, STRUCTURAL WELDING CODE STAINLESS STEEL
2. REPAIR WELDS FOUND DEFECTIVE IN ACCORDANCE WITH AWS D1.1 SECTION 5.26.
3. USE INTERMITTENT WELDS AT FIELD WELDS OF EMBED PLATES AND ANGLES TO AVOID SPALLING OR CRACKING OF THE EXISTING CONCRETE.
4. BUTT JOINT WELDS SHALL BE COMPLETE JOINT PENETRATION (CJP) UNLESS INDICATED OTHERWISE.

REINFORCED CONCRETE CONSTRUCTION:

1. ALL CONCRETE CONSTRUCTION SHALL CONFORM TO THE REQUIREMENTS OF 2026 LABC AND AS NOTED ON THE DRAWINGS.
2. ALL STRUCTURAL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS OF 5000 PSI USING ASTM C150 TYPE II CEMENT.
3. REINFORCING STEEL:

TYPICAL: ASTM A615, GRADE 60
4. FABRICATION AND PLACEMENT OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH CRSI MSP-1 "MANUAL OF STANDARD PRACTICE" AND ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE".
5. REINFORCING STEEL SHALL HAVE THE FOLLOWING CONCRETE COVERAGE EXCEPT AS OTHERWISE NOTED:

PLACED AGAINST EARTH..... 3 INCHES

EXPOSED TO EARTH OR WEATHER... 2 INCHES

ALL OTHER..... 2 INCHES
6. 90 DEGREE BENDS, UNLESS OTHERWISE SHOWN, SHALL BE ACI 318 STANDARD HOOKS.
7. PROVIDE 3/4" CHAMFER ON ALL EXPOSED CONCRETE EDGES UNLESS NOTED OTHERWISE.
8. ALL DETAILING, FABRICATION, AND PLACING OF REINFORCING BARS, UNLESS OTHERWISE NOTED, SHALL BE IN ACCORDANCE WITH ACI-315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", LATEST EDITION.
9. REINFORCEMENT BENDS AND LAPS, UNLESS OTHERWISE NOTED, SHALL SATISFY THE FOLLOWING MINIMUM REQUIREMENTS:

TENSION DEVELOPMENT LENGTH (L _d), GRADE 60 UNCOATED REINFORCING IN 5,000 PSI NORMAL WEIGHT CONCRETE, UNITS (INCHES)											
BAR SIZE	C-C SPACING (INCHES)	TOP BARS				OTHER BARS					
		COVER (INCHES)				COVER (INCHES)					
		c=0.75	c=1	c=1.5	c=2	c=3	c=0.75	c=1	c=1.5	c=2	c=3
#3	ALL	12	12	12	12	12	12	12	12	12	12
#4	2≤s<4	17	17	17	17	17	13	13	13	13	13
	4≤s<6	17	14	14	14	14	13	12	12	12	12
	6≤s	17	14	14	14	14	13	12	12	12	12
#5	2≤s<4	26	26	26	26	26	20	20	20	20	20
	4≤s<6	25	20	17	17	17	19	16	13	13	13
	6≤s	25	20	17	17	17	19	16	13	13	13
#6	2≤s<4	38	38	38	38	38	29	29	29	29	29
	4≤s<6	34	28	20	20	20	26	21	16	16	16
	6≤s	34	28	20	20	20	26	21	16	16	16
#7	2≤s<4	64	64	64	64	64	49	49	49	49	49
	4≤s<6	54	45	33	32	32	42	34	26	25	25
	6≤s	54	45	33	29	29	42	34	26	23	23
#8	2≤s<4	83	83	83	83	83	64	64	64	64	64
	4≤s<6	67	56	42	42	42	51	43	32	32	32
	6≤s	67	56	42	34	34	51	43	32	26	26
#9	2≤s<4	106	106	106	106	106	81	81	81	81	81
	4≤s<6	81	68	53	53	53	62	52	41	41	41
	6≤s	81	68	52	42	38	62	52	40	32	29
#10	2≤s<4	134	134	134	134	134	103	103	103	103	103
	4≤s<6	97	82	67	67	67	75	63	52	52	52
	6≤s	97	82	63	51	45	75	63	49	39	35
#11	2≤s<4	165	165	165	165	165	127	127	127	127	127
	4≤s<6	114	97	83	83	83	87	75	64	64	64
	6≤s	114	97	75	61	55	87	75	58	47	43

NOTES:

1. TOP BARS ARE HORIZONTAL BARS WITH MORE THAN 12 INCHES OF CONCRETE CAST BELOW THE BARS.
2. DEVELOPMENT LENGTHS SHOWN IN SCHEDULE ARE IN INCHES.
3. < MEANS LESS THAN, ≤ MEANS LESS THAN OR EQUAL TO, > MEANS GREATER THAN, ≥ MEANS GREATER THAN OR EQUAL TO.
4. MULTIPLY DEVELOPMENT LENGTHS SHOWN BY 1.33 FOR LIGHTWEIGHT CONCRETE.
5. WHERE 3500 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 7 PERCENT.

TENSION LAP SPLICE LENGTH (L _{sa}), GRADE 60 UNCOATED REINFORCING IN 5,000 PSI NORMAL WEIGHT CONCRETE, UNITS (INCHES)					
BAR SIZE	C-C SPACING (INCHES)	TOP BARS		OTHER BARS	
		COVER (INCHES)		COVER (INCHES)	
		c=2	c=3	c=2	c=3
#3	ALL	13	13	12	12
#4	2≤s<4	22	22	17	17
	4≤s<6	18	18	14	14
	6≤s	18	18	14	14
#5	2≤s<4	34	34	26	26
	4≤s<6	22	22	17	17
	6≤s	22	22	17	17
#6	2≤s<4	49	49	38	38
	4≤s<6	26	26	20	20
	6≤s	26	26	20	20
#7	2≤s<4	83	83	64	64
	4≤s<6	42	42	32	32
	6≤s	38	38	29	29
#8	2≤s<4	108	108	83	83
	4≤s<6	54	54	42	42
	6≤s	44	44	34	34
#9	2≤s<4	137	137	106	106
	4≤s<6	69	69	53	53
	6≤s	54	49	42	38
#10	2≤s<4	174	174	134	134
	4≤s<6	87	87	67	67
	6≤s	66	58	51	45
#11	2≤s<4	214	214	165	165
	4≤s<6	107	107	83	83
	6≤s	80	72	61	55

NOTES:

1. TOP BARS ARE HORIZONTAL BARS WITH MORE THAN 12 INCHES OF CONCRETE CAST BELOW THE BARS.
2. UNLESS NOTED OTHERWISE, ALL TENSION LAP SPLICES SHALL BE CLASS-B.
3. LAP SPLICES SHOWN IN SCHEDULES ARE IN INCHES.
4. < MEANS LESS THAN, ≤ MEANS LESS THAN OR EQUAL TO, > MEANS GREATER THAN, ≥ MEANS GREATER THAN OR EQUAL TO.
5. MULTIPLY LAP SPLICE LENGTHS SHOWN BY 1.33 FOR LIGHTWEIGHT CONCRETE. TABULATED VALUES ARE FOR CLASS-B LAP SPLICES. FOR CLASS A SPLICE, DIVIDE VALUE BY 1.33 WITH A MINIMUM LENGTH OF 12 INCHES.
6. WHERE 3500 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 7 PERCENT.

90%DESIGN

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES		Scale	AS SHOWN	DATE	APPROVED		DATE
		Designer	L SCOGGINS	09/02/2026	As to Design		
		Stamp	L SCOGGINS	09/02/2026	As to Operation		
		Drawn By	K SCHWALK	09/02/2026	As to Distribution		
		Checked By	E WILKINS	09/02/2026			
		Last Update	SGRIEBEL	09/02/2026	Senior Assistant GM of Water		
File Name		BPS BORDER.DWG		Recommended			

GROUNDWATER REPLENISHMENT PROJECT

BALBOA PUMP STATION IMPROVEMENTS

STRUCTURAL GENERAL NOTES

DEPARTMENT OF WATER AND POWER

WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER

D-06100-S-001

FILENAME: Autodesk Docs\\US CA_DBDCTE02_City of LA_Tillman AWEBS_BAL_MD_SB801.rvt
 PLOT DATE/TIME: 8/10/2026 8:03:27 AM

D-06100-S-002

THE FOLLOWING TYPES OF WORK REQUIRE SPECIAL INSPECTION AS DESCRIBED IN LACBC,SECTION 1705. REFER TO THE FOLLOWING VERIFICATION, TESTING AND INSPECTION SCHEDULES.

TABLE E
 CAST-IN-PLACE AND PRE-CAST CONCRETE SPECIAL INSPECTION SCHEDULE (LABC SECTION 1705.3)

FREQUENCY OF INSPECTION			
VERIFICATION AND INSPECTION	REFERENCED STANDARD	CONTINUOUS DURING TASK LISTED	PERIODIC DURING TASK LISTED
1. INSPECT OF REINFORCING STEEL, AND VERIFY PLACEMENT.	ACI 318 CH. 20, 25.2, 25.3, 26.5.1-26.5.3		X
2. INSPECT ANCHORS CAST IN CONCRETE.	ACI 318:17.8.2		X
3. INSPECT ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS. A. ADHESIVE ANCHORS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS. B. MECHANICAL ANCHORS AND ADHESIVE ANCHORS NOT DEFINED IN 4.A.	ACI 318:17.8.2.4 ACI 318:17.8.2	X	
4. VERIFYING USE OF REQUIRED DESIGN MIX.	ACI 318: CH. 19, 26.4.3, 26.4.4		X
5. PRIOR TO CONCRETE PLACEMENT, FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE.	ASTM C172 ASTM C31 ACI 318: 26.4.5, 26.12	X	
6. INSPECT OF CONCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES.	ACI 318: 26.4.5	X	
7. VERIFY MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES.	ACI 318: 26.4.7- 26.4.9		X
8. INSPECT FORMWORK FOR SHAPE, LOCATION, AND DIMENSIONS OF THE CONCRETE BEING FORMED.	ACI 318: 26.10.1(B)		X

DEFERRED SUBMITTALS

THE FOLLOWING DEFERRED SUBMITTAL ITEMS SHALL NOT BE INSTALLED UNTIL THE BUILDING OFFICIAL (LADBS) HAS APPROVE THE DEFERRED SUBMITTAL DOCUMENTS. THE DEFERRED SUBMITTALS SHALL BE IN THE ACCORDANCE WITH THE BUILDING CODE REQUIREMENTS SPECIAL INSPECTION ITEMS SHALL BE NOTED ON THE DEFERRED SUBMITTAL DRAWINGS EVEN IF THEY ARE NOTED ON THE APPROVED PERMIT DRAWINGS.

- EQUIPMENT ANCHORAGE
- PIPE SUPPORTS

ABBREVIATIONS

-A-		-I-		-T-	
AB	ANCHOR BOLT	ID	INSIDE DIAMETER	T	STAIR TREAD
ADJ	ADJUSTABLE	IF	INSIDE FACE	TC	TOP OF CURB
AL,ALUM	ALUMINUM	IN	INCH	TEMP	TEMPERATURE, TEMPORARY
ALT	ALTERNATE (IVE)	INT	INTERIOR, INTERNAL,	THK	THICK (NESS)
APPROX	APPROXIMATE (LY)	INTERMEDIATE		TOC	TOP OF CONCRETE
ARCH	ARCHITECTURAL	INV	INVERT	TPV	THERMOPLASTIC VULCANIZATE
AUTO	AUTOMATIC			TOS	TOP OF STEEL
AVG	AVERAGE	-J-		TYP	TYPICAL
				T & B	TOP AND BOTTOM
-B-		JT	JOINT	TO	TOP OF
BLDG	BUILDING	-L-		-U-	
BLK	BLOCK (ING)				
BLW	BELOW	LADBS	LOS ANGELES DEPARTMENT OF BUILDING AND SAFETY	UNO	UNLESS NOTED OTHERWISE
BM	BEAM			UVAOP	UV ADVANCED OXIDATION PROCESS
BOT	BOTTOM	LB(S)	POUND(S)		
BO	BOTTOM OF	LG	LONG	-V-	
BR CRANE	BRIDGE CRANE	LLV	LONG LEG VERTICAL		
BRBF	BUCKLING RESTRAINED BRACED FRAME	LSV	LONG SIDE VERTICAL	VAR	VARIES
		LP	LOW POINT, LOW PRESSURE	VERT	VERTICAL
-C-		LT	LEFT		
				-W-	
C	CHANNEL	-M-			
CHAM	CHAMFER			W	WIDE FLANGE STEEL BEAM
CHK PL	CHECKERED PLATE	MAT'L	MATERIAL	WP	WATERPROOF (ED) (ING),
CIR	CIRCLE	MAX	MAXIMUM		WORKING POINT
CL	CENTERLINE	MB	MACHINE BOLT	WS	WATERSTOP, WATER SUPPLY,
CIP	CAST IN PLACE	MECH	MECHANICAL		WATER SURFACE
CLJ	CONTROL JOINT	MED	MEDIUM	WT	WEIGHT
CLR	CLEAR (ANCE)	MET	METAL	WWF	WELDED WIRE FABRIC W/ WITH
CLSM	CONTROLLED LOW STRENGTH MATERIAL	MFR	MANUFACTURER		
CMU	CONCRETE MASONRY UNIT	MIN	MINIMUM, MINUTE		
COL	COLUMN	MISC	MISCELLANEOUS		
CONC	CONCRETE				
CONN	CONNECT (ION)	-N-			
CONT	CONTINUOUS, CONTINUATION,CONTINUED				
CONST	CONSTRUCTION	N/A	NOT APPLICABLE		
CONST JT	CONSTRUCTION JOINT	NIC	NOT IN CONTRACT		
CTR	CENTER	NOM	NOMINAL		
C-C	CENTER TO CENTER	NS	NEAR SIDE		
		NTS	NOT TO SCALE		
-D-		-O-			
DET	DETAIL				
DIA	DIAMETER	OC	ON CENTER		
DO	DIDO	OD	OUTSIDE DIAMETER		
DIAG	DIAGRAM, DIAGONAL	OF	OUTSIDE FACE		
DIM	DIM	OPNG	OPENING		
DN	DOWN	OPP	OPPOSITE		
DWG	DRAWING	OPP	HD OPPOSITE HAND		
DWL	DOWEL				
		-P-			
-E-		PJF	PREMOLDED JOINT FILLER		
EA	EACH	PL	PLATE		
EF	EACH FACE	PSI	POUNDS PER SQUARE INCH		
EL	ELEVATION	PSS	PRESSURE SUSTAINING		
ELECT	ELECTRIC (AL)		STATION		
EQ	EQUAL	PT	POINT, POINT OF TANGENCY		
EQUIP	EQUIPMENT	PVC	POLYVINYL CHLORIDE		
ES	EACH SIDE				
EW	EACH WAY	-R-			
EW, EF	EACH WAY, EACH FACE				
EXIST	EXISTING	R	RISER, RADIUS		
EXP	EXPANSION	RCP	REINFORCED CONCRETE PIPE		
EXP BLT	EXPANSION BOLT	RD	ROOF DRAIN, ROAD		
EXP JT	EXPANSION JOINT	RE:	REGARDING		
EXT	EXTERIOR, EXTENSION	REF	REFERENCE		
		REINF	REINFORCE (ING)		
-F-		REQ'D	REQUIRED		
FD	FLOOR DRAIN	RET	RETAINING, RETURN		
FIN	FINISH	RM	ROOM		
FLR	FLOOR	RO	ROUGH OPENING		
FRP	FIBERGLASS REINFORCED PLASTIC	RPM	REVOLUTION PER MINUTE		
FS	FAR SIDE	RT	RIGHT		
FT	FOOT, FEET				
FTG	FOOTING	-S-			
		SCBF	SPECIAL CONCENTRICALLY BRACED FRAME		
-G-			SCHEDULE		
GA	GAGE	SCH	SHEET		
GALV	GALVANIZED	SHT	SIMILAR		
GND	GROUND	SIM			
GRTG	GRATING	SL	SLOPE		
		SLV	SHORT LEG VERTICAL		
-H-		SPEC	SPECIFICATIONS		
		SQ	SQUARE		
HSS	HOLLOW STRUCTURAL SECTION	SS	STAINLESS STEEL		
HDG	HOT DIP GALVANIZED	STD	STANDARD		
HDPE	HIGH-DENSITY POLYETHYLENE	STIF	STIFFENER		
HEX	HEXAGONAL	STL	STEEL		
HORIZ	HORIZONTAL	STRUCT	STRUCTURAL		
HP	HIGH POINT, HORSEPOWER	SUPP	SUPPORT		
HR	HANDRAIL	SYM	SYMMETRICAL		
HT	HEIGHT	SYS	SYSTEM		
HVAC	HEATING, VENTILATING & AIR CONDITIONING				

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REVISIONS			Description	Approved
Number	Date	Initials		

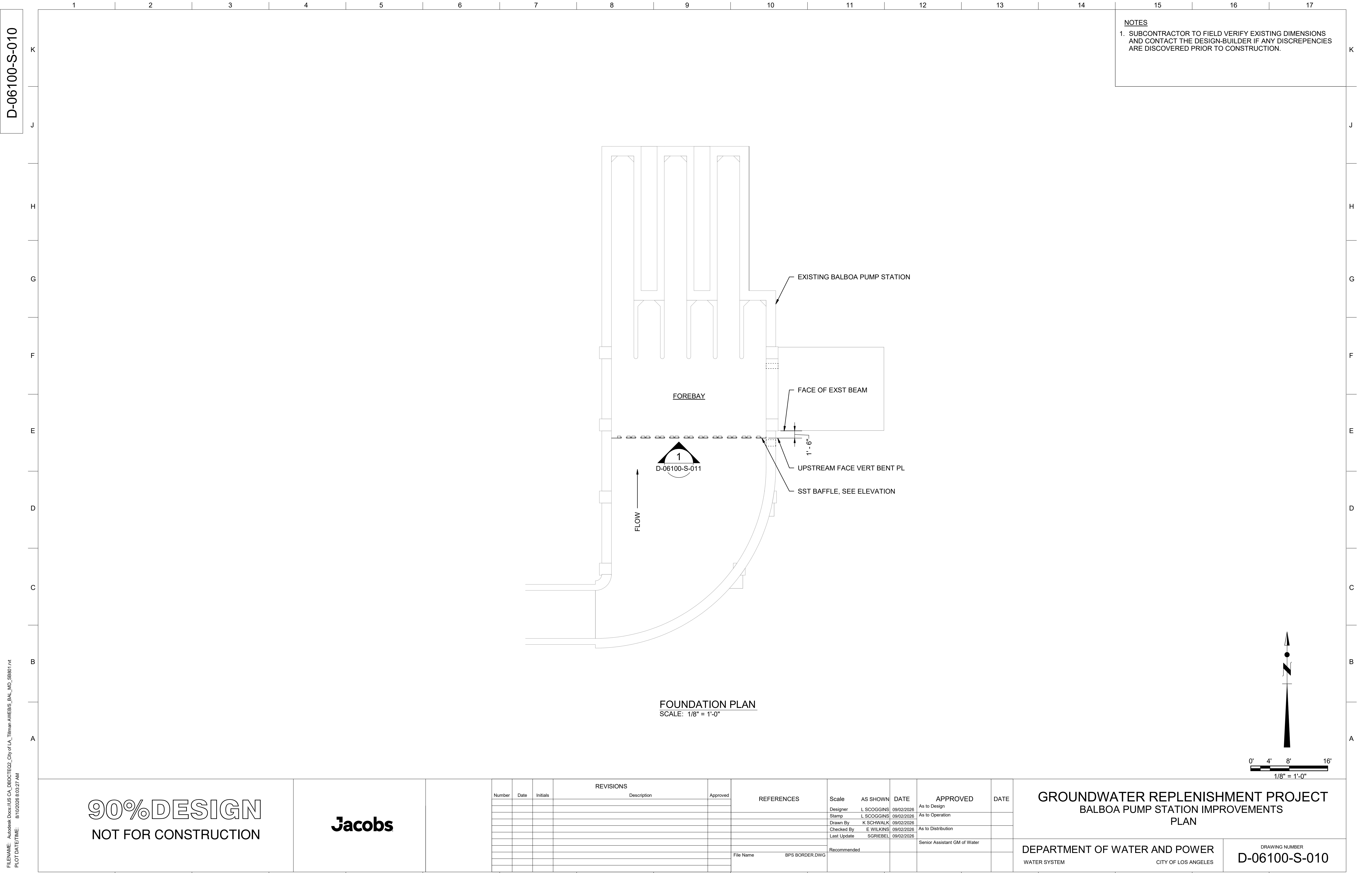
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		Designer	L SCOGGINS	09/02/2026	As to Operation		
		Stamp	L SCOGGINS	09/02/2026			
		Drawn By	K SCHWALK	09/02/2026			
		Checked By	E WILKINS	09/02/2026	As to Distribution		
		Last Update	SGRIEBEL	09/02/2026			
					Senior Assistant GM of Water		
		Recommended					
File Name		BPS BORDER.DWG					

GROUNDWATER REPLENISHMENT PROJECT
 BALBOA PUMP STATION IMPROVEMENTS
 SPECIAL INSPECTIONS AND ABBREVIATIONS

DEPARTMENT OF WATER AND POWER
 WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
 D-06100-S-002



NOTES

1. SUBCONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS AND CONTACT THE DESIGN-BUILDER IF ANY DISCREPENCIES ARE DISCOVERED PRIOR TO CONSTRUCTION.

FILENAME: Autodesk Docs\\US CA_DBDCTEC02_City of LA_Tillman A\\WEBS_BA_MD_SB061.rvt
PLOT DATE/TIME: 8/10/2026 8:03:27 AM

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Number	Date	Initials	Description	Approved

REFERENCES		Scale		AS SHOWN	DATE	APPROVED		DATE
		Designer	L. SCOGGINS	09/02/2026	As to Design			
		Stamp	L. SCOGGINS	09/02/2026	As to Operation			
		Drawn By	K. SCHWALK	09/02/2026	As to Distribution			
		Checked By	E. WILKINS	09/02/2026				
		Last Update	SGRIEBEL	09/02/2026				
		Recommended				Senior Assistant GM of Water		
File Name		BPS BORDER.DWG						

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PLAN

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

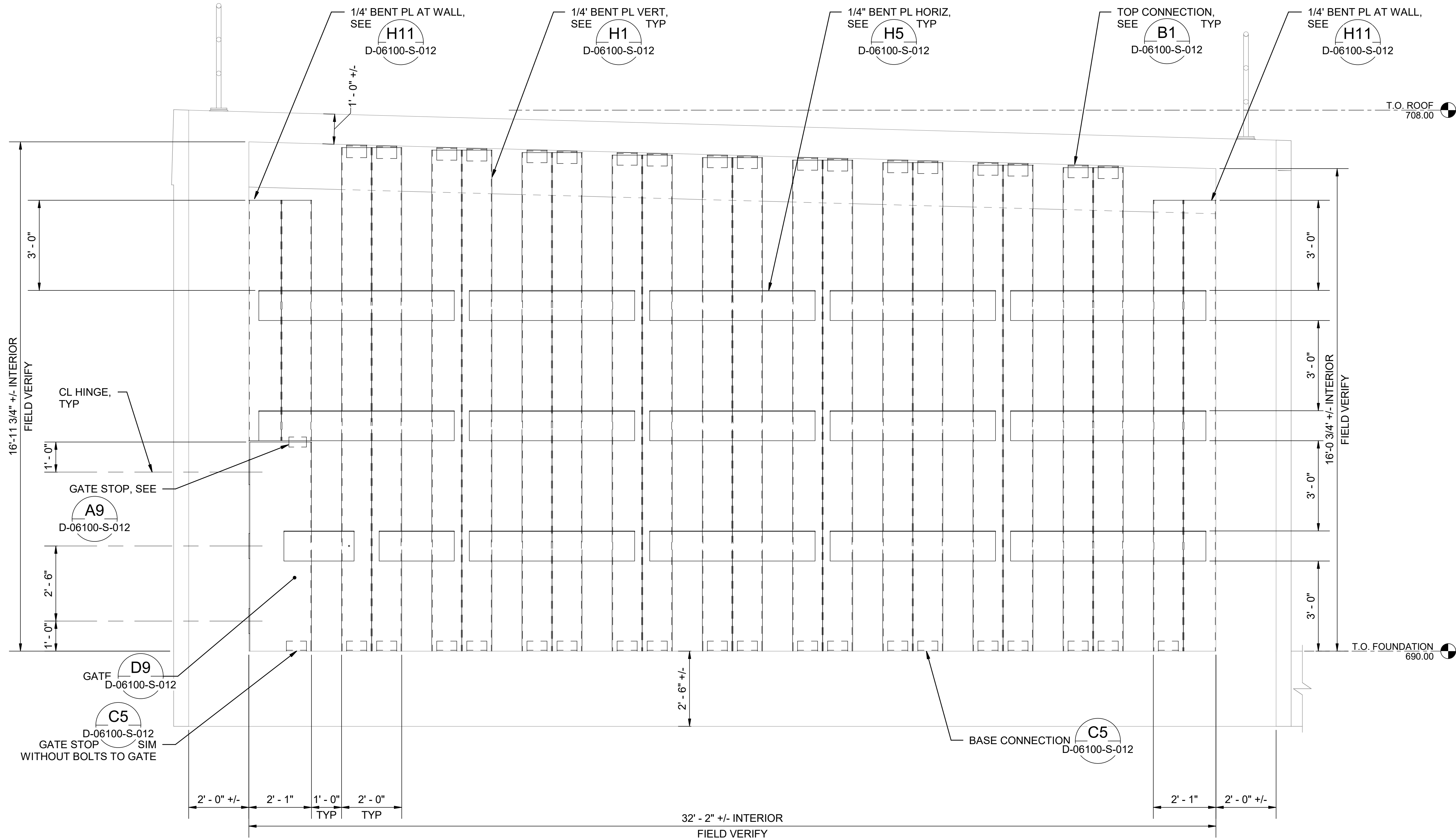
CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-S-010

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PLOT DATE/TIME: 8/10/2026 8:03:28 AM

D-06100-S-011

- NOTES**
- SUBCONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS AND CONTACT THE DESIGN-BUILDER IF ANY DISCREPANCIES ARE DISCOVERED PRIOR TO CONSTRUCTION.
 - SUBCONTRACTOR SHALL SUBMIT THE FOLLOWING FOR REVIEW AND APPROVAL: METAL FABRICATION SHOP DRAWINGS INCLUDING WELDING AND FASTENER INFORMATION.
 - PACKAGE, STORE, AND INSTALL STAINLESS STEEL ITEMS TO PROVIDE PROTECTION FROM CARBON IMPREGNATION.
 - MEET THE FOLLOWING MATERIAL REQUIREMENTS:
 - STAINLESS STEEL PLATE: ASTM A276, AISI TYPE 316 (316L FOR WELDED CONNECTIONS)
 - STAINLESS STEEL BOLTS AND THREADED RODS: ASTM F593, AISI TYPE 316, GROUP 2, CONDITION SH
 - STAINLESS STEEL NUTS: ASTM F594, AISI TYPE 316, CONDITION CW
 - ADHESIVE ANCHORS: HILTI HIT-RE 500 V3 WITH STAINLESS STEEL THREADED RODS



1 ELEVATION
D-06100-S-010 SCALE: 1/2" = 1'-0"

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

File Name BPS BORDER.DWG

Scale AS SHOWN
Designer L SCOGGINS 09/02/2026
Stamp L SCOGGINS 09/02/2026
Drawn By K SCHWALK 09/02/2026
Checked By E WILKINS 09/02/2026
Last Update SGRIEBEL 09/02/2026

Recommended

DATE

As to Design

As to Operation

As to Distribution

Senior Assistant GM of Water

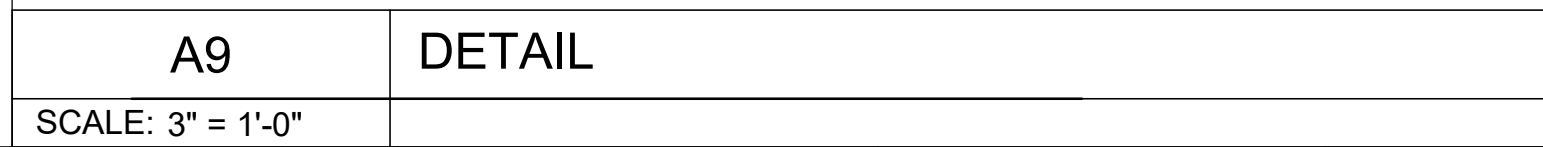
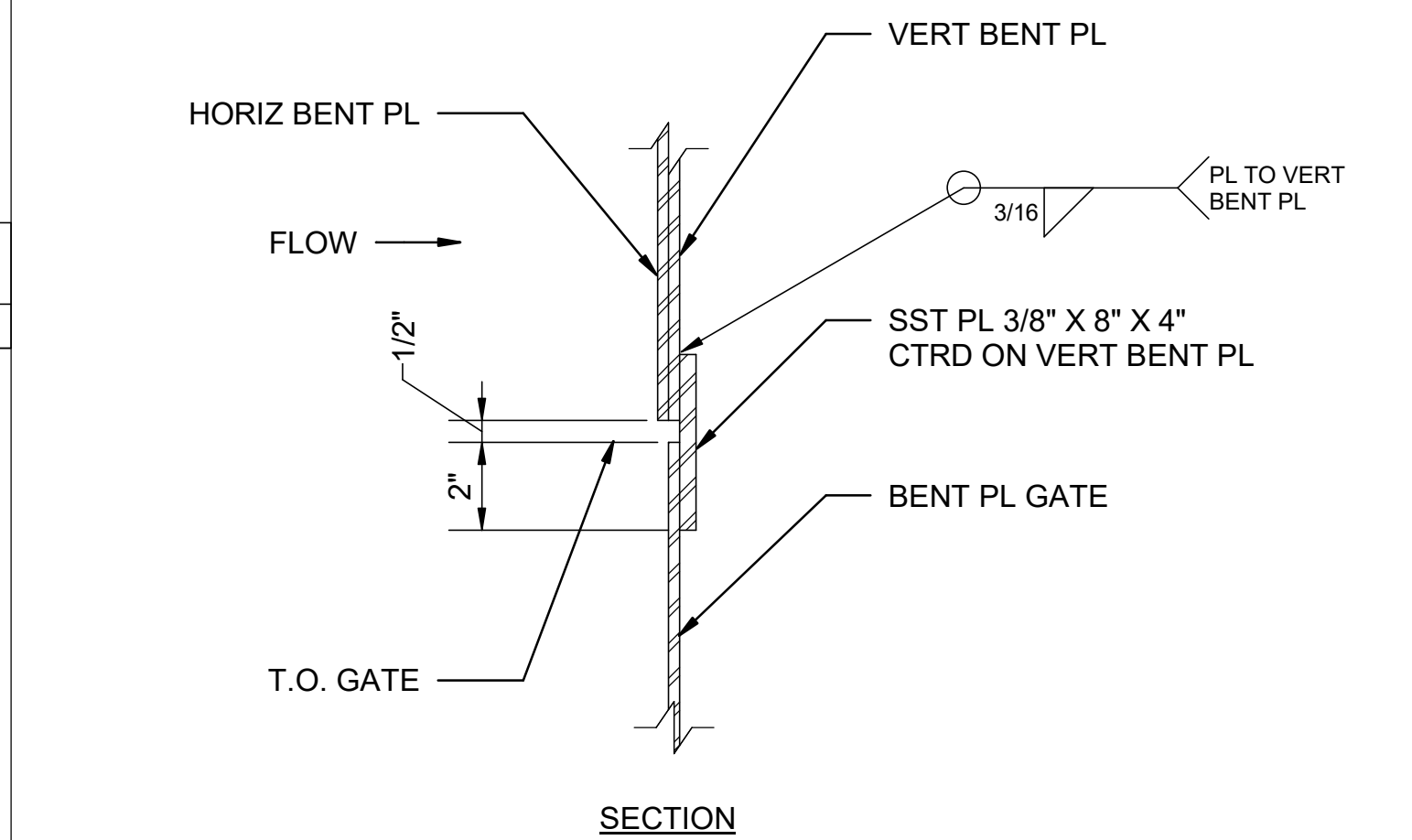
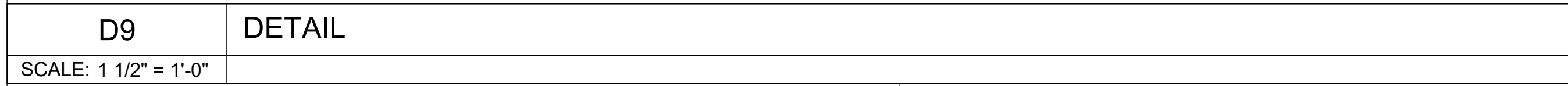
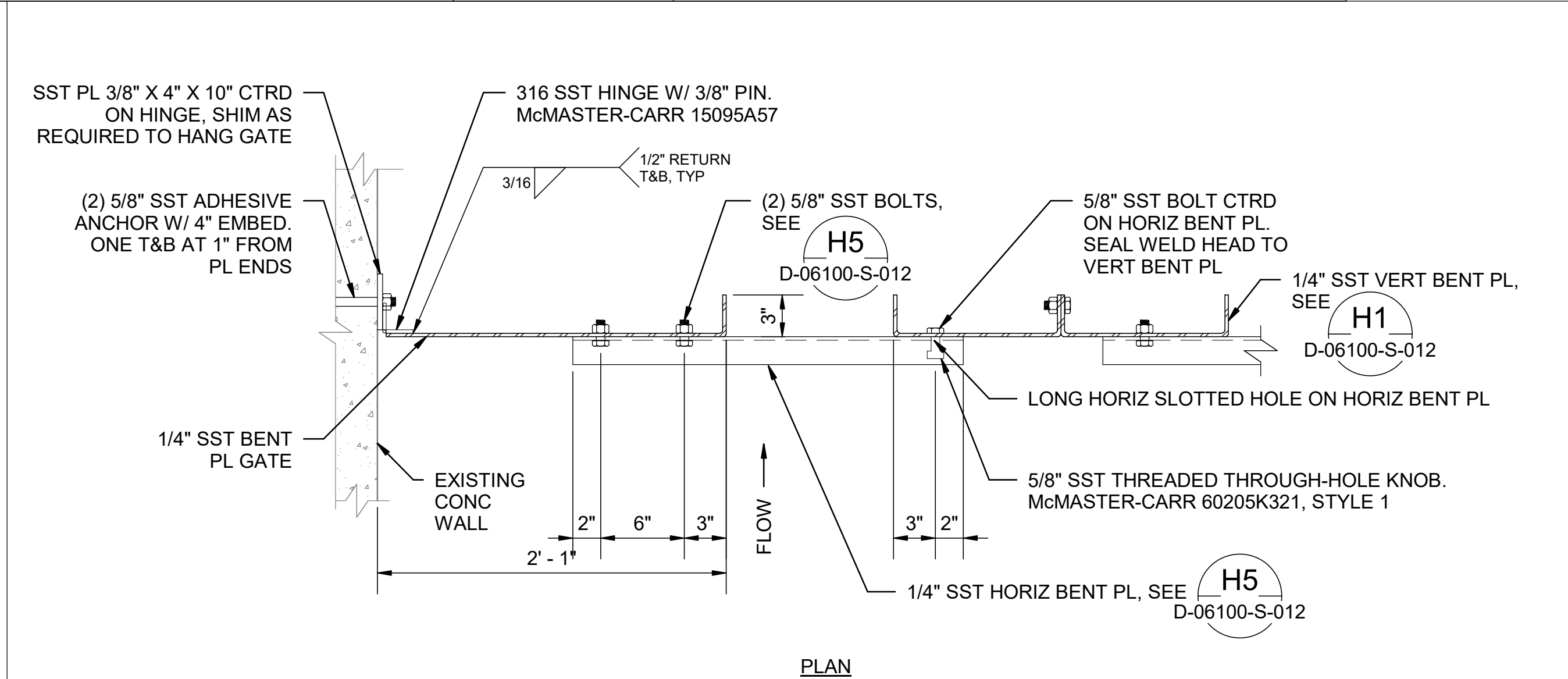
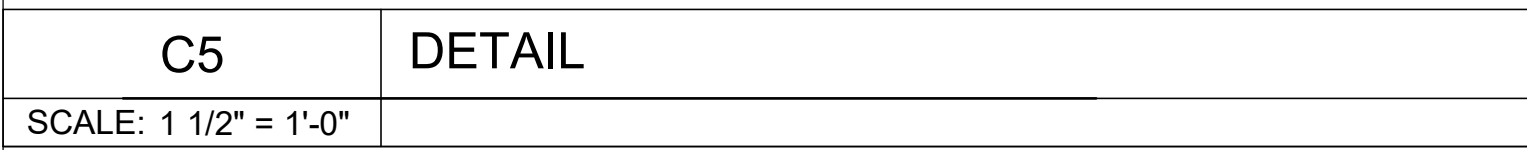
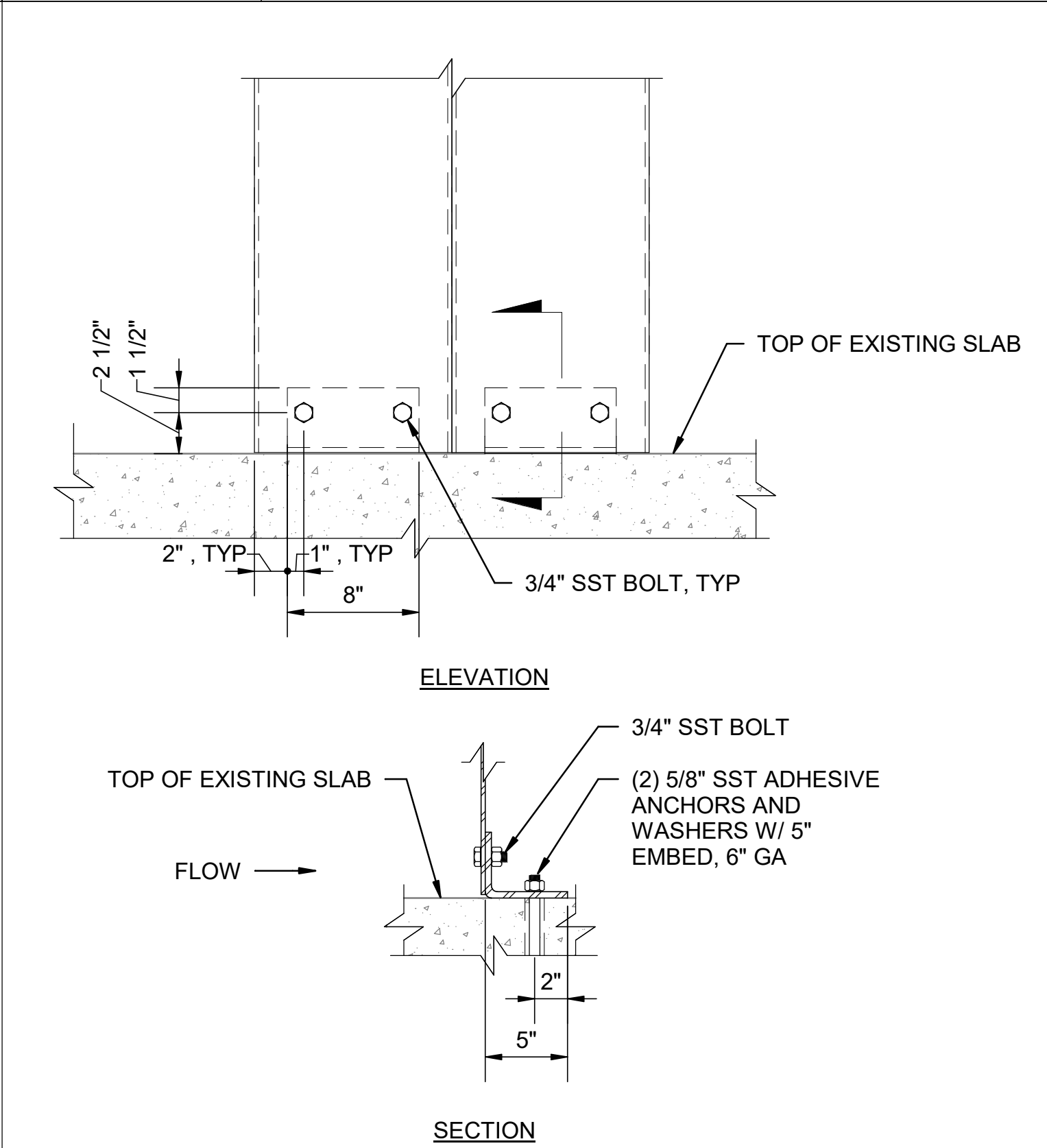
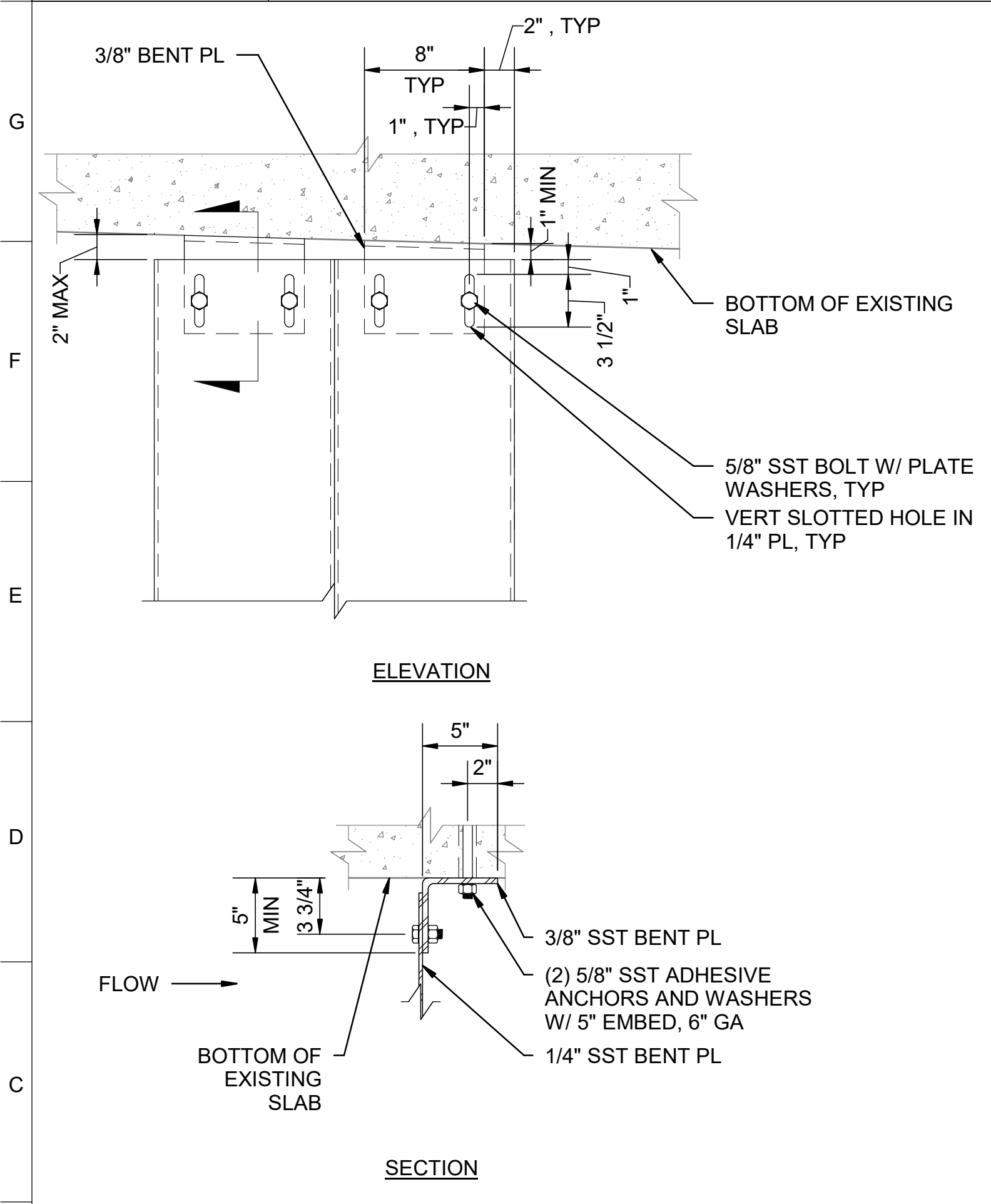
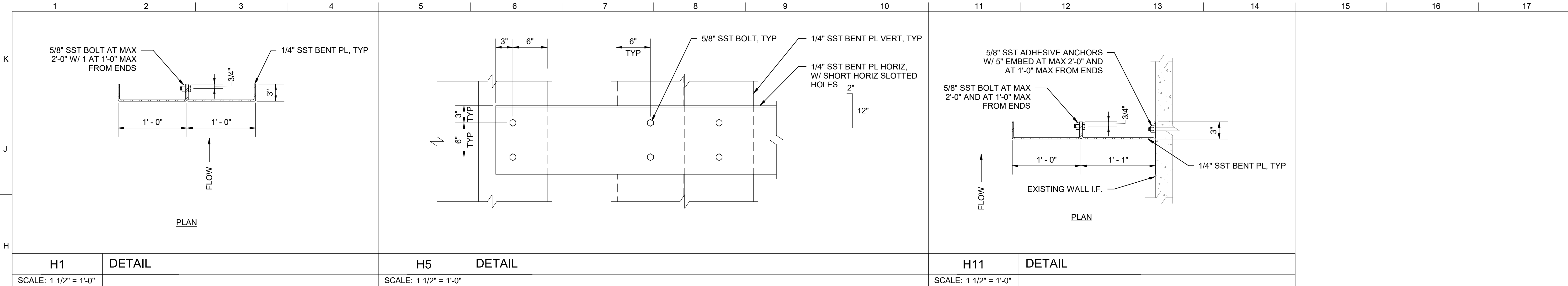
APPROVED

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
ELEVATION

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-S-011

D-06100-S-012



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REFERENCES		Scale		AS SHOWN	DATE	APPROVED		DATE
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Last Update		SGRIEBEL		09/02/2026	As to Distribution			
Recommended					Senior Assistant GM of Water			
File Name		BPS BORDER.DWG						

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
DETAILS

DEPARTMENT OF WATER AND POWER
WATER SYSTEM
CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-S-012

FILENAME: Autodesk Docs\\US CA_DBDCTEC02_City of LA_Tillman AWEBS_BAL_MD_SB801.rvt
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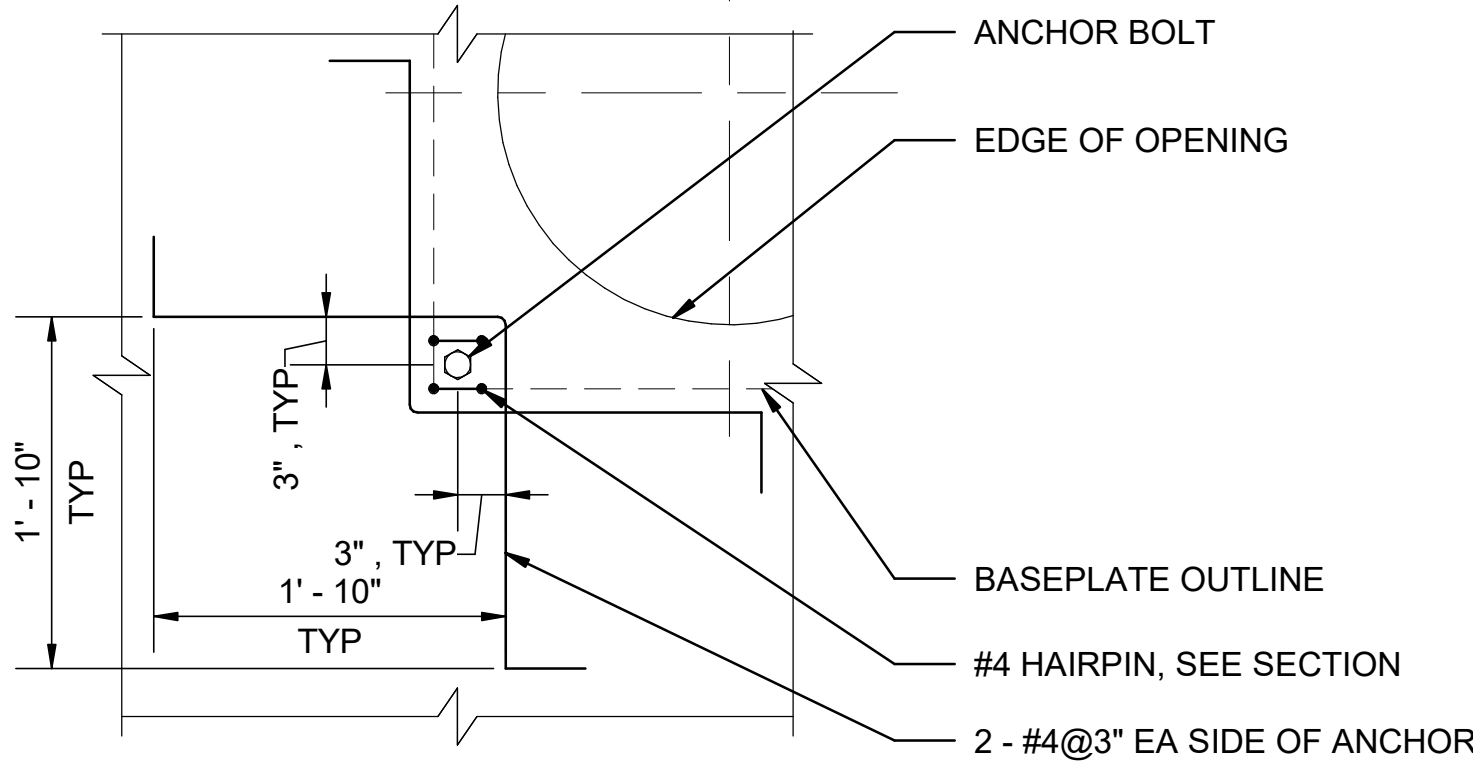
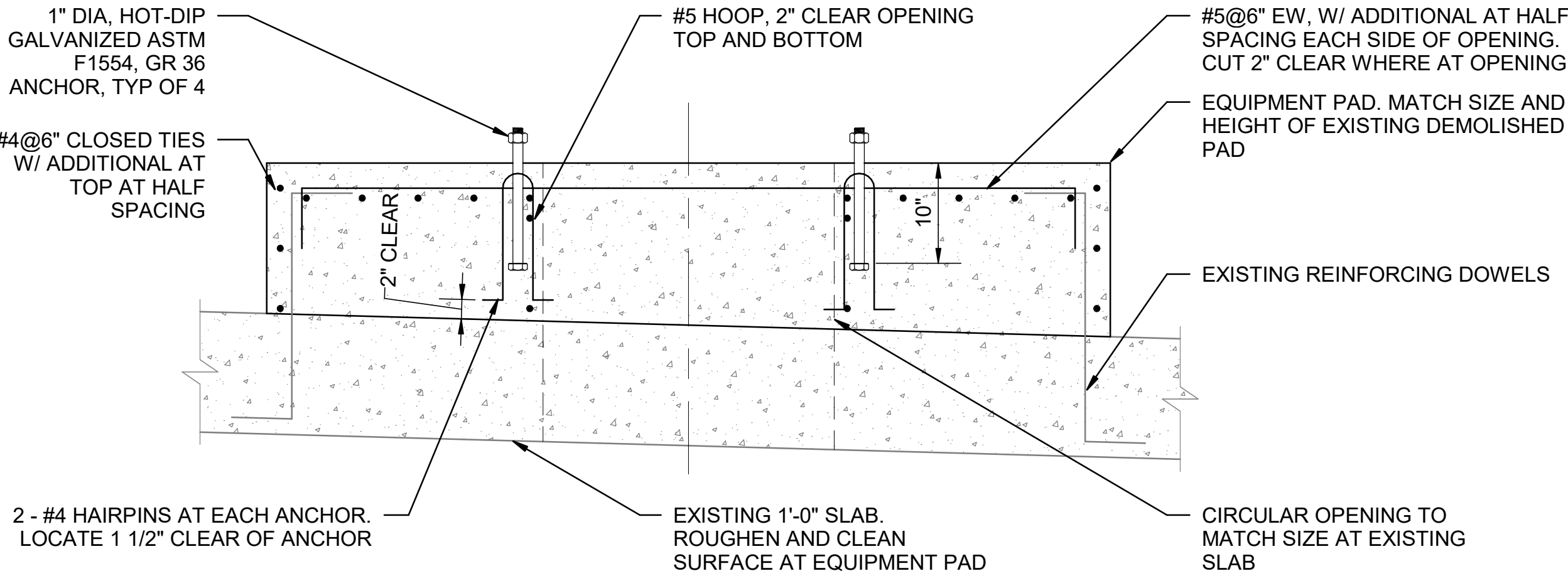
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GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
DETAILS

DEPARTMENT OF WATER AND POWER
WATER SYSTEMCITY OF LOS ANGELES

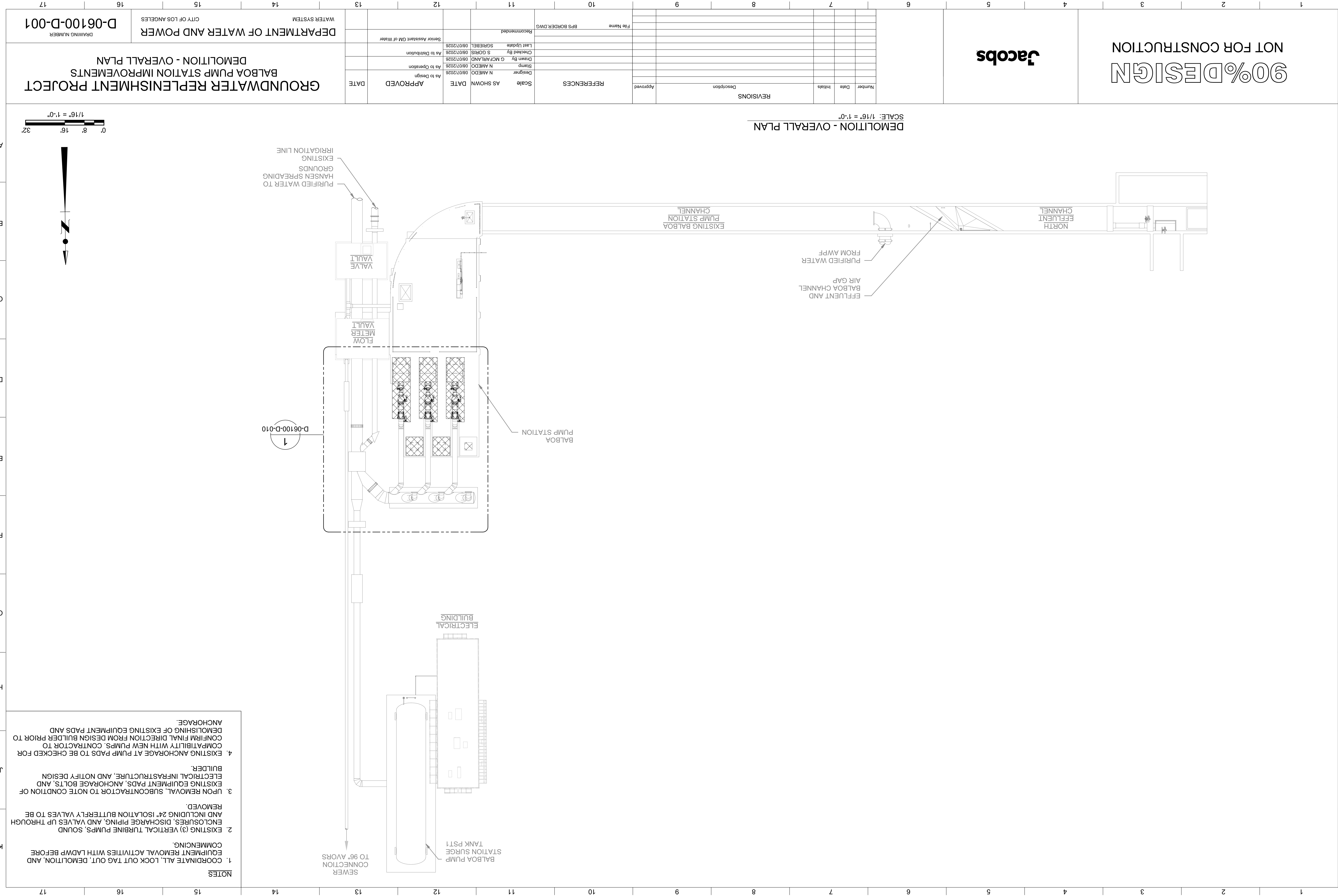
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A11

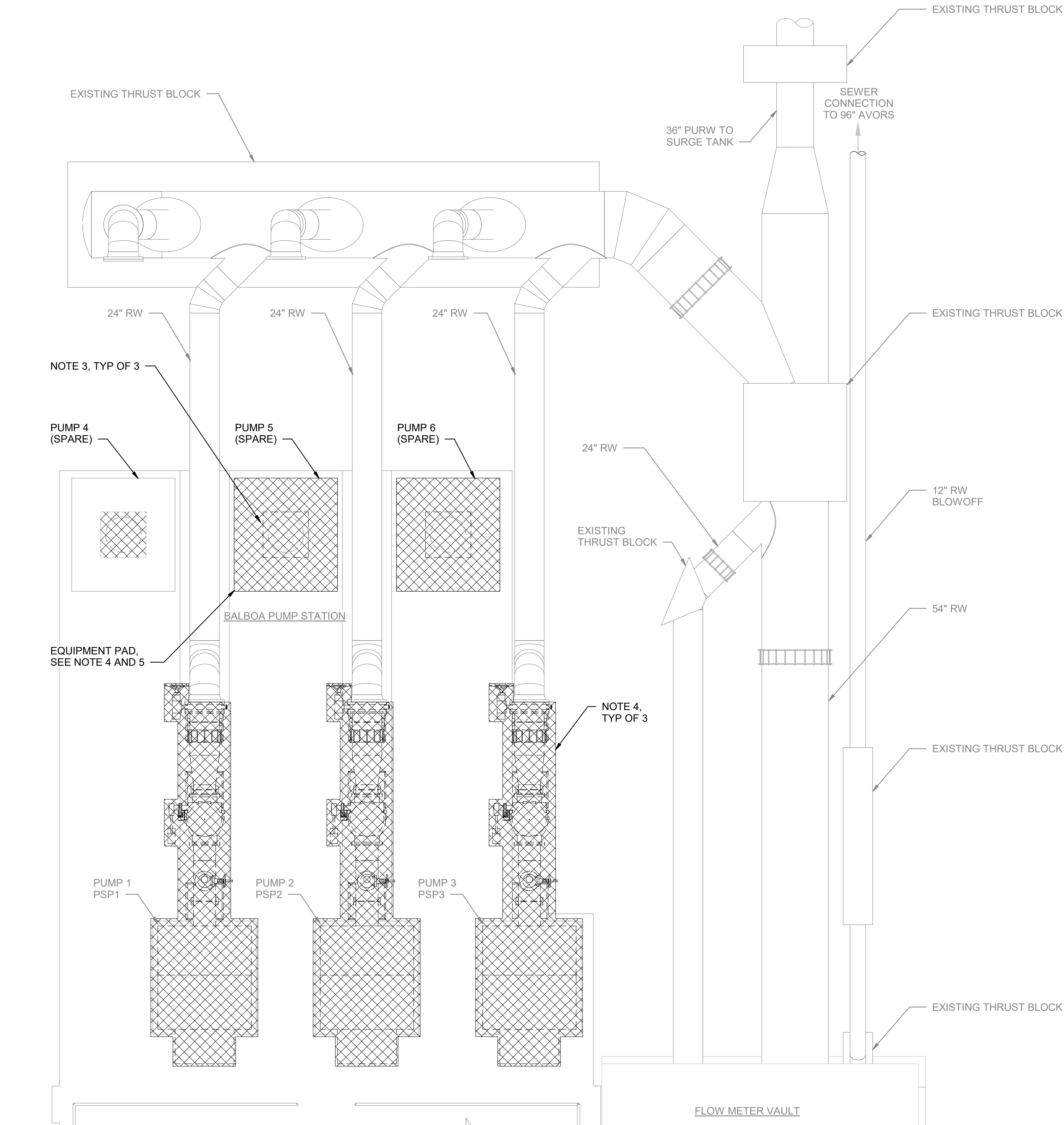
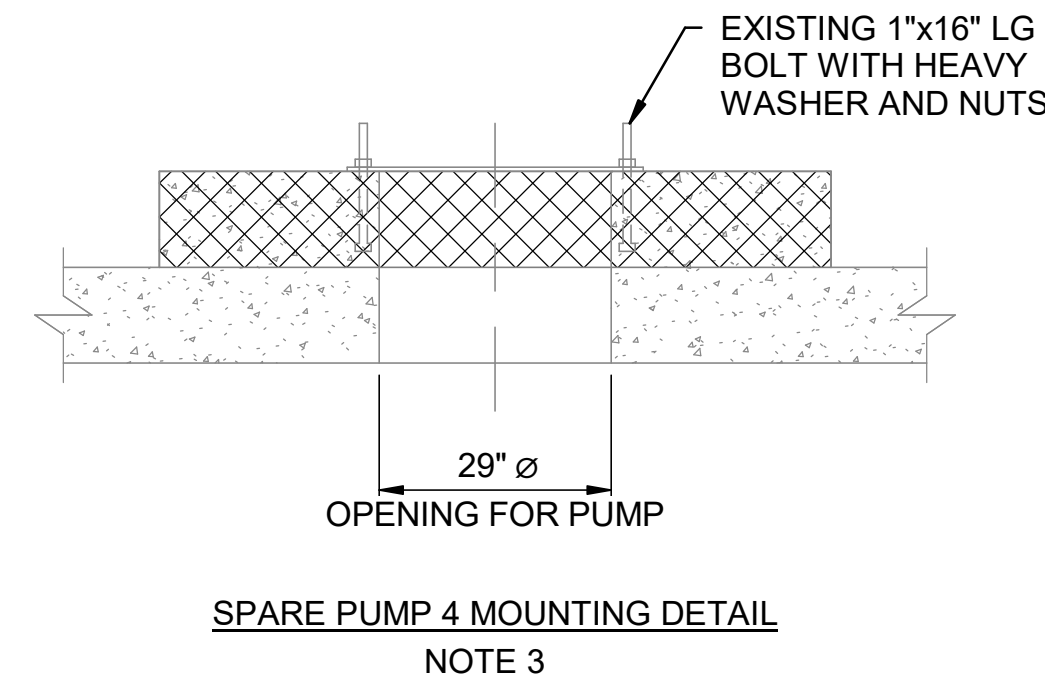
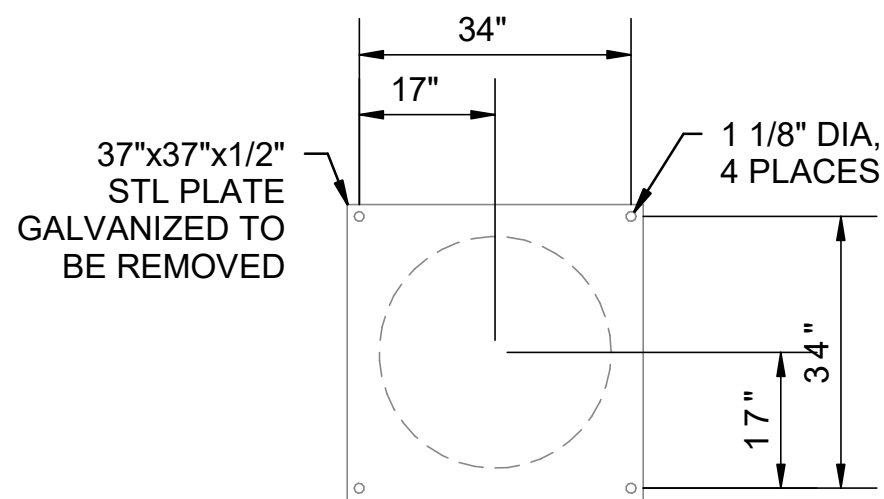
DETAIL

SCALE: 1" = 1'-0"



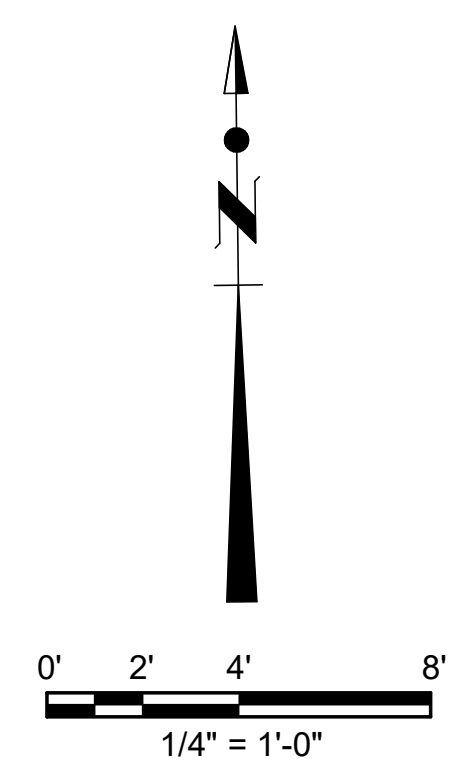
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D-06100-D-010



- NOTES**
- COORDINATE ALL, LOCK OUT TAG OUT, DEMOLITION, AND EQUIPMENT REMOVAL ACTIVITIES WITH LADWP BEFORE COMMENCING.
 - EXISTING (3) VERTICAL TURBINE PUMPS, SOUND ENCLOSURES, DISCHARGE PIPING, AND VALVES UP THROUGH AND INCLUDING 24" ISOLATION BUTTERFLY VALVES TO BE REMOVED.
 - EXISTING SPARE PUMP COVER PLATE TO BE REMOVED, SEE DETAIL.
 - UPON REMOVAL, SUBCONTRACTOR TO NOTE CONDION OF EXISTING EQUIPMENT PADS, ANCHORAGE BOLTS, AND ELECTRICAL INFRASTRUCTURE, AND NOTIFY DESIGN BUILDER. EQUIPMENT PADS AND ANCHORAGE ARE TO BE VERIFIED FOR SUITABILITY FOR REUSE.
 - DEMOLISH CONCRETE EQUIPMENT PADS AND PROTECT IN PLACE, VERTICAL REINFORCING DOWELS AT EQUIPMENT PAD PERIMETER. EQUIPMENT PADS SHALL REMAIN UNTIL THE EXISTING ANCHORAGE AND CONDITIONS HAVE BEEN ASSESSED PER NOTE 4, WHERE IT MAY BE DETERMINED EQUIPMENT PADS CAN BE REUSED IN CURRENT CONDITIONS.

1 DEMOLITION - ENLARGED PLAN
D-06100-D-001 SCALE: 1/4" = 1'-0"



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			Description		

REFERENCES		Scale	AS SHOWN	DATE	APPROVED		DATE
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		Checked By	S GORIS	08/07/2026	As to Distribution		
		Last Update	SGRIEBEL	08/07/2026	Senior Assistant GM of Water		
		Recommended					
File Name		BPS BORDER.DWG					

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
DEMOLITION - ENLARGED PLAN

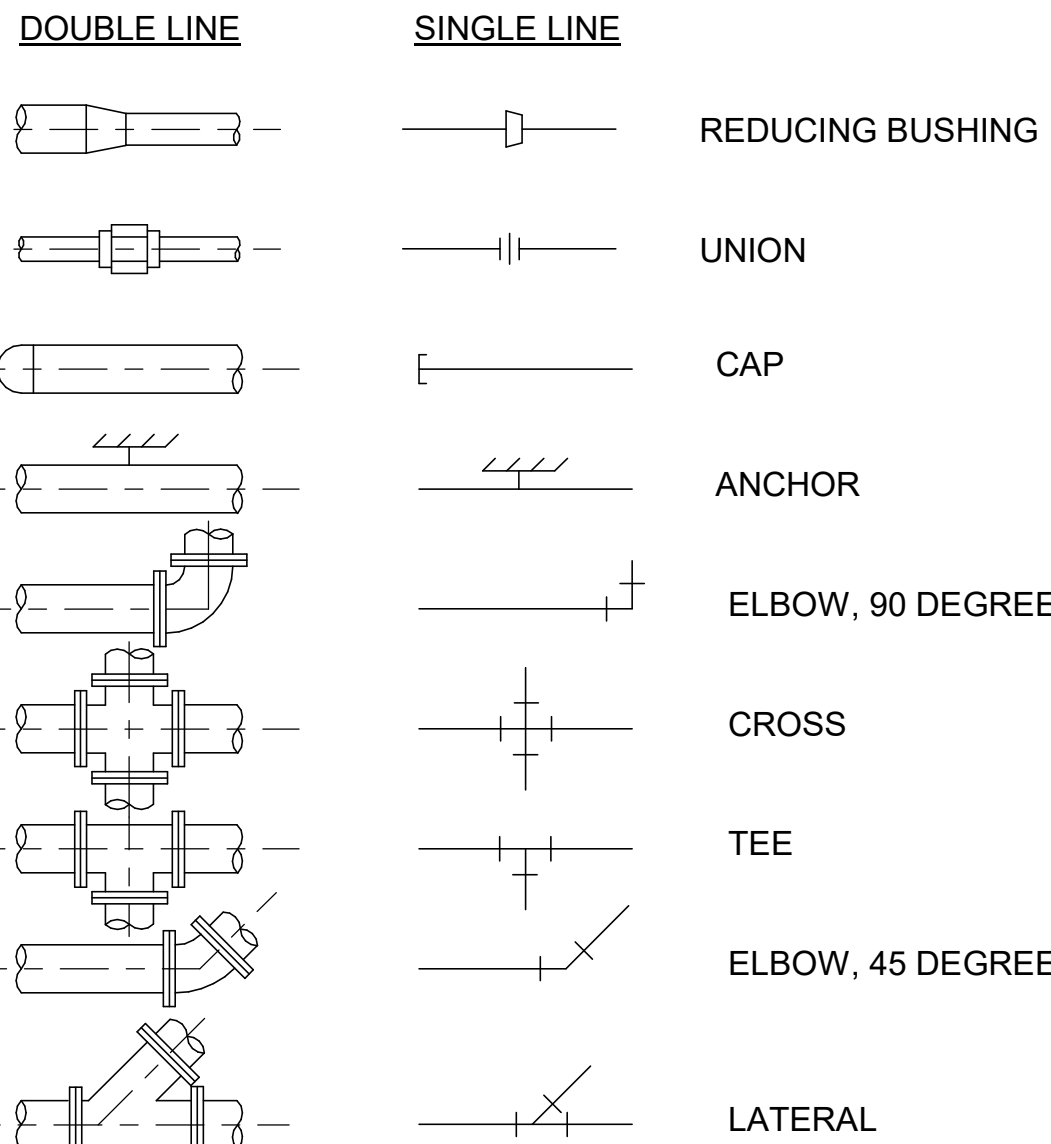
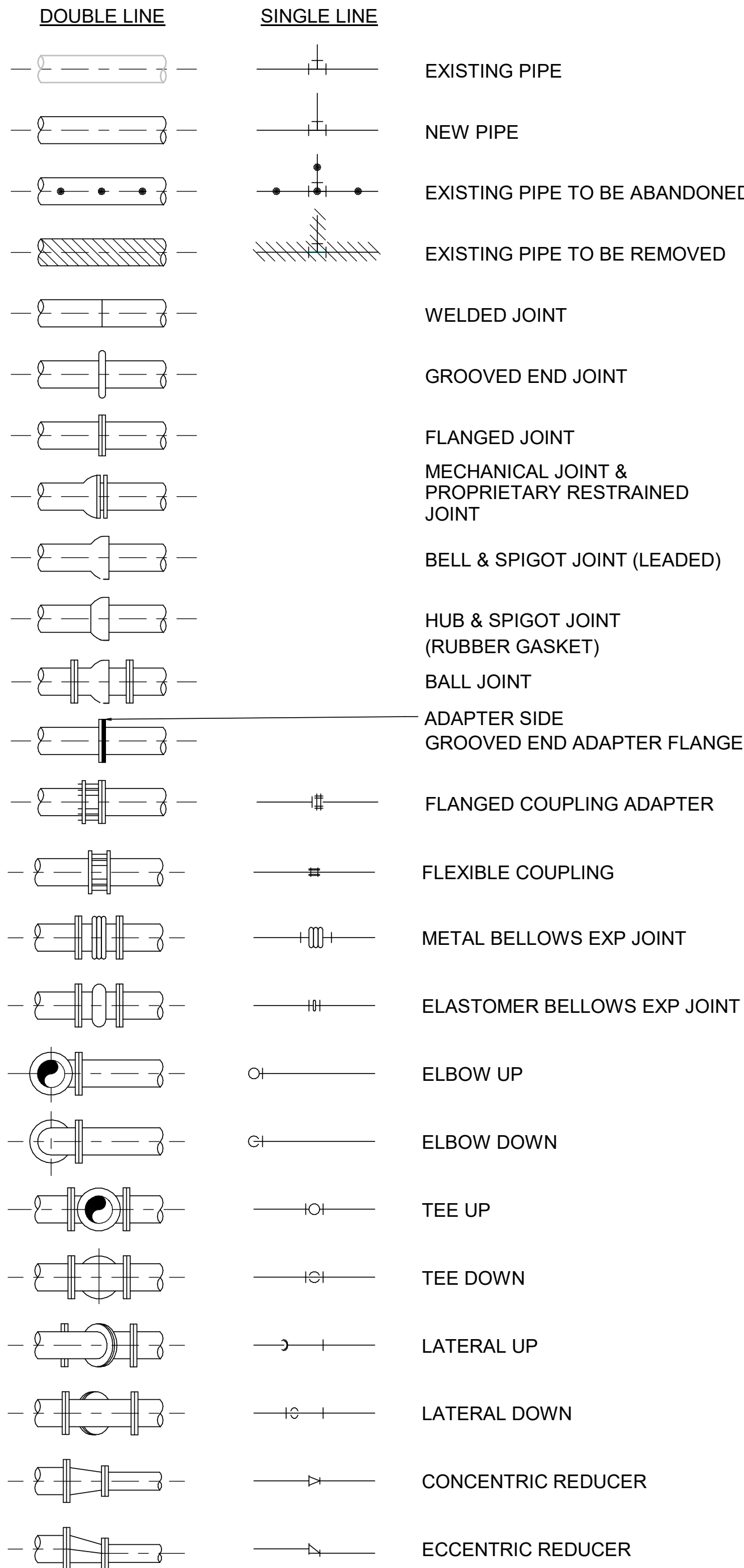
DEPARTMENT OF WATER AND POWER
WATER SYSTEM
CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-D-010

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D-06100-M-001

PIPE AND FITTING SYMBOLS

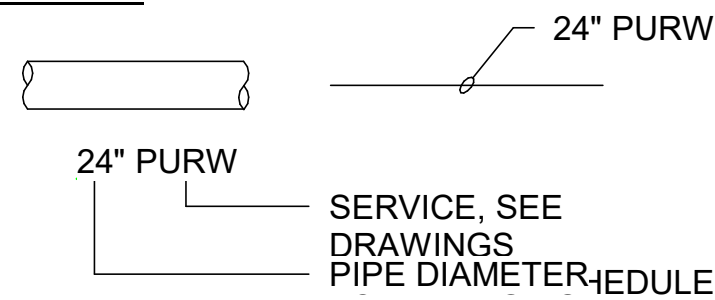


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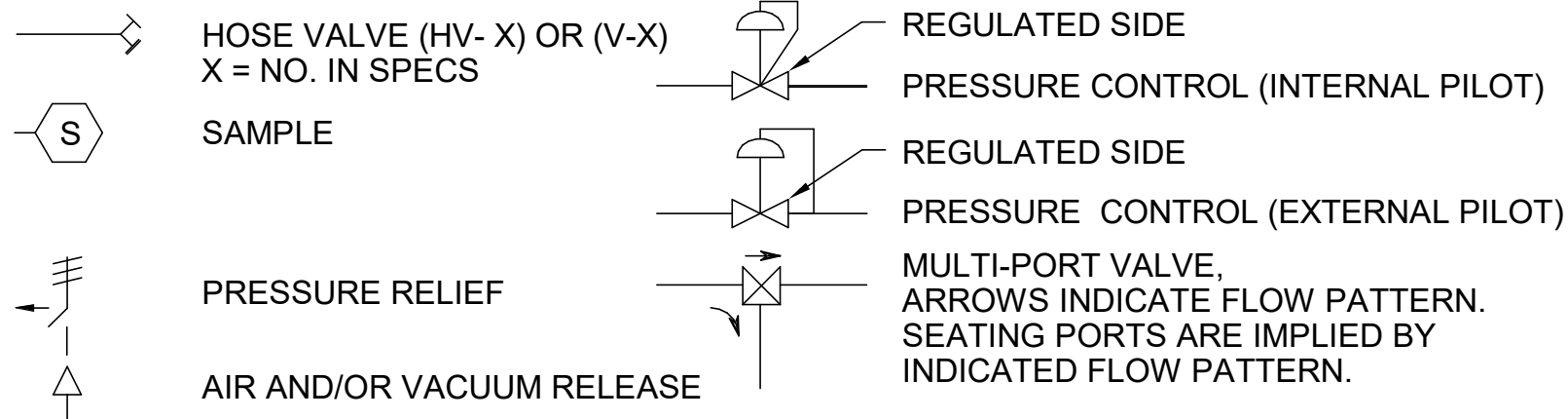
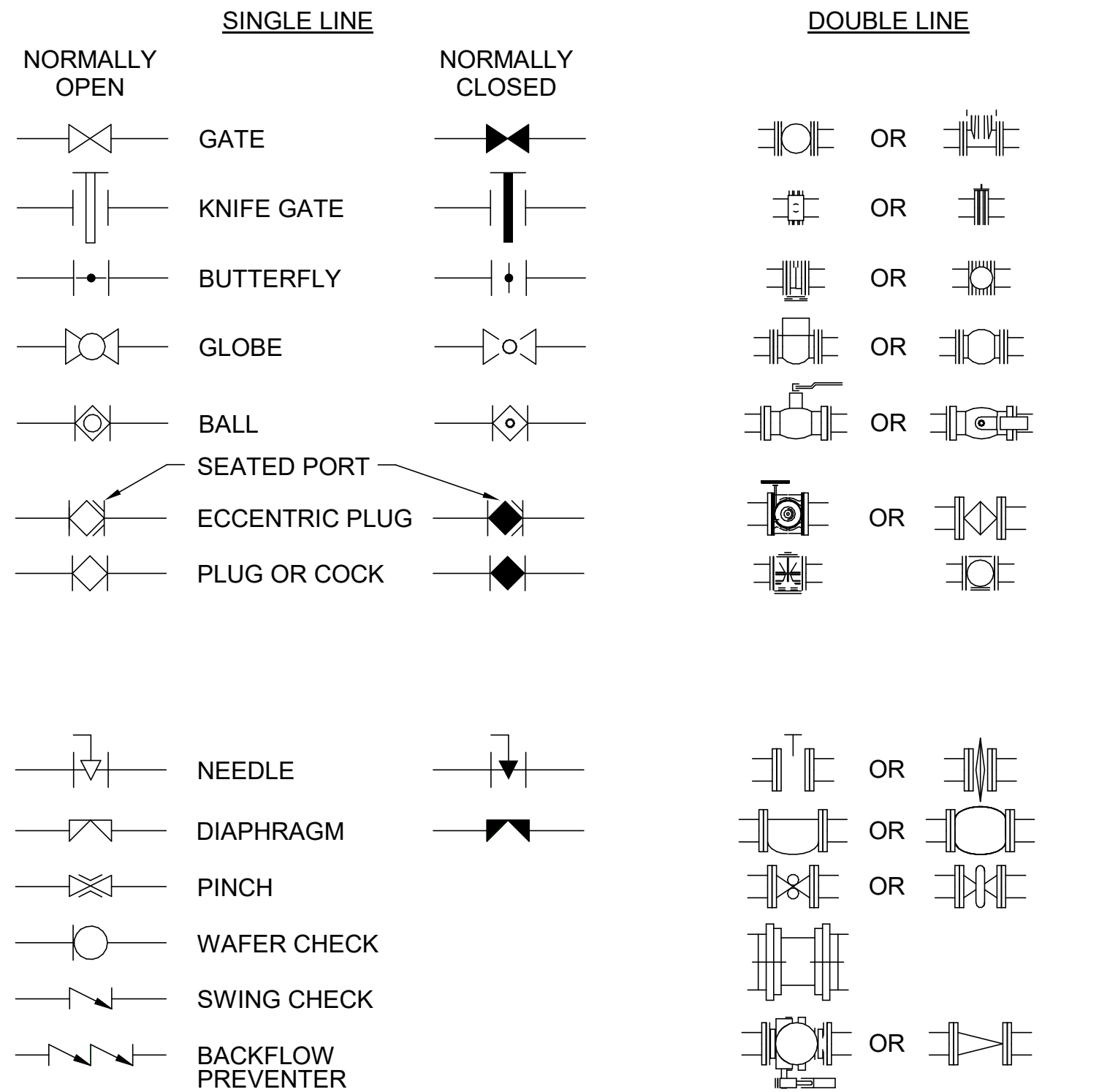
- ONLY FLANGED END CONNECTIONS ARE SHOWN HERE FOR DOUBLE LINE FITTINGS. FITTINGS WITH OTHER END PATTERNS ARE SHOWN SIMILARLY ON THE CONSTRUCTION DRAWINGS. ALSO SEE PIPING SPECIFICATIONS.
- SYMBOLS SHOWN HERE FOR SINGLE LINE FITTINGS ARE GENERIC ONLY. REFER TO PIPING SPECIFICATIONS FOR SPECIFIC END CONNECTIONS FOR SINGLE LINE PIPE AND FITTINGS.
- EXISTING PIPE AND EQUIPMENT IS SHOWN LIGHT-LINED AND/OR SCREENED AND IS NOTED AS EXISTING. NEW PIPING AND EQUIPMENT IS SHOWN HEAVY-LINED.

PIPING DESIGNATION

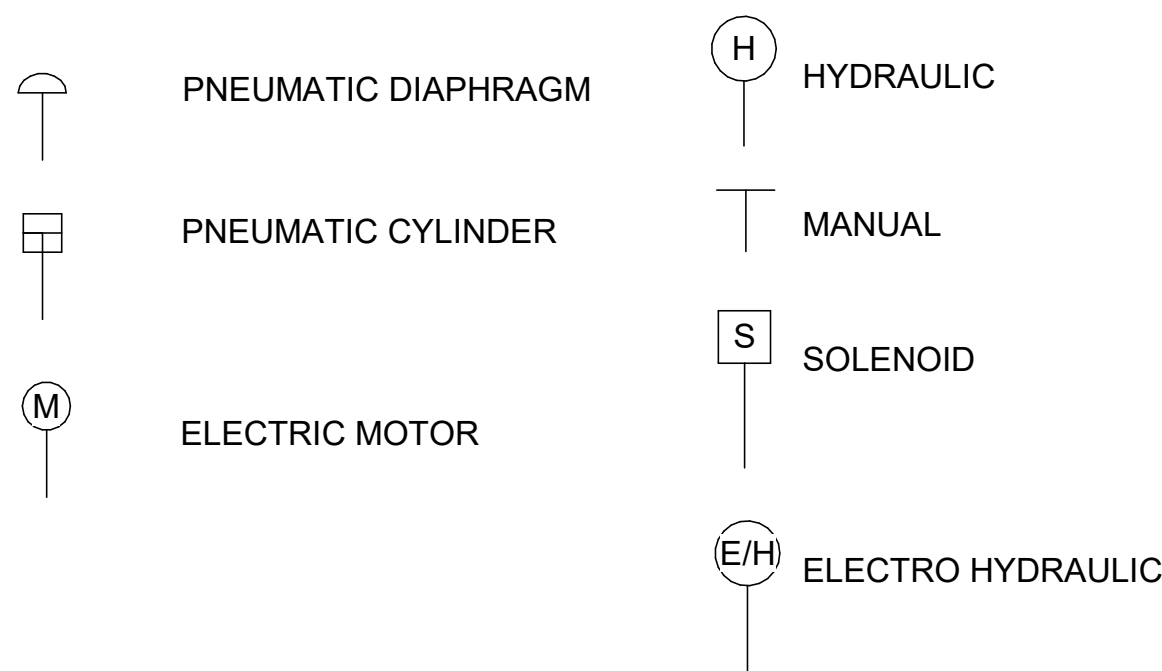
EXAMPLE:



VALVE SYMBOLS

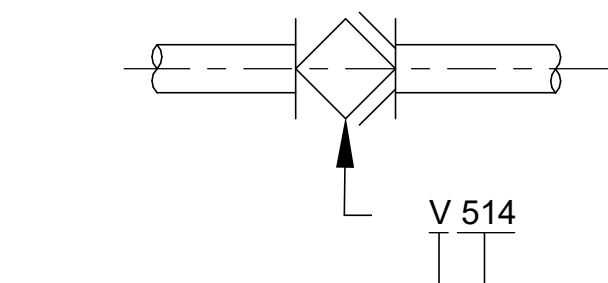


ACTUATOR SYMBOLS



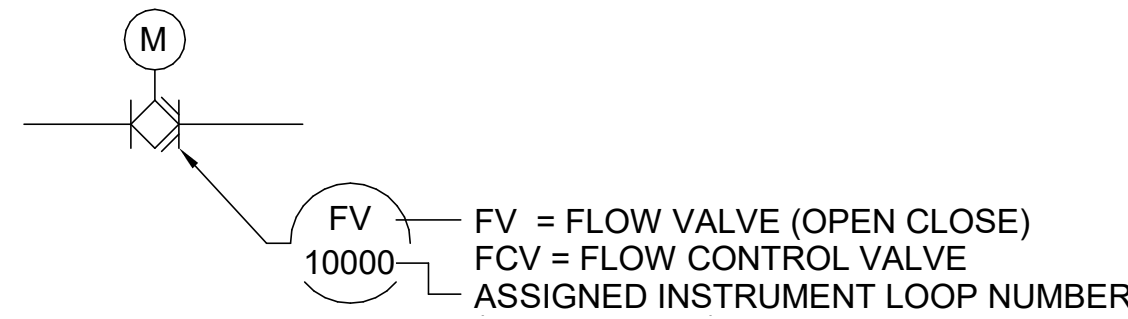
VALVE DESIGNATIONS

MANUAL VALVES AND CHECK VALVES



VALVE TYPE, SEE SPECIFICATION 40 27 02 - PROCESS VALVES AND OPERATORS

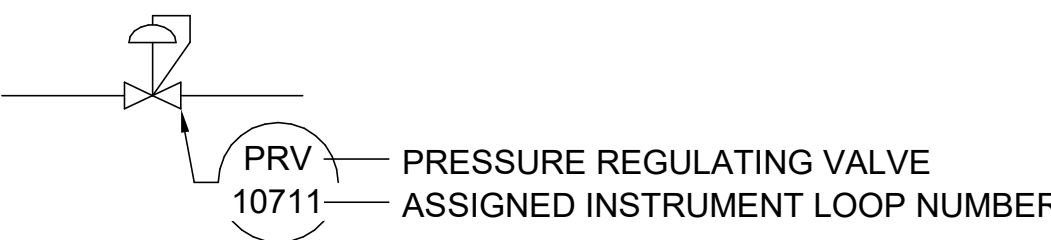
CONTROL VALVES



NOTE:

SEE I&C LEGENDS FOR FURTHER DEFINITIONS AND ACTUATOR TYPES.

SELF-CONTAINED REGULATING VALVES



PROCESS MECHANICAL LEGEND AND NOTES

GENERIC PIPING NOTES

- COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK (*) ARE SUPPLIED AS PART OF A VENDOR PACKAGE.
- LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
- SIZE OF FITTINGS SHOWN ON DRAWINGS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
- LOCATION AND NUMBER OF PIPE HANGERS AND PIPE SUPPORTS SHOWN ON PIPES REQUIRED TO BE DESIGNED BY SUBCONTRACTOR (AS SPECIFIED IN 40 05 15 PIPING SUPPORT SYSTEMS) ARE ONLY APPROXIMATE. SUBCONTRACTOR SHALL DESIGN SUPPORTS AS SPECIFIED.
- ALL JOINTS SHALL BE WATERTIGHT. WALL PIPES SHALL BE USED WHEREVER PIPING PASSES FROM A STRUCTURE TO BACKFILL.
- ALL FLEXIBLE CONNECTORS AND COUPLING ADAPTERS SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR TEST PRESSURES SPECIFIED.
- SYMBOLS, LEGENDS, AND PIPE USE IDENTIFICATIONS SHOWN SHALL BE FOLLOWED THROUGHOUT THE DRAWINGS, WHEREVER APPLICABLE. NOT ALL OF THE VARIOUS PIPING COMPONENTS ARE NECESSARILY USED IN THE PROJECT.
- ALL BURIED PIPING SPECIFIED TO BE PRESSURE TESTED, EXCEPT FLANGED, WELDED, OR SCREWED PIPING, SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED.
- NUMBER AND LOCATION OF UNIONS SHOWN ON DRAWINGS IS ONLY APPROXIMATE. PROVIDE ALL UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
- WHERE A GROOVED END COUPLING IS SHOWN, IT SHALL BE THE RIGID JOINT TYPE, UNLESS OTHERWISE SPECIFIED. WHERE A FLANGED COUPLING ADAPTER IS SHOWN, A STANDARD FLANGE SHALL BE JOINED TO THE COUPLING ADAPTER.

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES		Scale		DATE		APPROVED		DATE
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		Last Update	SGRIEBEL	08/07/2026				
		Recommended				Senior Assistant GM of Water		
File Name		BPS BORDER.DWG						

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
LEGEND

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-M-001

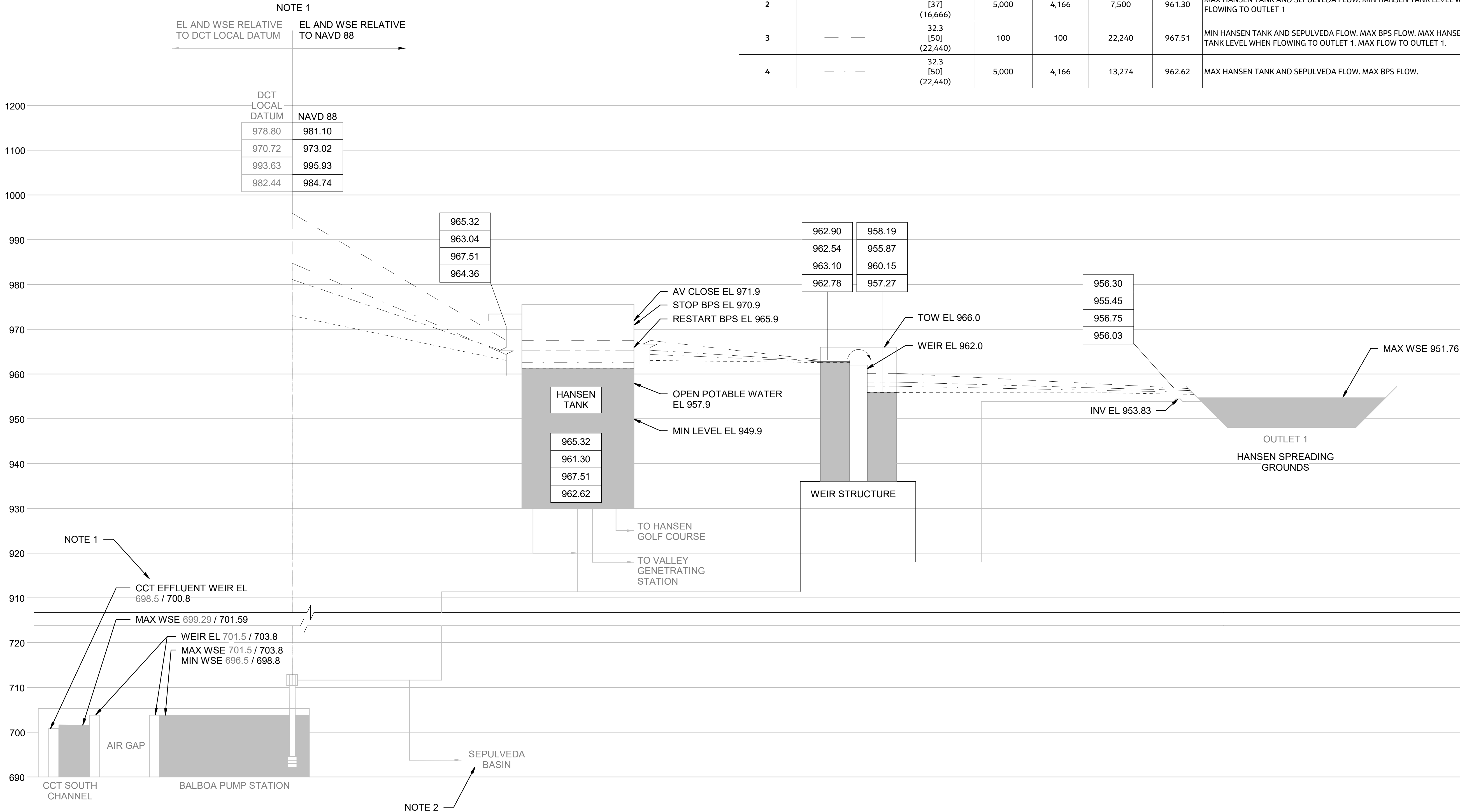
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D-06100-M-002

BALBOA PUMP STATION TO HANSEN TANK
AND HANSEN SPREADING GROUNDS OUTLET 1

SCENARIO NUMBER	LINE TYPE	BALBOA PS FLOW	HANSEN TANK OUTLET FLOW	SEPULVEDA OUTLET FLOW	SPREADING GROUNDS FLOW	HANSEN TANK WSE	NOTES
		MGD - [cfs] - (gpm)	gpm	gpm	gpm	ft	
1	---	24 [37] (16,666)	100	100	16,466	965.32	MIN HANSEN TANK AND SEPULVEDA FLOW.
2	----	24 [37] (16,666)	5,000	4,166	7,500	961.30	MAX HANSEN TANK AND SEPULVEDA FLOW. MIN HANSEN TANK LEVEL WHEN FLOWING TO OUTLET 1
3	---	32.3 [50] (22,440)	100	100	22,240	967.51	MIN HANSEN TANK AND SEPULVEDA FLOW. MAX BPS FLOW. MAX HANSEN TANK LEVEL WHEN FLOWING TO OUTLET 1. MAX FLOW TO OUTLET 1.
4	---	32.3 [50] (22,440)	5,000	4,166	13,274	962.62	MAX HANSEN TANK AND SEPULVEDA FLOW. MAX BPS FLOW.

- NOTES
- BALBOA PUMP STATION EL AND WSE ARE SHOWN IN TERMS OF DCT LOCAL DATUM. ALL DOWNSTREAM EL AND WSE ARE SHOWN IN TERMS OF NAVD 88. CORRECTION FACTOR FOR DCT LOCAL DATUM = NAVD88 - 2.30 FT. REFER TO SHEET XXX FOR SURVEY CONTROL STATEMENTS.
 - FLOW TO SEPULVEDA BASIN WAS ASSUMED TO VARY BETWEEN 100 AND 4,166 GPM. FLOW FROM HANSEN TANK WAS ASSUMED TO VARY BETWEEN 100 AND 5,000 GPM.
 - ALL HYDRAULIC SCENARIOS ASSUME ONLY ONE OUTLET AT HANSEN SPREADING GROUNDS IS ONLINE AT A TIME. SYSTEM HYDRAULICS DICTATE THE FLOW SPLIT BETWEEN THE HANSEN TANK AND THE ONLINE OUTLET AT THE SPREADING GROUNDS.



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			Description		

REFERENCES

File Name BPS BORDER.DWG

Scale AS SHOWN
Designer N VASTINE 08/07/2026
Stamp N AMEDO 08/07/2026
Drawn By G MCFARLAND 08/07/2026
Checked By S GORIS 08/07/2026
Last Update SGRIEBEL 08/07/2026

Recommended

DATE

As to Design
As to Operation
As to Distribution

Senior Assistant GM of Water

APPROVED

DATE

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
HYDRAULIC PROFILE

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-M-002

remove dash TYP

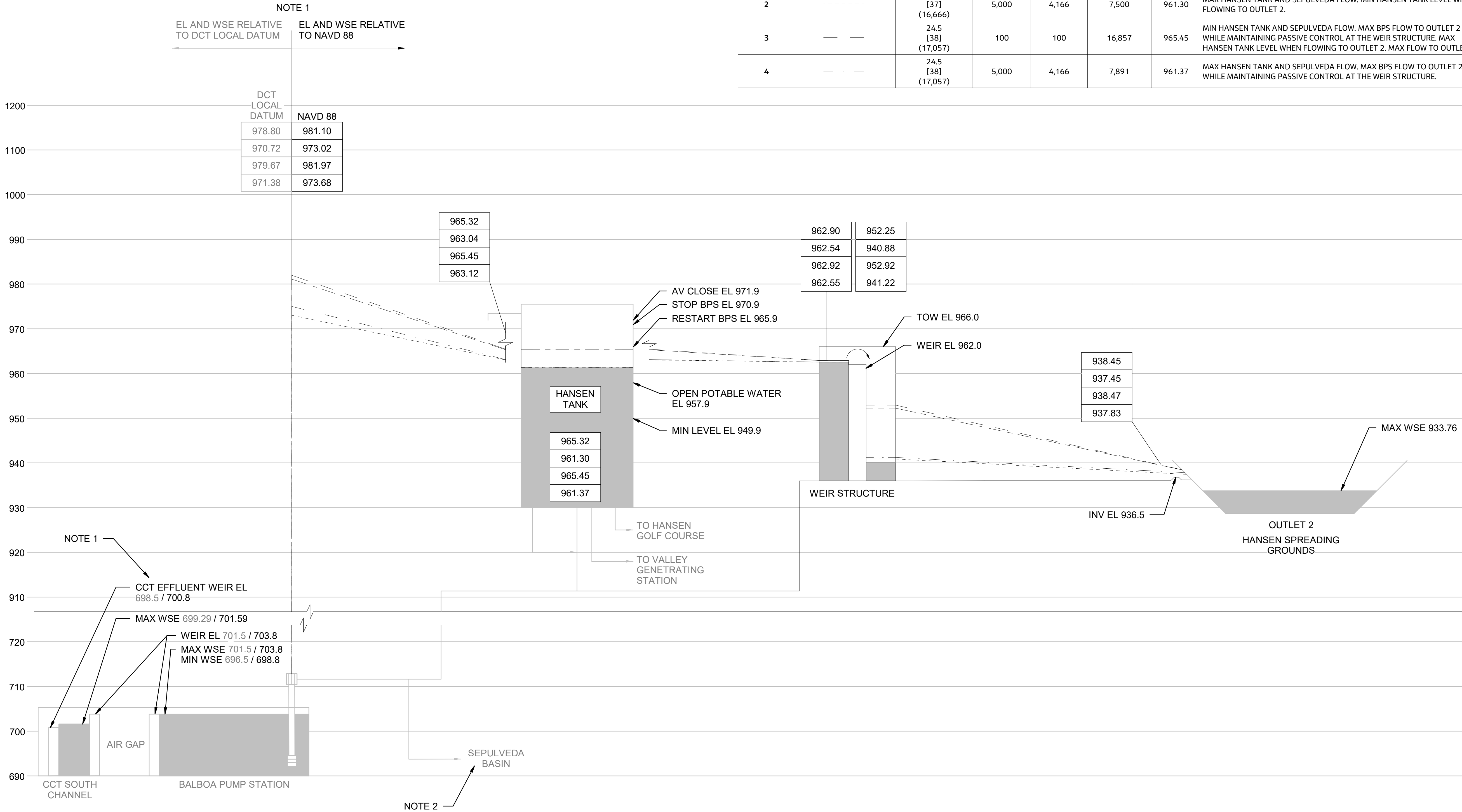
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PLOT DATE/TIME: 8/5/2026 7:04:23 AM

D-06100-M-003

BALBOA PUMP STATION TO HANSEN TANK
AND HANSEN SPREADING GROUNDS OUTLET 2

SCENARIO NUMBER	LINE TYPE	BALBOA PS FLOW	HANSEN TANK OUTLET FLOW	SEPULVEDA OUTLET FLOW	SPREADING GROUNDS FLOW	HANSEN TANK WSE	NOTES
		MGD - [cfs] - (gpm)	gpm	gpm	gpm	ft	
1	---	24 [37] (16,666)	100	100	16,466	965.32	MIN HANSEN TANK AND SEPULVEDA FLOW.
2	----	24 [37] (16,666)	5,000	4,166	7,500	961.30	MAX HANSEN TANK AND SEPULVEDA FLOW. MIN HANSEN TANK LEVEL WHEN FLOWING TO OUTLET 2.
3	---	24.5 [38] (17,057)	100	100	16,857	965.45	MIN HANSEN TANK AND SEPULVEDA FLOW. MAX BPS FLOW TO OUTLET 2 WHILE MAINTAINING PASSIVE CONTROL AT THE WEIR STRUCTURE. MAX HANSEN TANK LEVEL WHEN FLOWING TO OUTLET 2. MAX FLOW TO OUTLET 2.
4	---	24.5 [38] (17,057)	5,000	4,166	7,891	961.37	MAX HANSEN TANK AND SEPULVEDA FLOW. MAX BPS FLOW TO OUTLET 2 WHILE MAINTAINING PASSIVE CONTROL AT THE WEIR STRUCTURE.

- NOTES
- BALBOA PUMP STATION EL AND WSE ARE SHOWN IN TERMS OF DCT LOCAL DATUM. ALL DOWNSTREAM EL AND WSE ARE SHOWN IN TERMS OF NAVD 88. CORRECTION FACTOR FOR DCT LOCAL DATUM = NAVD88 - 2.30 FT. REFER TO SHEET XXX FOR SURVEY CONTROL STATEMENTS.
 - FLOW TO SEPULVEDA BASIN WAS ASSUMED TO VARY BETWEEN 100 AND 4,166 GPM. FLOW FROM HANSEN TANK WAS ASSUMED TO VARY BETWEEN 100 AND 5,000 GPM.
 - ALL HYDRAULIC SCENARIOS ASSUME ONLY ONE OUTLET AT HANSEN SPREADING GROUNDS IS ONLINE AT A TIME. SYSTEM HYDRAULICS DICTATE THE FLOW SPLIT BETWEEN THE HANSEN TANK AND THE ONLINE OUTLET AT THE SPREADING GROUNDS.



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NOT FOR CONSTRUCTION

Jacobs

Number	Date	Initials	REVISIONS	Approved
			Description	

REFERENCES

Scale AS SHOWN

DATE

APPROVED

DATE

Designer N VASTINE 08/07/2026
Stamp N AMEDO 08/07/2026
Drawn By G MCFARLAND 08/07/2026
Checked By S GORIS 08/07/2026
Last Update SGRIEBEL 08/07/2026

As to Design

As to Operation

As to Distribution

Senior Assistant GM of Water

File Name BPS BORDER.DWG

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
HYDRAULIC PROFILE - 2

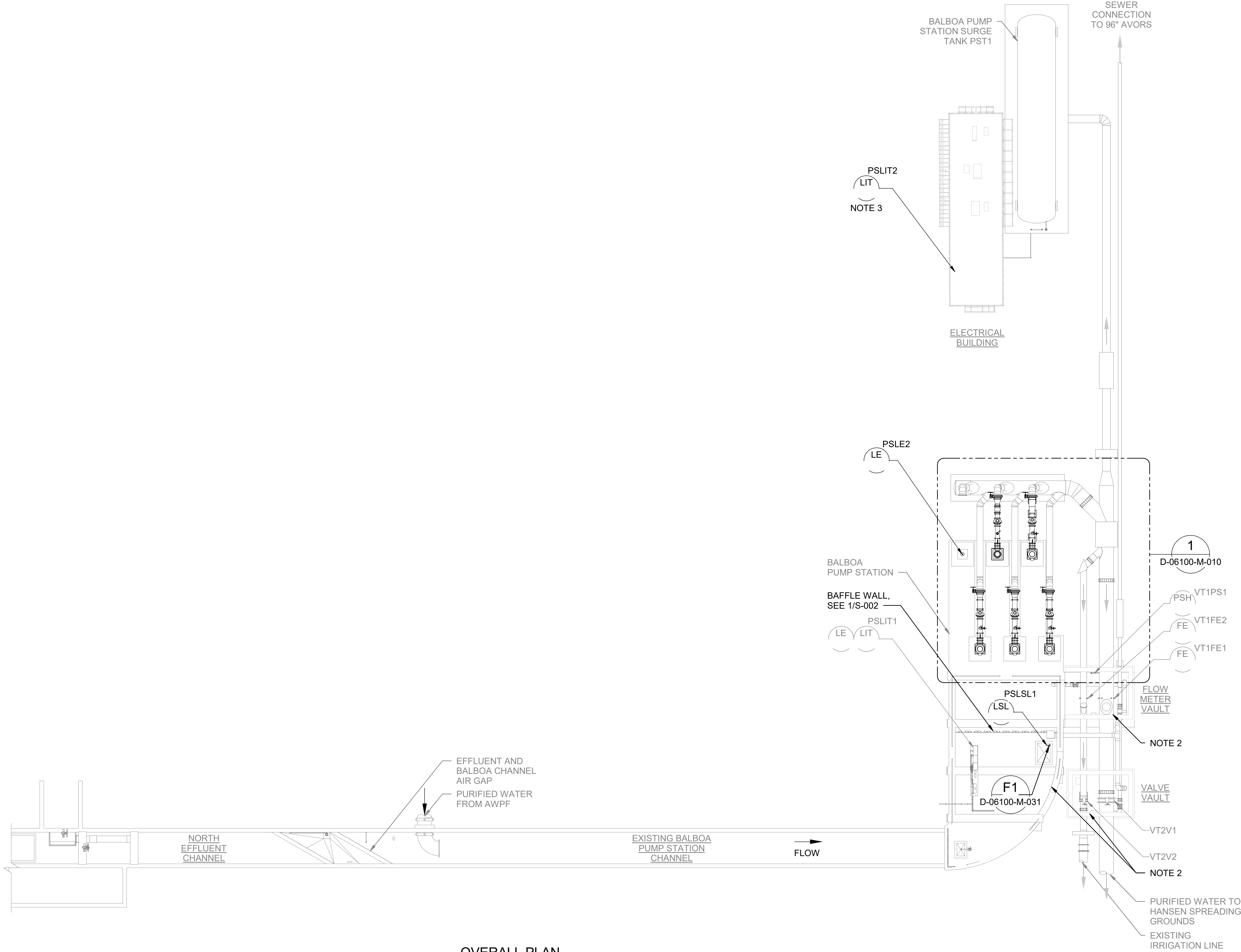
DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-M-003

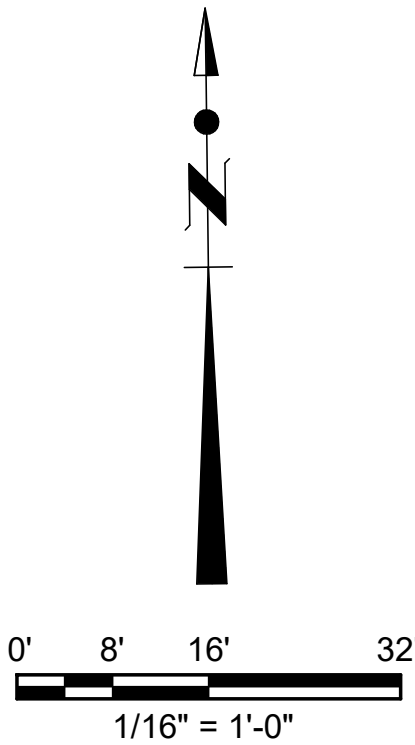
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D-06100-M-005



- NOTES**
1. REFER TO EAST VALLEY RECYCLING WATER PROJECT RECORD DRAWINGS D4972 FOR FURTHER INFORMATION RELATED TO EXISTING INFRASTRUCTURE.
 2. SLAB NOT SHOWN FOR CLARITY.
 3. SEE DRAWING E-104 FOR PSLIT2 LOCATION WITHIN PLC CABINET PSPLC.

OVERALL PLAN
SCALE: 1/16" = 1'-0"



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REVISIONS			Description	Approved
Number	Date	Initials		

REFERENCES

File Name BPS BORDER.DWG

Scale AS SHOWN DATE
Designer N AMEDO 08/07/2026
Stamp N AMEDO 08/07/2026
Drawn By G MCFARLAND 08/07/2026
Checked By S GORIS 08/07/2026
Last Update SGRIEBEL 08/07/2026

Recommended

APPROVED
As to Design
As to Operation
As to Distribution

Senior Assistant GM of Water

**GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
OVERALL PLAN**

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-M-005

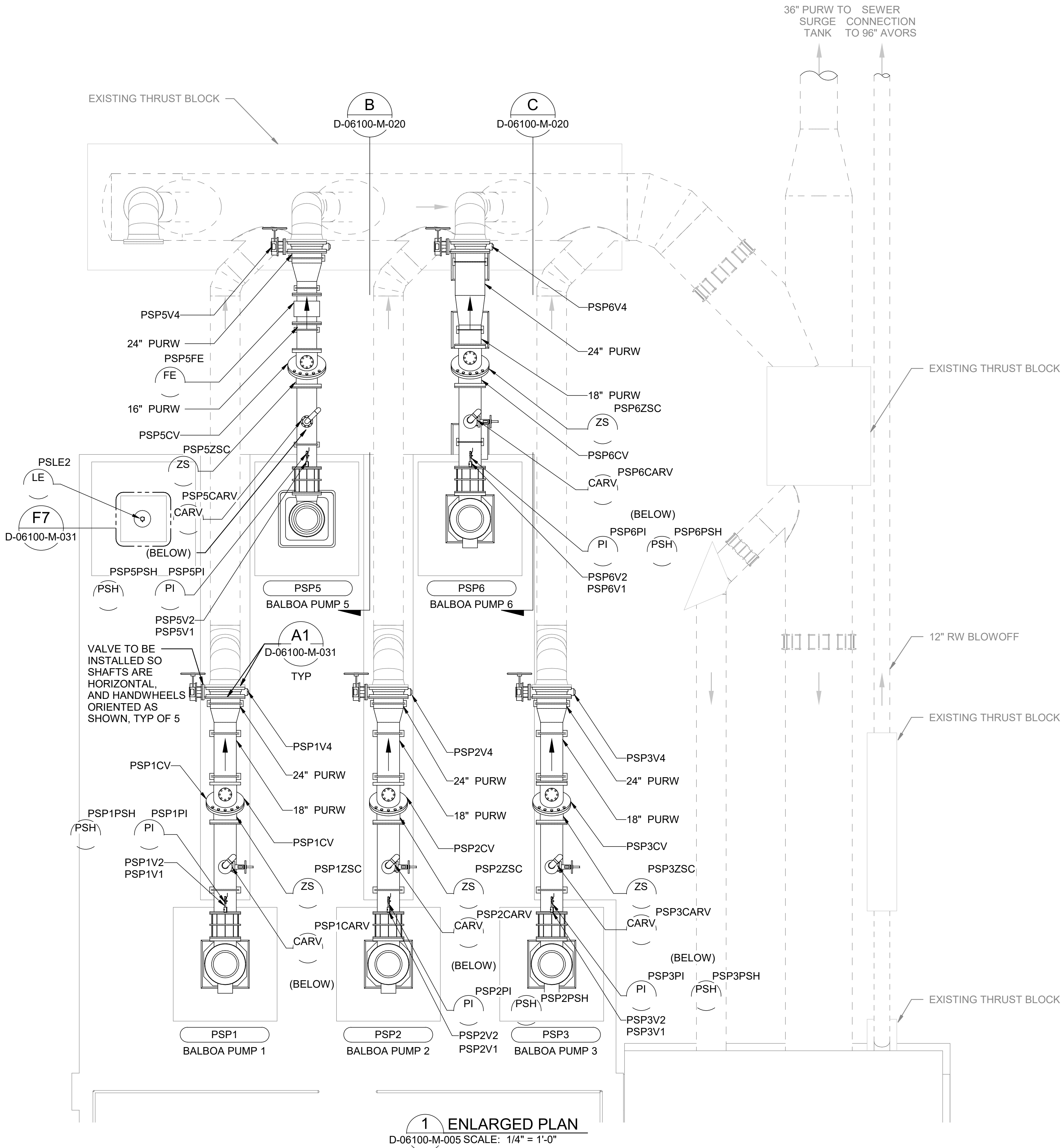
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D-06100-M-010

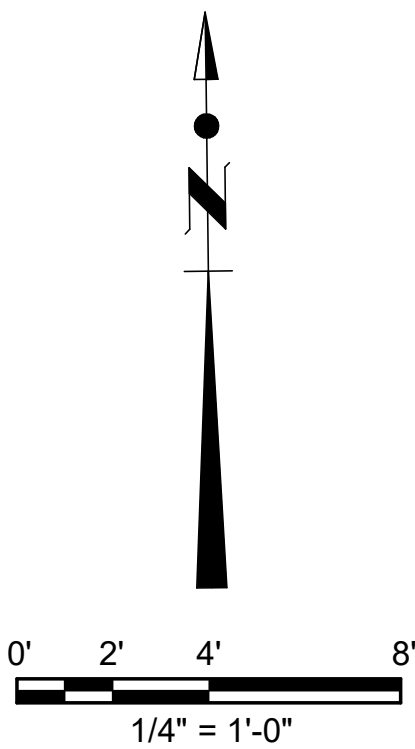
- NOTES**
- REFER TO EAST VALLEY RECYCLING WATER PROJECT RECORD DRAWINGS D4972 FOR FURTHER INFORMATION RELATED TO EXISTING INFRASTRUCTURE.
 - PSP1, PSP2, PSP3 AND PSP6 ARE IDENTICAL 1000HP PUMPS.
 - PSP5 IS A 500HP PUMP.

PIPE SCHEDULE		
SERVICE	PURIFIED WATER	
FLOW STREAM	PURW	
EXPOSURE	EXPOSED OUTDOORS	
SIZE	4" THRU 24"	<4"
PIPE MATERIAL	CARBON STEEL	STAINLESS STEEL
SPEC SECTION	40 27 00.03	40 27 00.08
JOINT TYPE	WELDED, THREADED AND FLANGED	THREADED
DESIGN PRESSURE	125 PSI	
TEST PRESSURE	HYDROSTATIC TO 275 PSI	
PIPE LABEL COLOR	PURPLE	
PIPE COATING	HIGH BUILD EPOXY: SYSTEM NO. 4 PER SPECIFICATION 09 90 00	NONE
PIPE LINING	CEMENT MORTAR	NONE

REFERENCE SPECIFICATIONS 40 27 00 - PROCESS PIPING GENERAL, 40 27 00.03 - CARBON STEEL PIPE AND FITTINGS DATA SHEET, AND 40 27 00.08 - STAINLESS STEEL PIPE AND FITTINGS DATA SHEET FOR FURTHER DETAIL.



1 ENLARGED PLAN
D-06100-M-005 SCALE: 1/4" = 1'-0"



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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

File Name BPS BORDER.DWG

Scale	AS SHOWN	DATE	APPROVED	DATE
Designer	N AMEDO	08/07/2026	As to Design	
Stamp	N AMEDO	08/07/2026	As to Operation	
Drawn By	G MCFARLAND	08/07/2026		
Checked By	S GORIS	08/07/2026	As to Distribution	
Last Update	SGRIEBEL	08/07/2026		
			Senior Assistant GM of Water	

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
ENLARGED PLAN

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

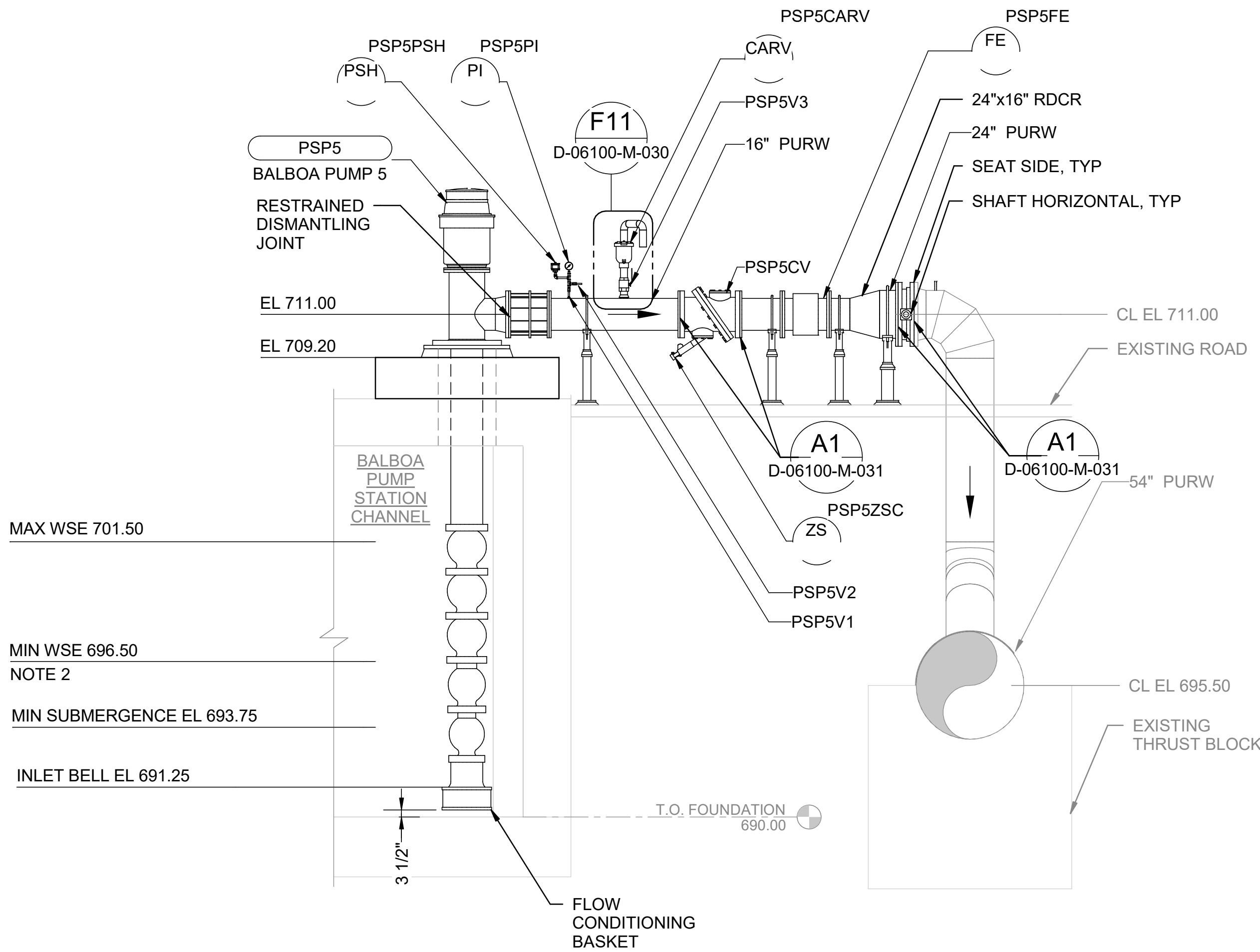
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D-06100-M-010

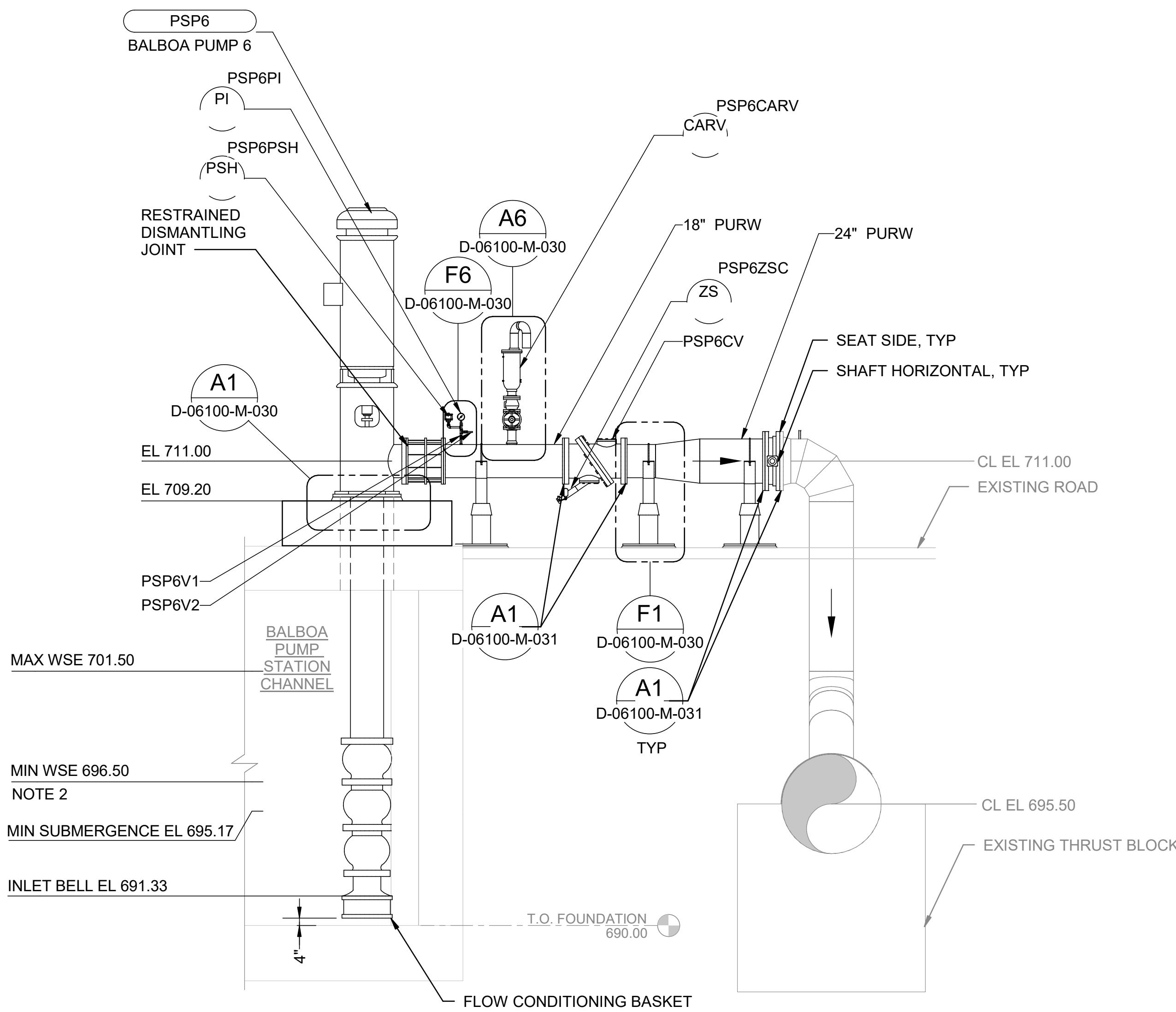
D-06100-M-020

NOTES

1. REFERENCE PUMP SPECIFICATION 44 42 56.03 - VERTICAL TURBINE PUMPS FOR MORE DETAIL.



B SECTION
D-06100-M-010 SCALE: 1/4" = 1'-0"
PSP5



C SECTION
D-06100-M-010 SCALE: 1/4" = 1'-0"
PSP1, PSP2, PSP3, PSP6

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES		Scale		DATE		APPROVED		DATE	
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		Designer	N AMEDO	08/07/2026		As to Operation			
		Stamp	N AMEDO	08/07/2026		As to Distribution			
		Drawn By	G MCFARLAND	08/07/2026					
		Checked By	S GORIS	08/07/2026					
		Last Update	SGRIEBEL	08/07/2026					
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GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
WEST SECTIONS

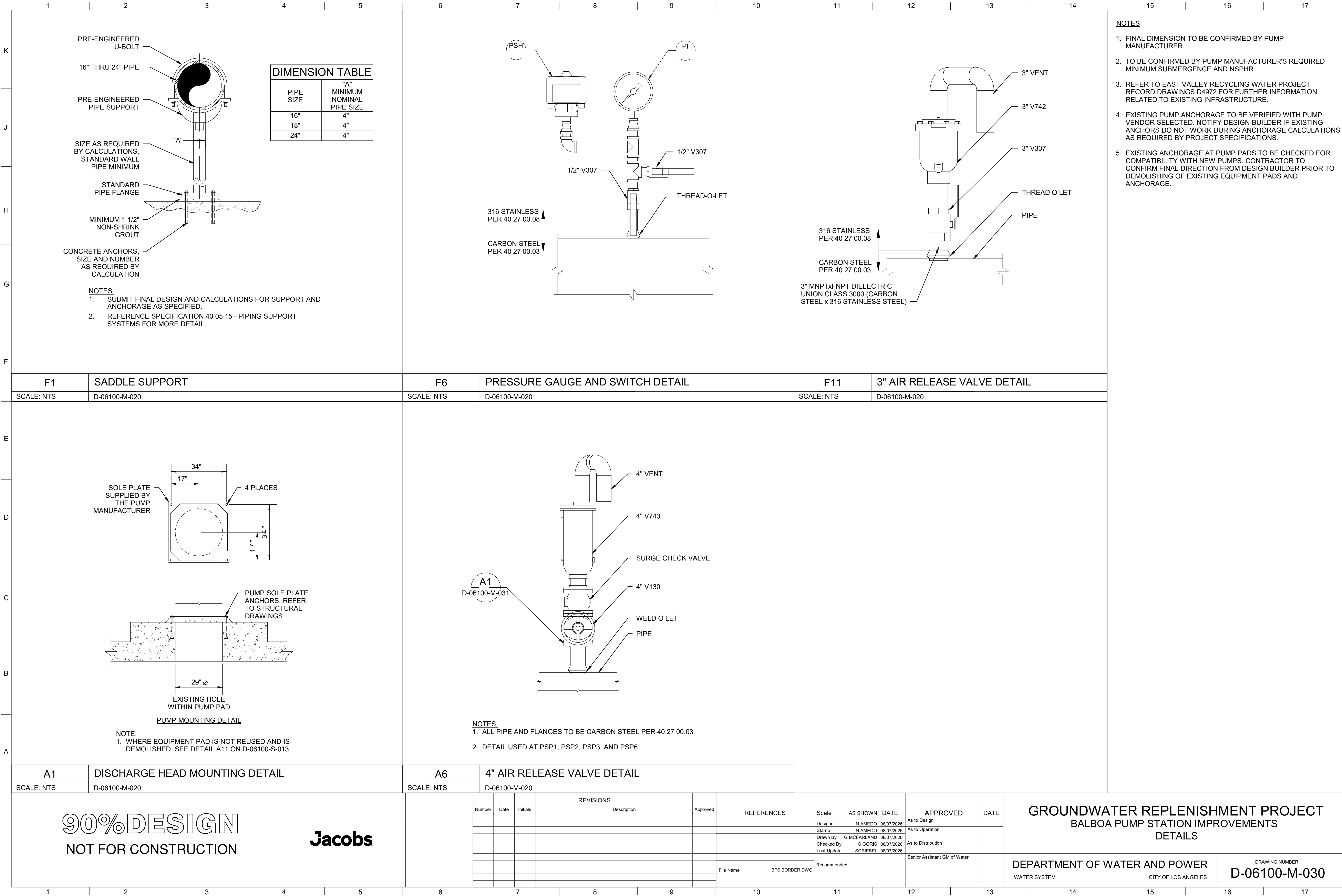
DEPARTMENT OF WATER AND POWER
WATER SYSTEM

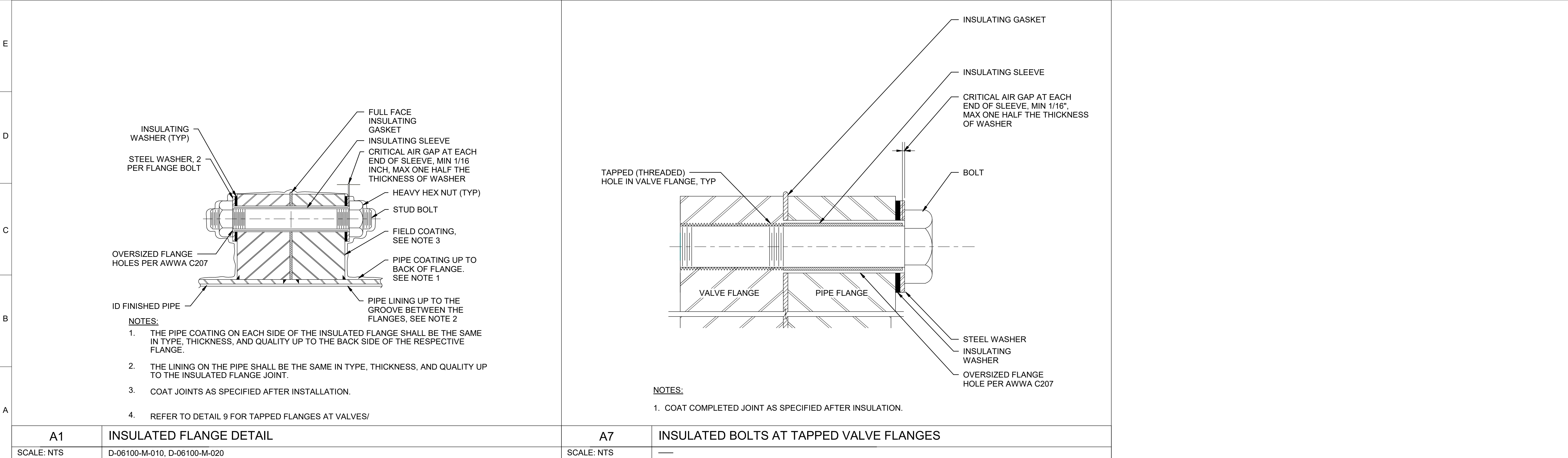
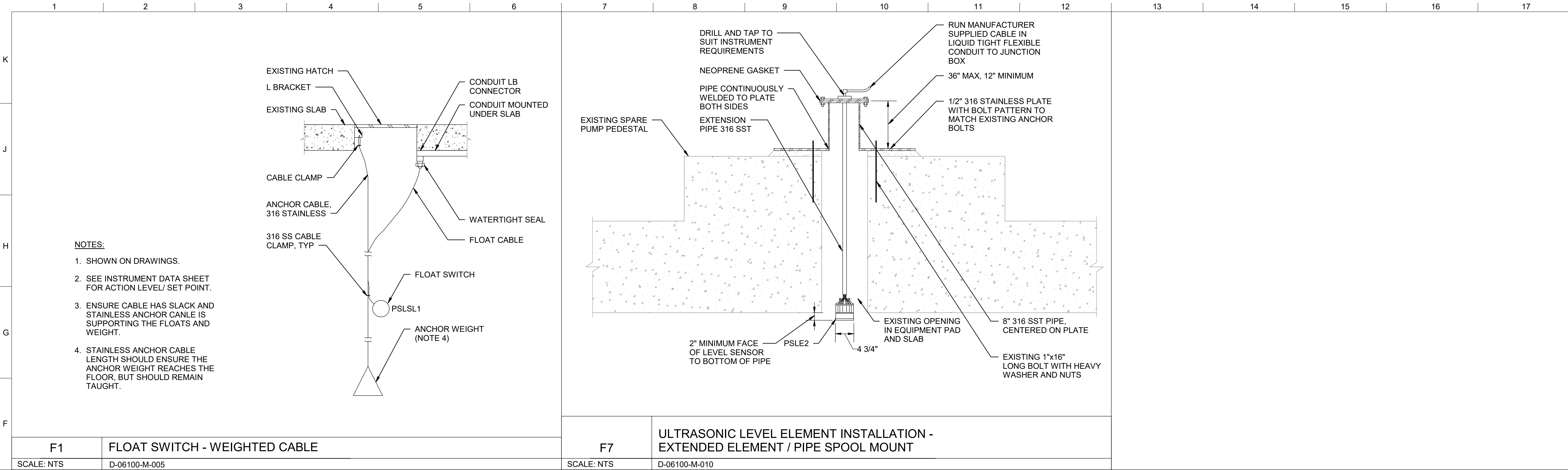
CITY OF LOS ANGELES

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PLOT DATE/TIME: 8/5/2026 7:04:28 AM

D-06100-M-030





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Stamp		N AMEDO		08/07/2026		As to Operation			
Drawn By		G MCFARLAND		08/07/2026		As to Distribution			
Checked By		S GORIS		08/07/2026		Senior Assistant GM of Water			
Last Update		SGRIEBEL		08/07/2026					
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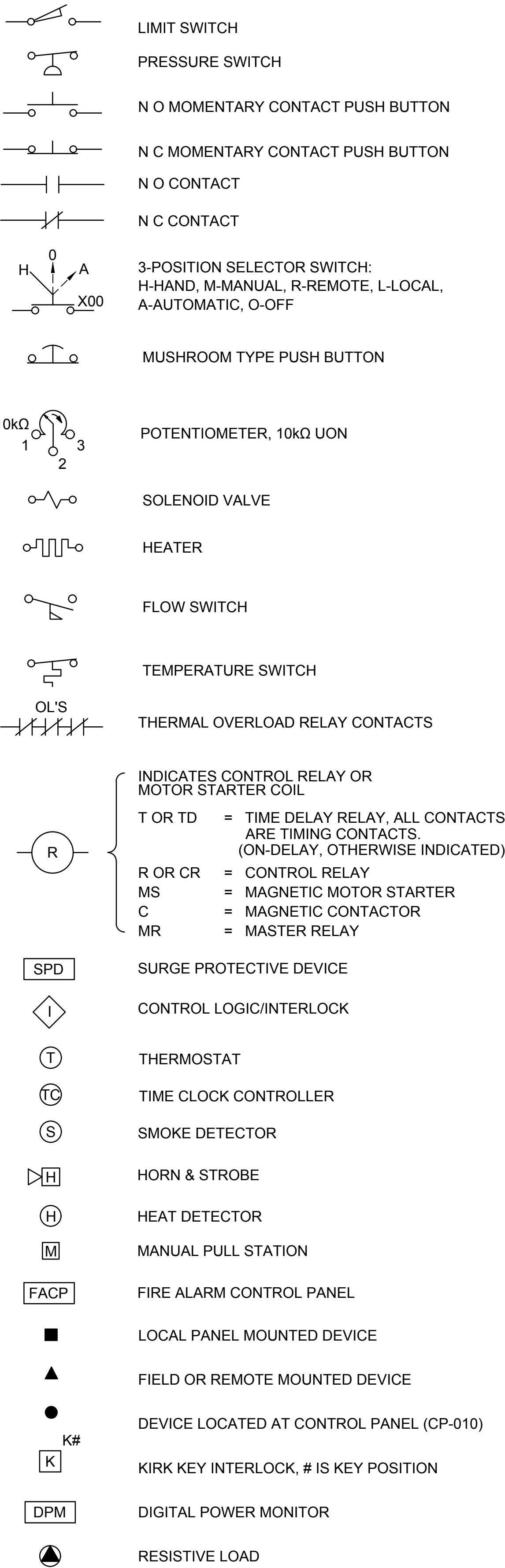
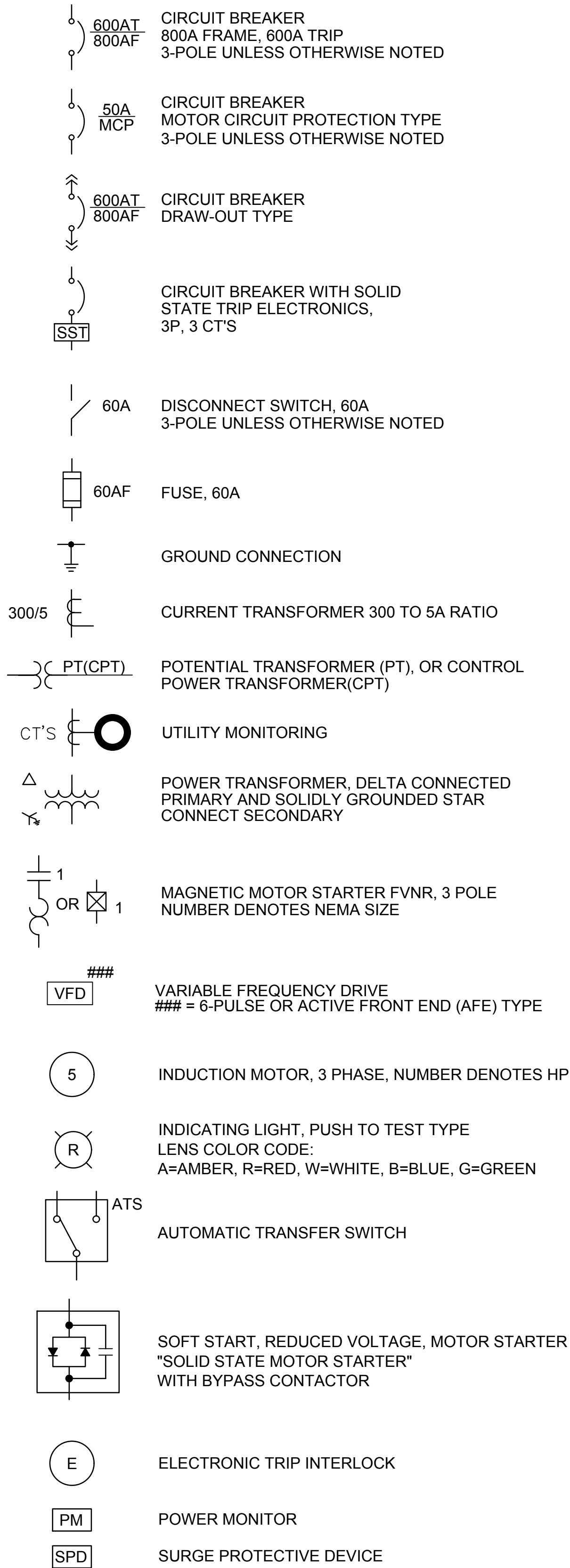
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BALBOA PUMP STATION IMPROVEMENTS
DETAILS

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

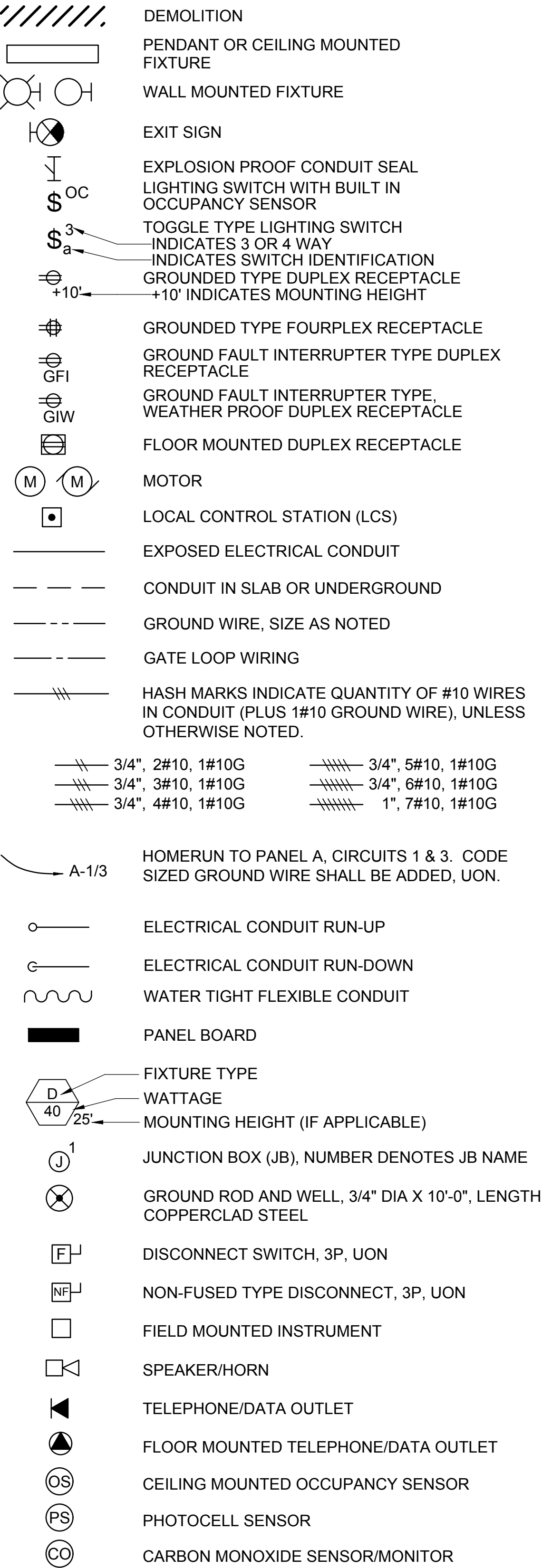
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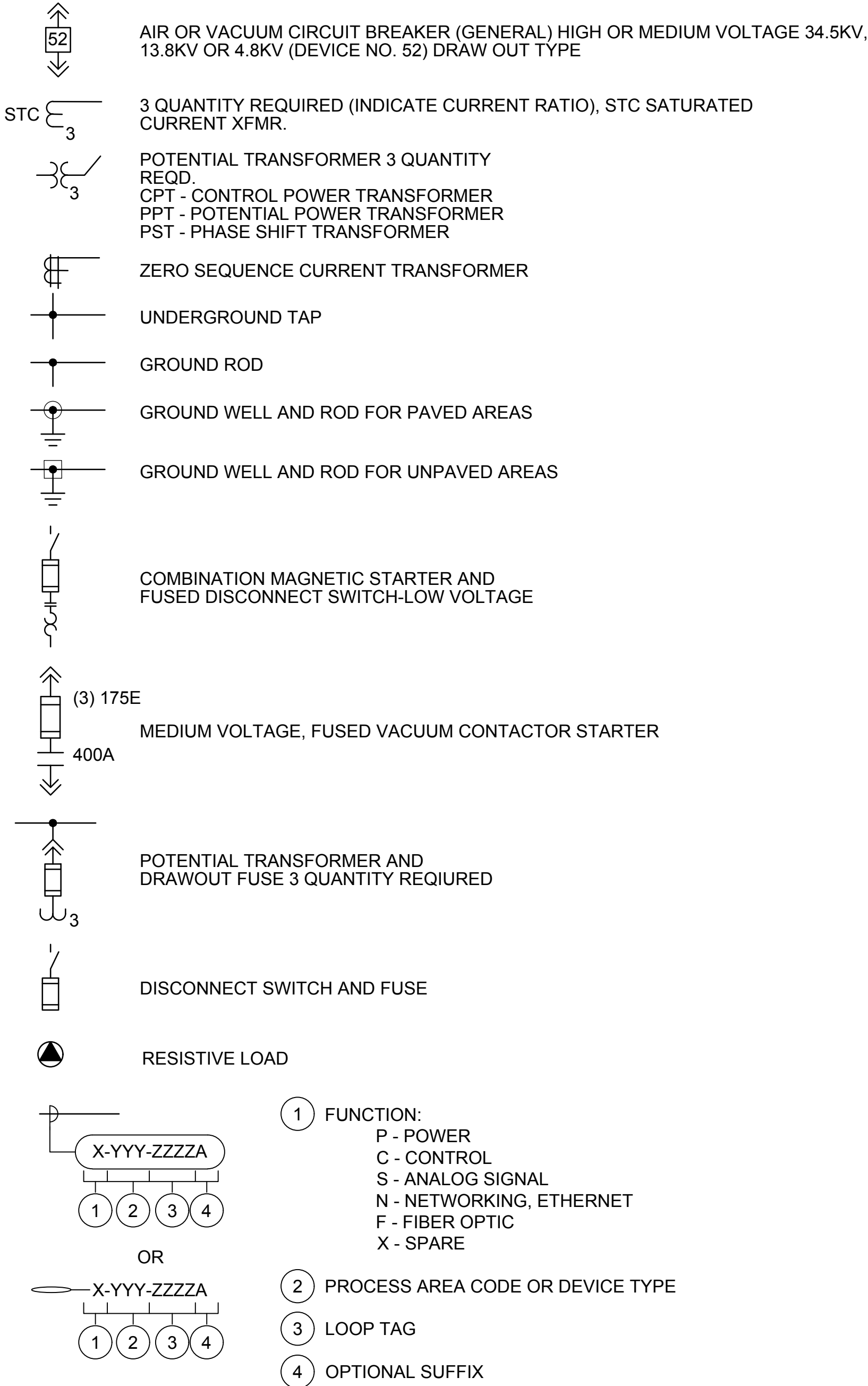
ELECTRICAL DIAGRAM LEGEND



ELECTRICAL PLAN LEGEND



ELECTRICAL SINGLE LINE LEGEND



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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

Scale AS SHOWN

DATE

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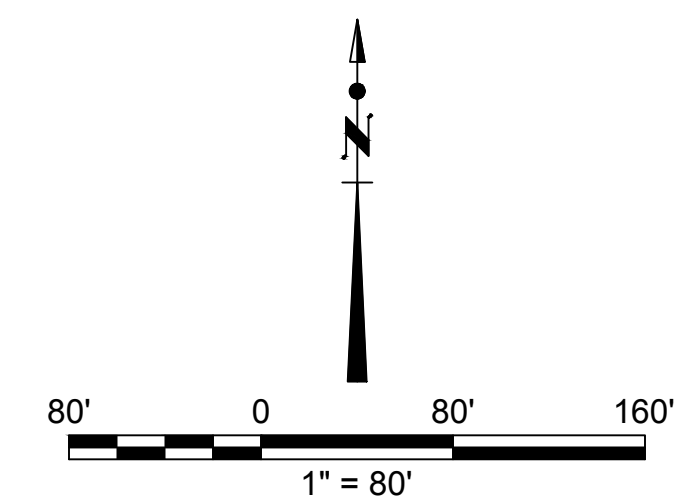
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GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
LEGEND AND ABBREVIATIONS

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-E-001



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Scale	AS SHOWN	DATE
Designer	R UYEKAWA	09/02/2028
Stamp	R UYEKAWA	09/02/2028
Drawn By	B DIETER	09/02/2028
Checked By	E LOVERING	09/02/2028
Last Update	SGRIEBEL	09/02/2028

APPROVED		DATE
As to Design		
As to Operation		
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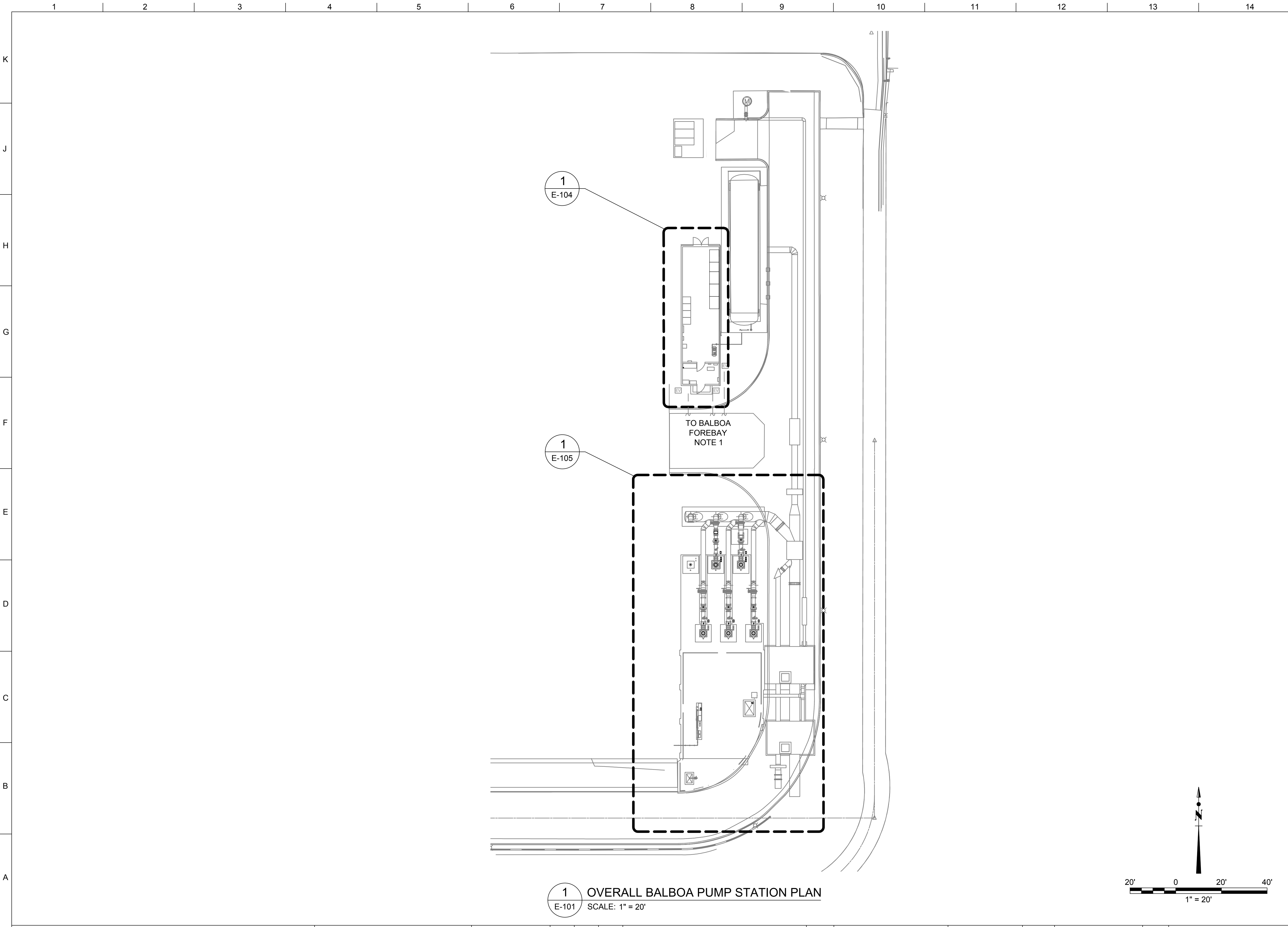
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DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

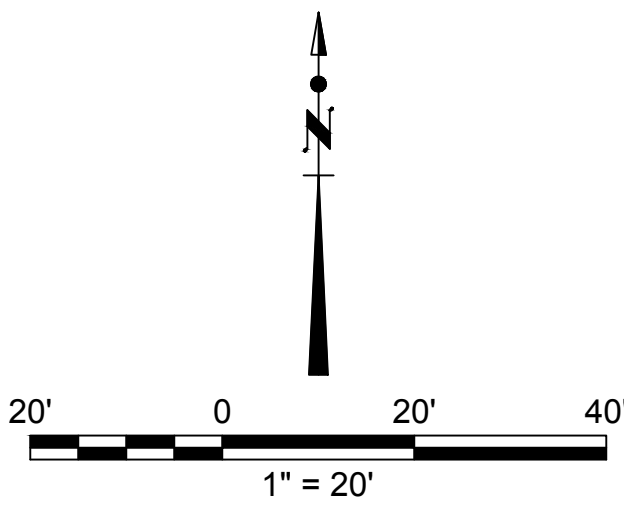
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D-06100-E-102



1 OVERALL BALBOA PUMP STATION PLAN
E-101 SCALE: 1" = 20'



NOTE:

1. EXISTING UNDERGROUND DUCT BANK FROM THE BALBOA ELECTRICAL ROOM IN THE BALBOA FOREBAY AREA. DUCTBANK DETAILS AND SURVEY LOCATION ARE NOT CURRENTLY KNOWN. SUBCONTRACTOR SHALL VERIFY PRIOR TO ANY EXCAVATION IN THIS CROSSING.

LEGEND:

--- EXISTING DUCT BANK

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NOT FOR CONSTRUCTION



REVISIONS					Approved
Number	Date	Initials	Description		

REFERENCES		Scale		DATE	APPROVED		DATE
		AS SHOWN					
		Designer	R UYEKAWA	09/02/2026	As to Design		
		Stamp	R UYEKAWA	09/02/2026	As to Operation		
		Drawn By	B DIETER	09/02/2026			
		Checked By	E LOVERING	09/02/2026	As to Distribution		
		Last Update	SGRIEBEL	09/02/2026			
		Recommended			Senior Assistant GM of Water		
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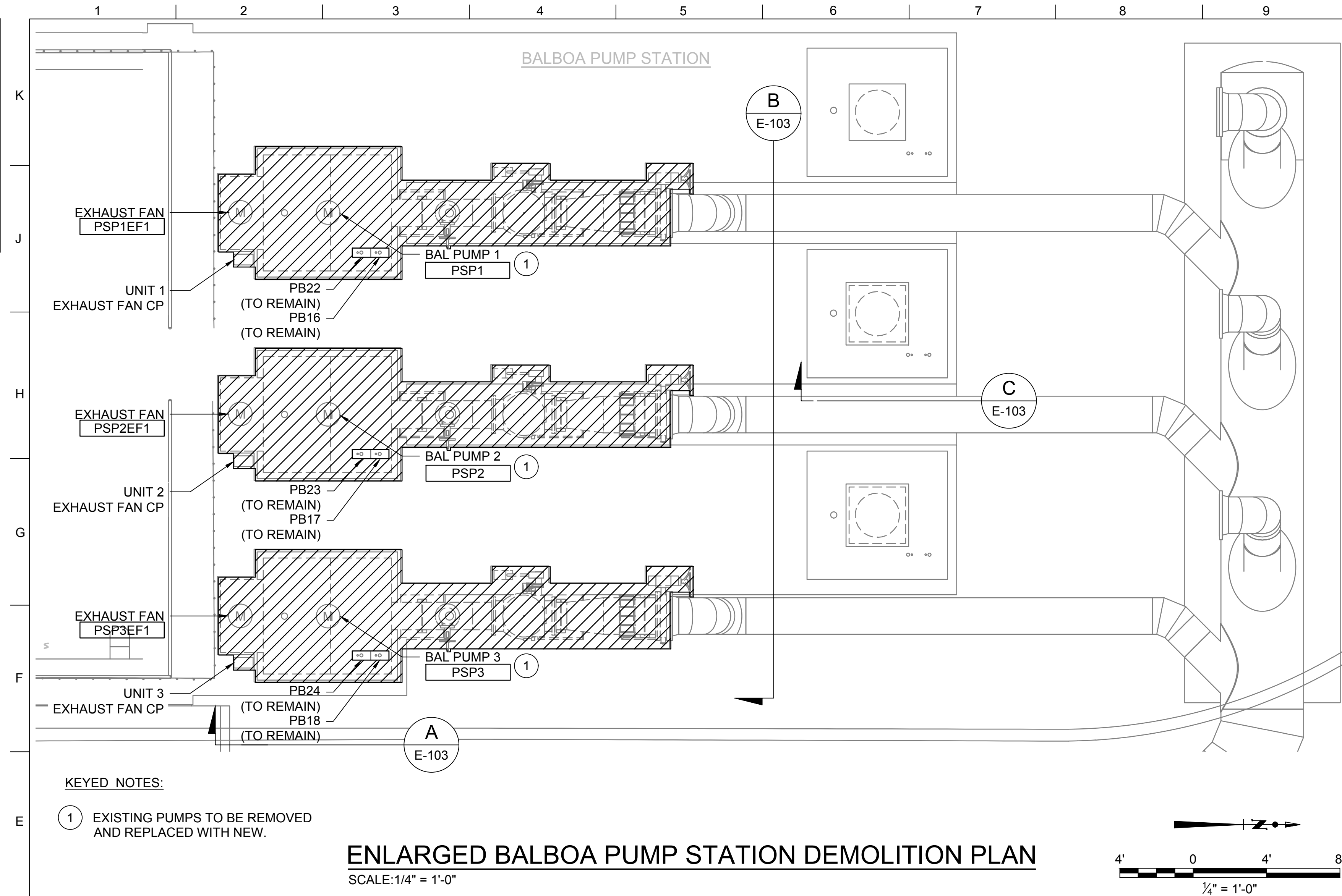
GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
OVERALL BALBOA PUMP STATION PLAN

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

remove BALBOA and PUMP STATION from all titles
DRAWING NUMBER
D-06100-E-102

D-06100-E-103



LEGEND:

DEMOLITION

UNIT 1
EXHAUST FAN CP

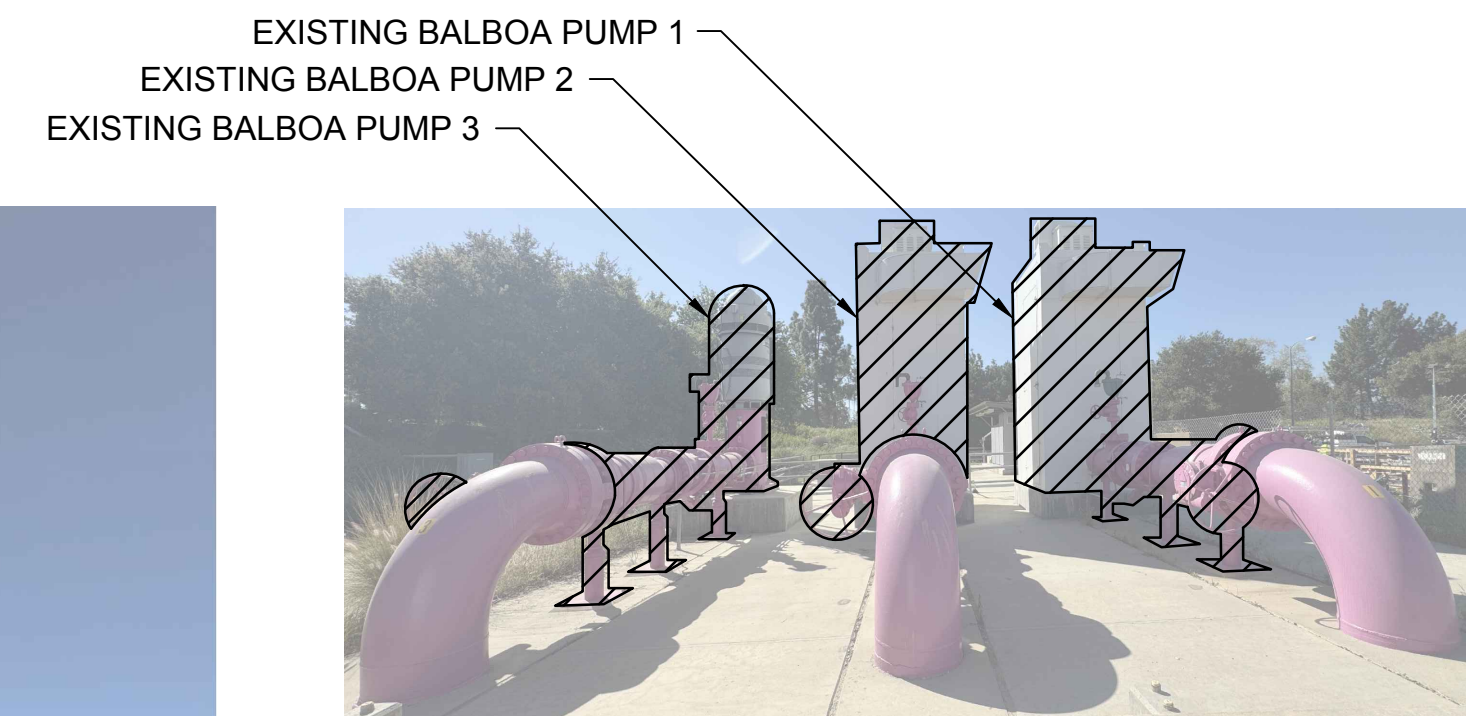
UNIT 2
EXHAUST FAN CP

UNIT 3
EXHAUST FAN CP

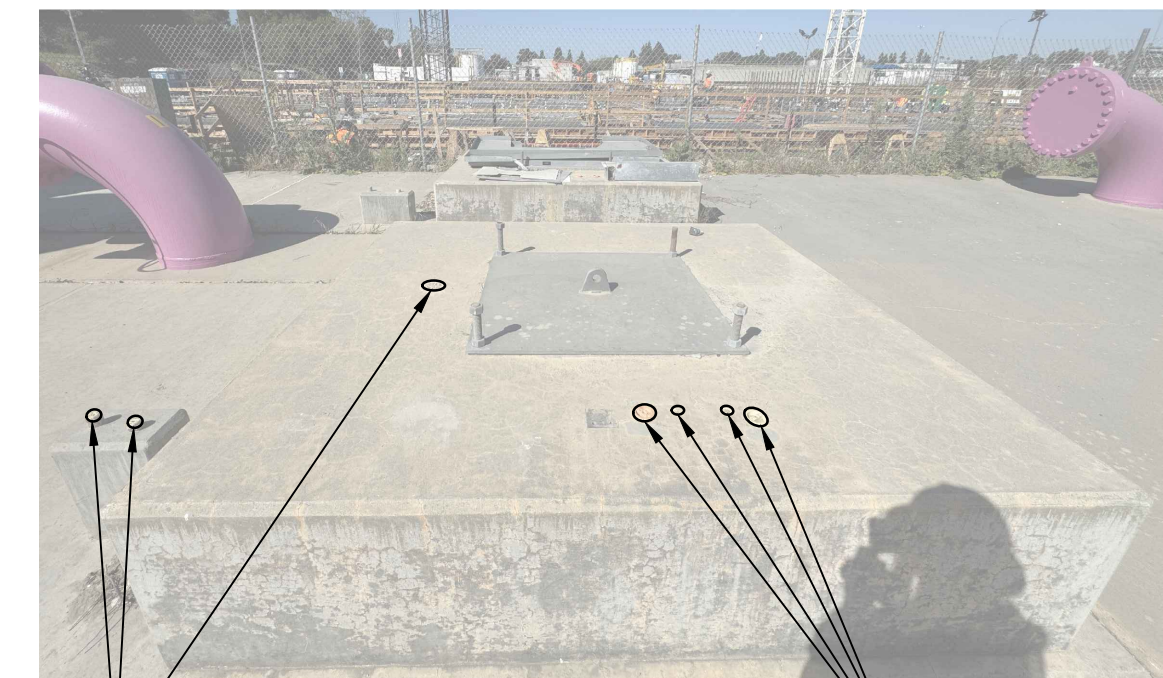
INTERCEPT THESE EXISTING
CONDUITS ABOVE GROUND.
STUB AND CAP FOR REUSE.
(TYPICAL FOR ALL EXISTING
PUMP PEDESTALS AND
EXHAUST FAN PANELS)

PROTECT IN PLACE ALL EXISTING PULL BOXES,
CONDUITS AND CONDUIT STUB-UPS.
(TYPICAL FOR ALL EXISTING PUMP PEDESTALS)

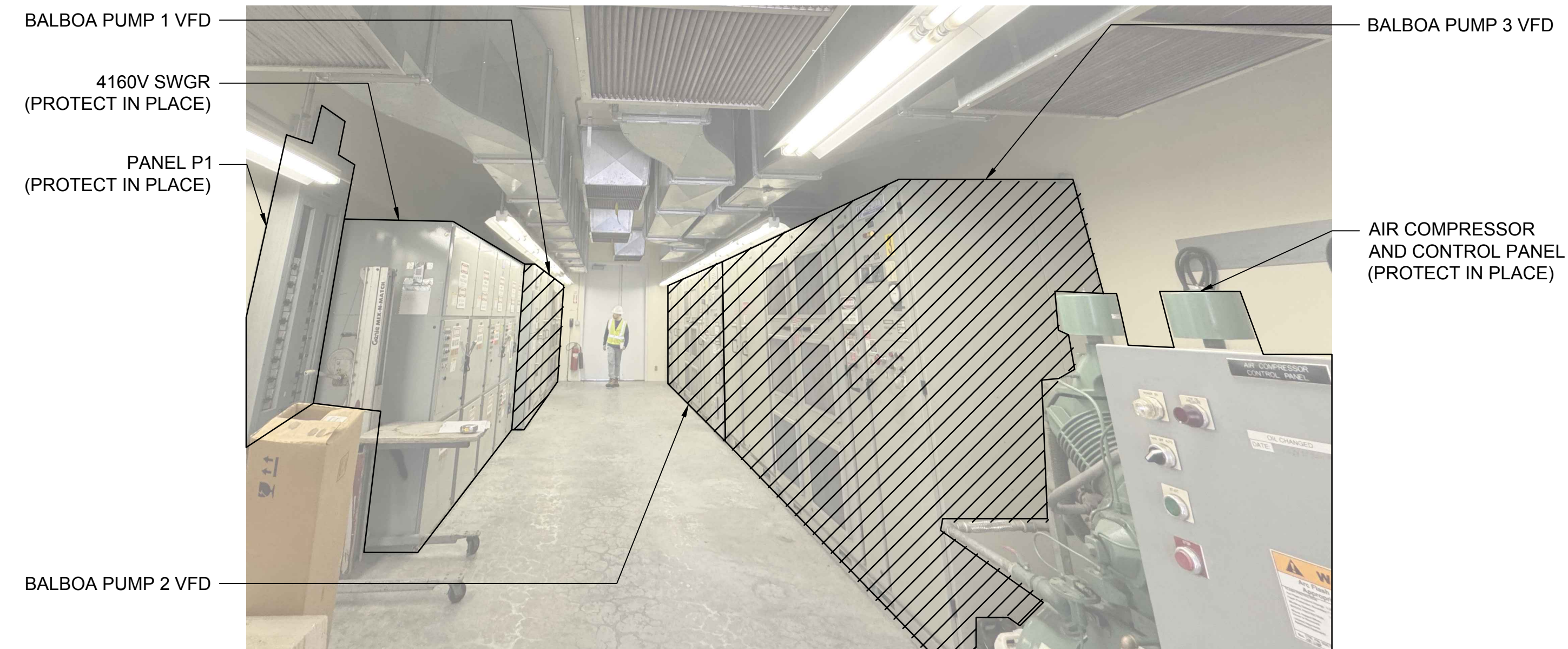
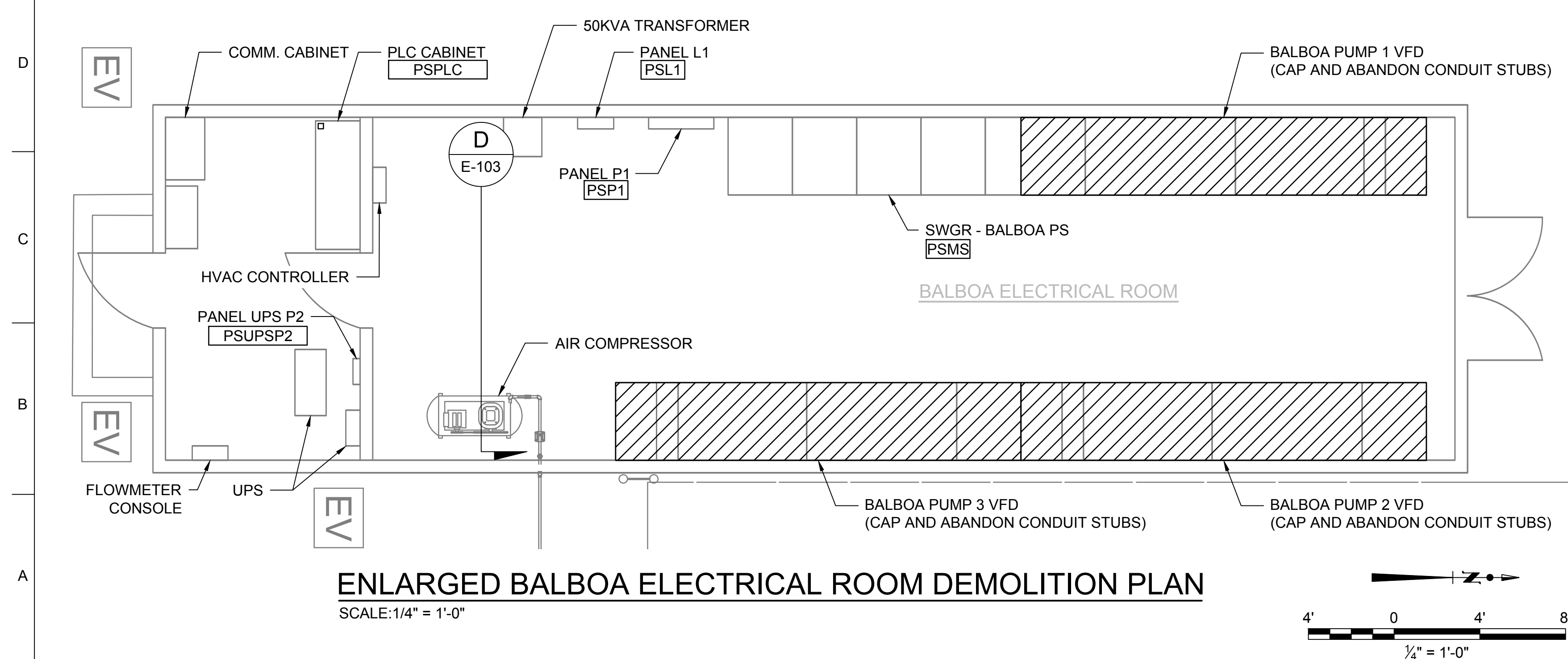
A BALBOA PUMP STATION
E-103 SCALE: N.T.S



B BALBOA PUMPS 1, 2, AND 3
E-103 SCALE: N.T.S



C BALBOA PUMP PEDESTAL 5
E-103 SCALE: N.T.S



D ENLARGED BALBOA ELECTRICAL ROOM
E-103 SCALE: N.T.S

90%DESIGN
NOT FOR CONSTRUCTION



REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

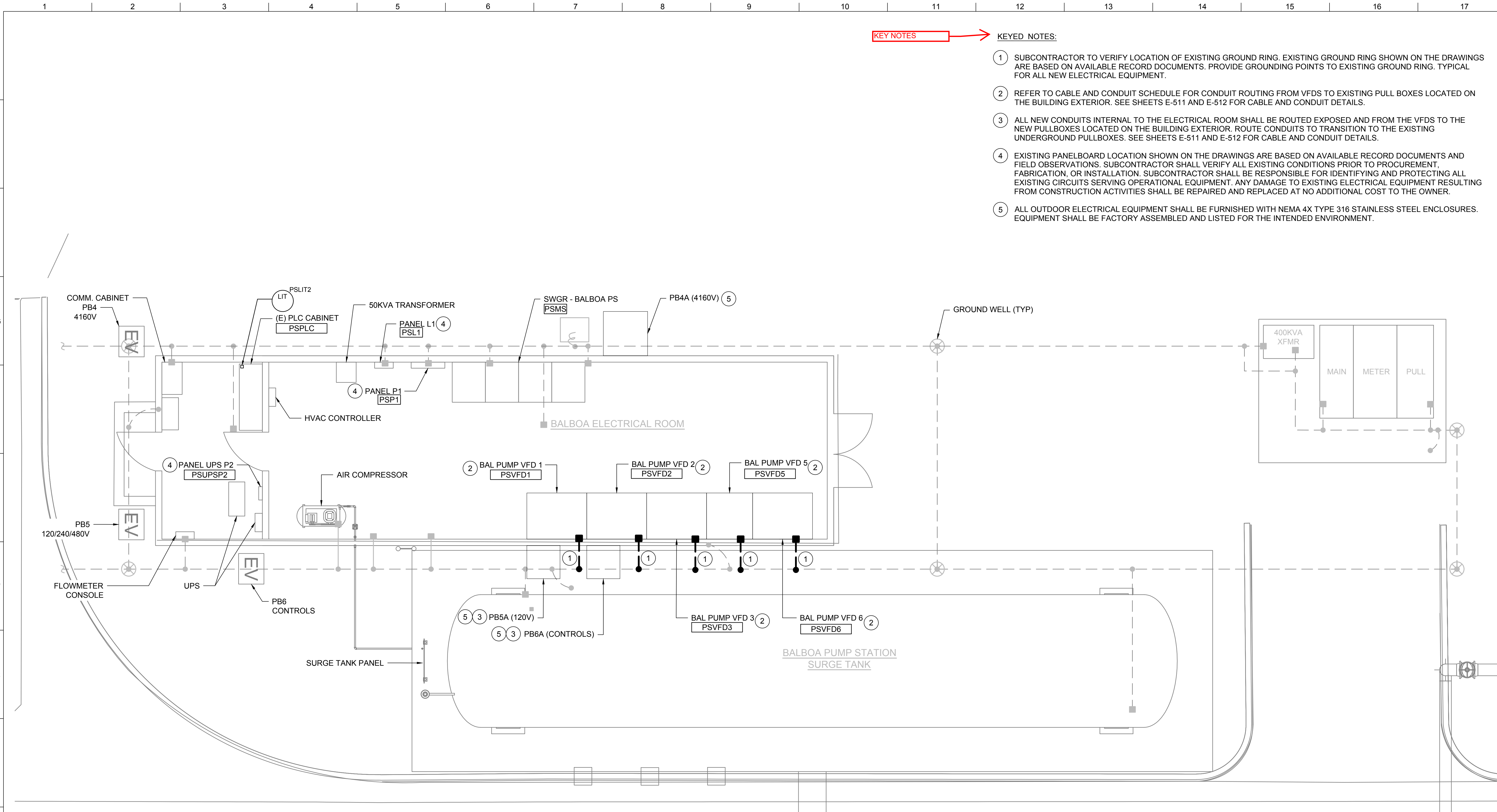
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Drawn By	B DIETER	09/02/2026		
Checked By	E LOVERING	09/02/2026	As to Distribution	
Last Update	SGRIEBEL	09/02/2026		
Recommended			Senior Assistant GM of Water	

**GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
BALBOA DEMOLITION PLAN**

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

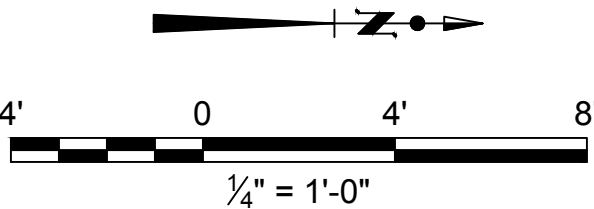
DRAWING NUMBER
D-06100-E-103



KEY NOTES

- KEYED NOTES:
- 1 SUBCONTRACTOR TO VERIFY LOCATION OF EXISTING GROUND RING. EXISTING GROUND RING SHOWN ON THE DRAWINGS ARE BASED ON AVAILABLE RECORD DOCUMENTS. PROVIDE GROUNDING POINTS TO EXISTING GROUND RING. TYPICAL FOR ALL NEW ELECTRICAL EQUIPMENT.
 - 2 REFER TO CABLE AND CONDUIT SCHEDULE FOR CONDUIT ROUTING FROM VFDS TO EXISTING PULL BOXES LOCATED ON THE BUILDING EXTERIOR. SEE SHEETS E-511 AND E-512 FOR CABLE AND CONDUIT DETAILS.
 - 3 ALL NEW CONDUITS INTERNAL TO THE ELECTRICAL ROOM SHALL BE ROUTED EXPOSED AND FROM THE VFDS TO THE NEW PULLBOXES LOCATED ON THE BUILDING EXTERIOR. ROUTE CONDUITS TO TRANSITION TO THE EXISTING UNDERGROUND PULLBOXES. SEE SHEETS E-511 AND E-512 FOR CABLE AND CONDUIT DETAILS.
 - 4 EXISTING PANELBOARD LOCATION SHOWN ON THE DRAWINGS ARE BASED ON AVAILABLE RECORD DOCUMENTS AND FIELD OBSERVATIONS. SUBCONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS PRIOR TO PROCUREMENT, FABRICATION, OR INSTALLATION. SUBCONTRACTOR SHALL BE RESPONSIBLE FOR IDENTIFYING AND PROTECTING ALL EXISTING CIRCUITS SERVING OPERATIONAL EQUIPMENT. ANY DAMAGE TO EXISTING ELECTRICAL EQUIPMENT RESULTING FROM CONSTRUCTION ACTIVITIES SHALL BE REPAIRED AND REPLACED AT NO ADDITIONAL COST TO THE OWNER.
 - 5 ALL OUTDOOR ELECTRICAL EQUIPMENT SHALL BE FURNISHED WITH NEMA 4X TYPE 316 STAINLESS STEEL ENCLOSURES. EQUIPMENT SHALL BE FACTORY ASSEMBLED AND LISTED FOR THE INTENDED ENVIRONMENT.

1 ENLARGED BALBOA ELECTRICAL ROOM PLAN
E-102 SCALE: 1/4" = 1'-0"



90%DESIGN
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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES		Scale		DATE		APPROVED		DATE	
		AS SHOWN				As to Design			
		Designer	R UYEKAWA	09/02/2026		As to Operation			
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		Checked By	E LOVERING	09/02/2026					
		Last Update	SGRIEBEL	09/02/2026		Senior Assistant GM of Water			
		Recommended							
		File Name							

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
ENLARGED BALBOA ELECTRICAL ROOM PLAN

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-E-104

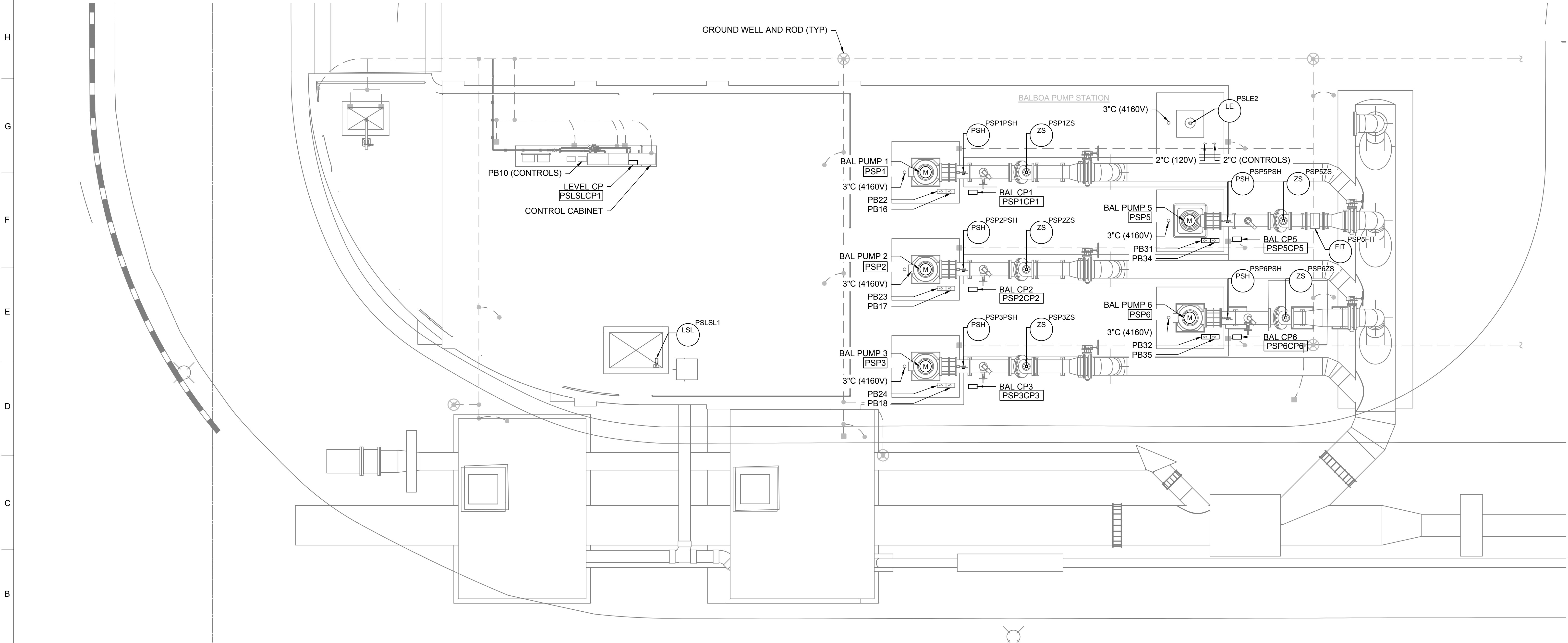
- GENERAL NOTES:
- NOTES
1.

SUBCONTRACTOR TO VERIFY LOCATION OF EXISTING GROUND RING. EXISTING GROUND RING SHOWN ON THE DRAWINGS ARE BASED ON AVAILABLE RECORD DOCUMENTS. PROVIDE GROUNDING POINTS TO EXISTING GROUND RING. TYPICAL FOR ALL NEW ELECTRICAL EQUIPMENT.
2.

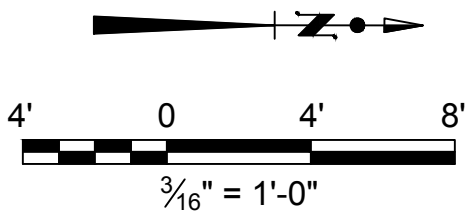
SUBCONTRACTOR TO VERIFY ALL EXISTING CONDUIT PATHWAYS THAT WILL BE UTILIZED. SEE SHEETS E-511 AND E-512 FOR CABLE AND CONDUIT DETAILS. NO CONDUIT PENETRATIONS THROUGH THE EXISTING FOREBAY ALLOWED.
3.

EXISTING EQUIPMENT LOCATIONS SHOWN ON THE DRAWINGS ARE BASED ON AVAILABLE RECORD DOCUMENTS AND FIELD OBSERVATIONS. SUBCONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS PRIOR TO PROCUREMENT, FABRICATION, OR INSTALLATION. SUBCONTRACTOR SHALL BE RESPONSIBLE FOR IDENTIFYING AND PROTECTING ALL EXISTING CIRCUITS SERVING OPERATIONAL EQUIPMENT. ANY DAMAGE TO EXISTING ELECTRICAL EQUIPMENT RESULTING FROM CONSTRUCTION ACTIVITIES SHALL BE REPAIRED AND REPLACED AT NO ADDITIONAL COST TO THE OWNER.
4.

ALL OUTDOOR ELECTRICAL EQUIPMENT SHALL BE FURNISHED WITH NEMA 4X TYPE 316 STAINLESS STEEL ENCLOSURES. EQUIPMENT SHALL BE FACTORY ASSEMBLED AND LISTED FOR THE INTENDED ENVIRONMENT.



1 ENLARGED BALBOA PUMP STATION PLAN
E-102 SCALE: 3/16" = 1'-0"



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REVISIONS				
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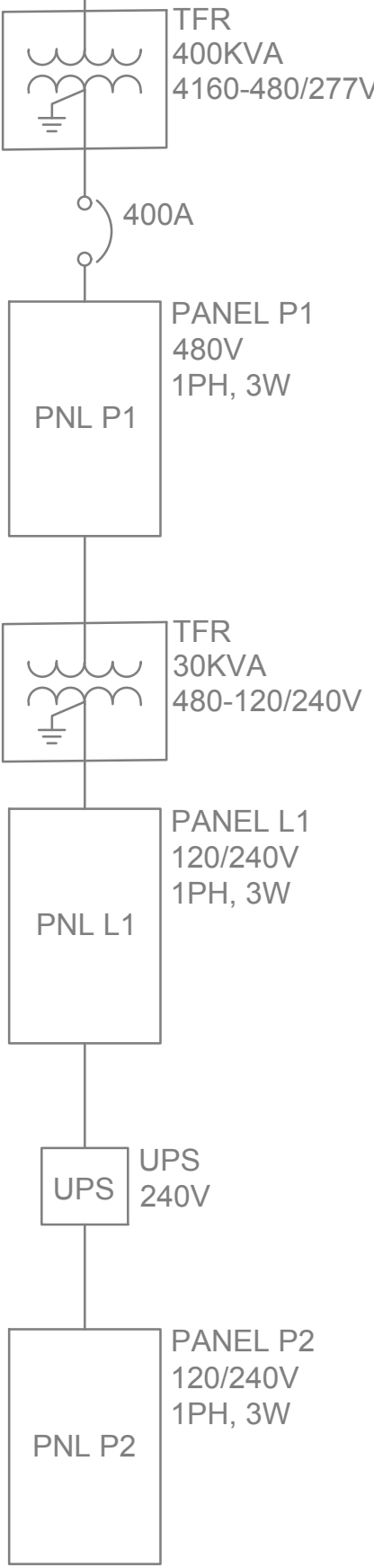
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						As to Distribution			
						Senior Assistant GM of Water			

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
ENLARGED BALBOA PUMP STATION PLAN

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-E-105



SWGR - BALBOA PUMP STATION (4160V)						
LOAD	HP	VFD	CONNECTED LOAD (A)	DEMAND LOAD (A)	DEMAND KVA	REMARKS
BALBOA PUMP 1 (PSP1)	1000	X	125.0	125.0	873.0	DUTY - DEMAND KVA ASSUMES 95% EFFICIENCY AND 0.9 P.F.
BALBOA PUMP 2 (PSP2)	1000	X	125.0	125.0	873.0	DUTY - DEMAND KVA ASSUMES 95% EFFICIENCY AND 0.9 P.F.
BALBOA PUMP 3 (PSP3)	1000	X	125.0	125.0	873.0	DUTY - DEMAND KVA ASSUMES 95% EFFICIENCY AND 0.9 P.F.
BALBOA PUMP 5 (PSP5)	500	X	68.0	0.0	0.0	LO FLO
BALBOA PUMP 6 (PSP6)	1000	X	125.0	0.0	0.0	STANDBY
TFR	-	-	40.0	40.0	290.0	PER D-4972 AS-BUILT AND NEW LOADS
25% LARGEST MOTOR LOAD	-	-	31.3	31.3	225.2	
TOTAL			639.0	446.0	3134.0	

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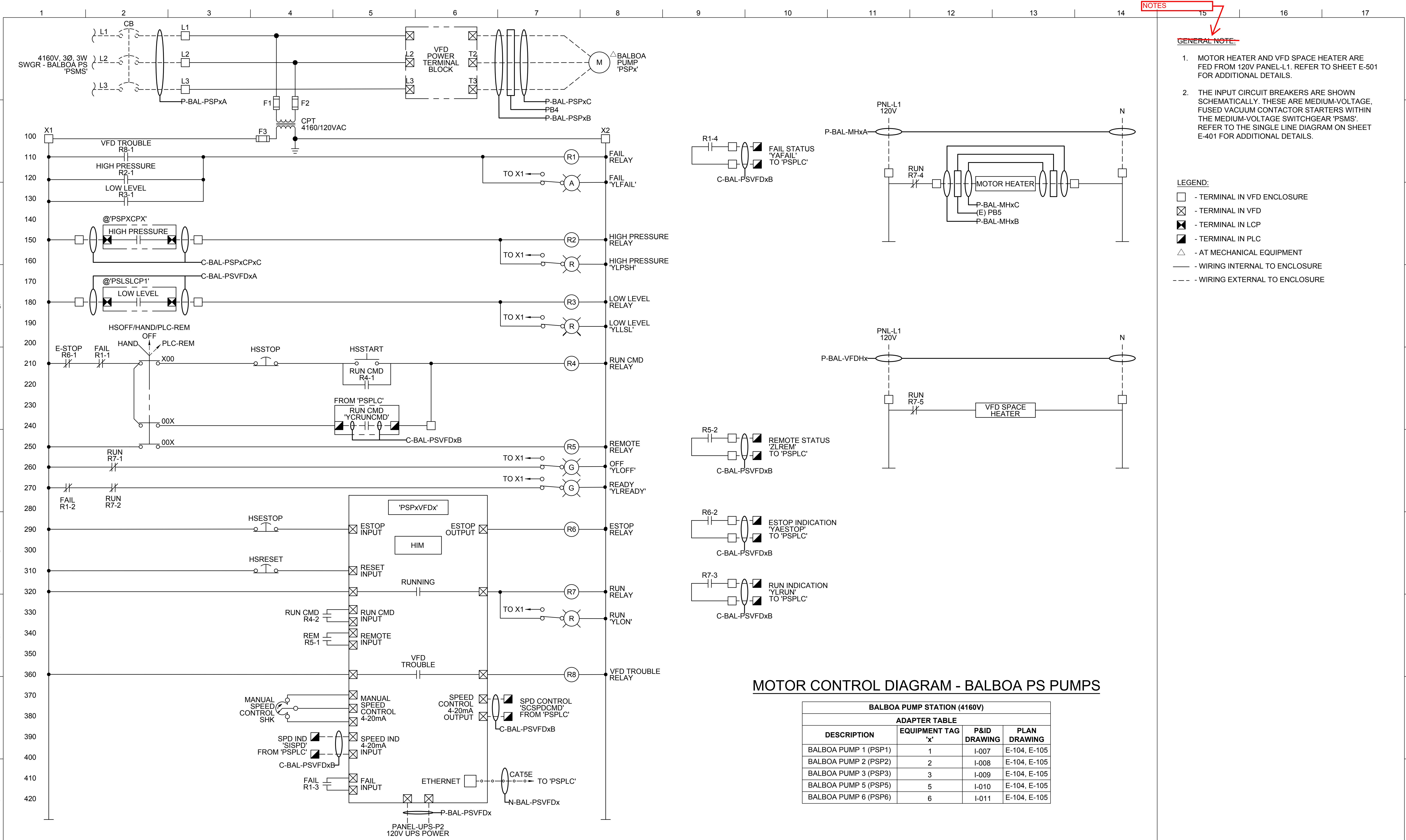


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	Designer	R UYEKAWA	09/02/2026	As to Design	
	Stamp	R UYEKAWA	09/02/2026	As to Operation	
	Drawn By	B DIETER	09/02/2026		
	Checked By	E LOVERING	09/02/2026	As to Distribution	
	Last Update	SGRIEBEL	09/02/2026		
				Senior Assistant GM of Water	
File Name	Recommended				
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DRAWING NUMBER
D-06100-E-401

D-06100-E-411

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES			
Scale	AS SHOWN	DATE	APPROVED
Designer	R UYEKAWA	09/02/2026	As to Design
Stamp	R UYEKAWA	09/02/2026	As to Operation
Drawn By	B DIETER	09/02/2026	As to Distribution
Checked By	E LOVERING	09/02/2026	As to Distribution
Last Update	SGRIEBEL	09/02/2026	As to Distribution
Recommended		4/22/26	Senior Assistant GM of Water
File Name	D-06100-E-411.dwg		

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
CONTROL DIAGRAM

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-E-411

FIX DATES AND
OVERLAP

D-06100-E-511

FILENAME: C:\PWP\WORKDIR\JACOBS-AMER-WTRID0274660-D-06-00-E-511.DWG
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		2			3			4			5			6			7			8			9			10			11			12			13			14			15			16			17
CABLE AND CONDUIT SCHEDULE																																															
#	SYSTEM	VOLT TYPE	CONDUIT TAG	SIZE (IN)	UG CONDUIT TYPE	AG CONDUIT TYPE	CONDUCTORS	GND	SPARE	FROM TAG NO	FROM DESCRIPTION	TO TAG NO.	TO DESCRIPTION	SINGLE LINE DWG	CONTROL DIAGRAM DWG	ELECTRICAL PLAN DWG	CABLE BLOCK DIAGRAM	REMARKS																													
1	BAL PUMP 1	4160V	P-BAL-PSP1A	2.00	-	RGS	3#2/0	1#6	N/A	PSMS	(E) SWGR - BALBOA PS	PSVFD1	VFD - BAL PUMP 1	E-401	E-411	E-104	E-521	1000HP, 125FLA, ROUTE EXPOSED																													
2	BAL PUMP 1	4160V	P-BAL-PSP1B	2.00	PVC	RGS	3#2/0	1#6	N/A	PSVFD1	VFD - BAL PUMP 1	PB4	(E) PULLBOX 4 - 4160V	E-401	E-411	E-104	E-521	PASS THRU PB4A																													
3	BAL PUMP 1	4160V	P-BAL-PSP1C	3.00	EXISTING	EXISTING	3#2/0	1#6	N/A	PB4	(E) PULLBOX 4 - 4160V	PSP1	PUMP 1 - BAL	E-401	E-411	E-104, E-105	E-521	UTILIZE (E) 4160V 3°C TO PUMP 1																													
4	BAL PUMP 1	120V	P-BAL-PSMH1A	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFD1	VFD - BAL PUMP 1	-	-	E-104	-	ROUTE EXPOSED																													
5	BAL PUMP 1	120V	P-BAL-PSMH1B	1.00	PVC	RGS	2#12	1#12	N/A	PSVFD1	VFD - BAL PUMP 1	PB5	(E) PULLBOX 5 - 120V	-	-	E-104	-	PASS THRU PB5A																													
6	BAL PUMP 1	120V	P-BAL-PSMH1C	2.00	EXISTING	EXISTING	2#12	1#12	N/A	PB5	(E) PULLBOX 5 - 120V	PSMH1	MOTOR HEATER - PUMP 1	-	-	E-104, E-105	-	UTILIZE (E) 120V 2°C TO PUMP 1																													
7	BAL PUMP 1	120V	P-BAL-PSVFDH1	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFDH1	VFD SPACE HEATER/CONTROLS - BAL PUMP 1	-	-	E-104	-	ROUTE EXPOSED																													
8	BAL PUMP 1	120V	P-BAL-PSVFD1	1.00	-	RGS	2#12	1#12	N/A	PSUPSP2	(E) PANEL-UPS-P2 - 120/240V	PSVFD1	VFD - BAL PUMP 1	-	E-411	E-104	E-521	ROUTE EXPOSED, UPS POWER																													
9	BAL PUMP 2	4160V	P-BAL-PSP2A	2.00	-	RGS	3#2/0	1#6	N/A	PSMS	(E) SWGR - BALBOA PS	PSVFD2	VFD - BAL PUMP 2	E-401	E-411	E-104	E-522	1000HP, 125FLA, ROUTE EXPOSED																													
10	BAL PUMP 2	4160V	P-BAL-PSP2B	2.00	EXISTING	EXISTING	3#2/0	1#6	N/A	PSVFD2	VFD - BAL PUMP 2	PB4	(E) PULLBOX 4 - 4160V	E-401	E-411	E-104	E-522	PASS THRU PB4A																													
11	BAL PUMP 2	4160V	P-BAL-PSP2C	3.00	EXISTING	EXISTING	3#2/0	1#6	N/A	PB4	(E) PULLBOX 4 - 4160V	PSP2	PUMP 2 - BAL	E-401	E-411	E-104, E-105	E-522	UTILIZE (E) 4160V 3°C TO PUMP 2																													
12	BAL PUMP 1	120V	P-BAL-PSMH2A	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFD2	VFD - BAL PUMP 2	-	-	E-104	-	ROUTE EXPOSED																													
13	BAL PUMP 1	120V	P-BAL-PSMH2B	1.00	PVC	RGS	2#12	1#12	N/A	PSVFD2	VFD - BAL PUMP 2	PB5	(E) PULLBOX 5 - 120V	-	-	E-104	-	PASS THRU PB5A																													
14	BAL PUMP 2	120V	P-BAL-PSMH2C	2.00	EXISTING	EXISTING	2#12	1#12	N/A	PB5	(E) PULLBOX 5 - 120V	PSMH2	MOTOR HEATER - PUMP 2	-	-	E-104, E-105	-	UTILIZE (E) 120V 2°C TO PUMP 2																													
15	BAL PUMP 2	120V	P-BAL-PSVFDH2	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFDH2	VFD SPACE HEATER/CONTROLS - BAL PUMP 2	-	-	E-104	-	ROUTE EXPOSED																													
16	BAL PUMP 2	120V	P-BAL-PSVFD2	1.00	-	RGS	2#12	1#12	N/A	PSUPSP2	(E) PANEL-UPS-P2 - 120/240V	PSVFD2	VFD - BAL PUMP 2	-	E-411	E-104	E-522	ROUTE EXPOSED, UPS POWER																													
17	BAL PUMP 3	4160V	P-BAL-PSP3A	2.00	-	RGS	3#2/0	1#6	N/A	PSMS	(E) SWGR - BALBOA PS	PSVFD3	VFD - BAL PUMP 3	E-401	E-411	E-104	E-523	1000HP, 125FLA, ROUTE EXPOSED																													
18	BAL PUMP 3	4160V	P-BAL-PSP3B	2.00	PVC	RGS	3#2/0	1#6	N/A	PSVFD3	VFD - BAL PUMP 3	PB4	(E) PULLBOX 4 - 4160V	E-401	E-411	E-104	E-523	PASS THRU PB4A																													
19	BAL PUMP 3	4160V	P-BAL-PSP3C	3.00	EXISTING	EXISTING	3#2/0	1#6	N/A	PB4	(E) PULLBOX 4 - 4160V	PSP3	PUMP 3 - BAL	E-401	E-411	E-104, E-105	E-523	UTILIZE (E) 4160V 3°C TO PUMP 3																													
20	BAL PUMP 1	120V	P-BAL-PSMH3A	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFD3	VFD - BAL PUMP 3	-	-	E-104	-	ROUTE EXPOSED																													
21	BAL PUMP 1	120V	P-BAL-PSMH3B	1.00	PVC	RGS	2#12	1#12	N/A	PSVFD3	VFD - BAL PUMP 3	PB5	(E) PULLBOX 5 - 120V	-	-	E-104	-	PASS THRU PB5A																													
22	BAL PUMP 3	120V	P-BAL-PSMH3C	2.00	EXISTING	EXISTING	2#12	1#12	N/A	PB5	(E) PULLBOX 5 - 120V	PSMH3	MOTOR HEATER - PUMP 3	-	-	E-104, E-105	-	UTILIZE (E) 120V 2°C TO PUMP 3																													
23	BAL PUMP 3	120V	P-BAL-PSVFDH3	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFDH3	VFD SPACE HEATER/CONTROLS - BAL PUMP 3	-	-	E-104	-	ROUTE EXPOSED																													
24	BAL PUMP 3	120V	P-BAL-PSVFD3	1.00	-	RGS	2#12	1#12	N/A	PSUPSP2	(E) PANEL-UPS-P2 - 120/240V	PSVFD3	VFD - BAL PUMP 3	-	E-411	E-104	E-523	ROUTE EXPOSED, UPS POWER																													
25	BAL PUMP 5	4160V	P-BAL-PSP5A	2.00	-	RGS	3#4	1#8	N/A	PSMS	(E) SWGR - BALBOA PS	PSVFD5	VFD - BAL PUMP 5	E-401	E-411	E-104	E-525	500HP, 68FLA, ROUTE EXPOSED																													
26	BAL PUMP 5	4160V	P-BAL-PSP5B	2.00	PVC	RGS	3#4	1#8	N/A	PSVFD5	VFD - BAL PUMP 5	PB4	(E) PULLBOX 4 - 4160V	E-401	E-411	E-104	E-525	PASS THRU PB4A																													
27	BAL PUMP 5	4160V	P-BAL-PSP5C	3.00	EXISTING	EXISTING	3#4	1#8	N/A	PB4	(E) PULLBOX 4 - 4160V	PSP5	PUMP 5 - BAL	E-401	E-411	E-104, E-105	E-525	UTILIZE (E) 4160V 3°C TO PUMP 5																													
28	BAL PUMP 1	120V	P-BAL-PSMH5A	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFD5	VFD - BAL PUMP 5	-	-	E-104	-	ROUTE EXPOSED																													
29	BAL PUMP 1	120V	P-BAL-PSMH5B	1.00	PVC	RGS	2#12	1#12	N/A	PSVFD5	VFD - BAL PUMP 5	PB5	(E) PULLBOX 5 - 120V	-	-	E-104	-	PASS THRU PB5A																													
30	BAL PUMP 5	120V	P-BAL-PSMH5C	2.00	EXISTING	EXISTING	2#12	1#12	N/A	PB5	(E) PULLBOX 5 - 120V	PSMH5	MOTOR HEATER - PUMP 5	-	-	E-104, E-105	-	UTILIZE (E) 120V 2°C TO PUMP 5																													
31	BAL PUMP 5	120V	P-BAL-PSVFDH5	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFDH5	VFD SPACE HEATER/CONTROLS - BAL PUMP 5	-	-	E-104	-	ROUTE EXPOSED																													
32	BAL PUMP 5	120V	P-BAL-PSVFD5	1.00	-	RGS	2#12	1#12	N/A	PSUPSP2	(E) PANEL-UPS-P2 - 120/240V	PSVFD5	VFD - BAL PUMP 5	-	E-411	E-104	E-525	ROUTE EXPOSED, UPS POWER																													
33	BAL PUMP 5	120V	P-BAL-PSP5FITA	1.00	PVC	RGS	2#12	1#12	N/A	PSUPSP2	(E) PANEL-UPS-P2 - 120/240V	PB31	PULLBOX 31 - 120V	-	-	E-104, E-105	E-525	UPS POWER, PASS THRU PB5 TO PNL-UPS-P2, UTILIZE (E) CONDUIT FROM PB31 TO PB5																													
34	BAL PUMP 5	120V	P-BAL-PSP5FITB	1.00	-	RGS	2#12	1#12	N/A	PB31	PULLBOX 31 - 120V	PSP5FIT	FLOW TRANSMITTER	-	-	E-105	E-525	ROUTE EXPOSED, UPS POWER																													
35	BAL PUMP 6	4160V	P-BAL-PSP6A	2.00	-	RGS	3#2/0	1#6	N/A	PSMS	(E) SWGR - BALBOA PS	PSVFD6	VFD - BAL PUMP 6	E-401	E-411	E-104	E-526	1000HP, 125FLA, ROUTE EXPOSED																													
36	BAL PUMP 6	4160V	P-BAL-PSP6B	2.00	PVC	RGS	3#2/0	1#6	N/A	PSVFD6	VFD - BAL BUMP 6	PB4	(E) PULLBOX 4 - 4160V	E-401	E-411	E-104	E-526	PASS THRU PB4A																													
37	BAL PUMP 6	4160V	P-BAL-PSP6C	3.00	EXISTING	EXISTING	3#2/0	1#6	N/A	PB4	(E) PULLBOX 4 - 4160V	PSP6	PUMP 6 - BAL	E-401	E-411	E-104, E-105	E-526	UTILIZE (E) 4160V 3°C TO PUMP 6																													
38	BAL PUMP 1	120V	P-BAL-PSMH6A	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V	PSVFD6	VFD - BAL PUMP 6	-	-	E-104	-	ROUTE EXPOSED																													
39	BAL PUMP 1	120V	P-BAL-PSMH6B	1.00	PVC	RGS	2#12	1#12	N/A	PSVFD6	VFD - BAL PUMP 6	PB5	(E) PULLBOX 5 - 120V	-	-	E-104	-	PASS THRU PB5A																													
40	BAL PUMP 6	120V	P-BAL-PSMH6C	2.00	EXISTING	EXISTING	2#12	1#12	N/A	PB5	(E) PULLBOX 5 - 120V	PSMH6	MOTOR HEATER - PUMP 6	-	-	E-104, E-105	-	UTILIZE (E) 120V 2°C TO PUMP 6																													
41	BAL PUMP 6	120V	P-BAL-PSVFDH6	1.00	-	RGS	2#12	1#12	N/A	PSL1	(E) PANEL-L1 - 120/208V																																				

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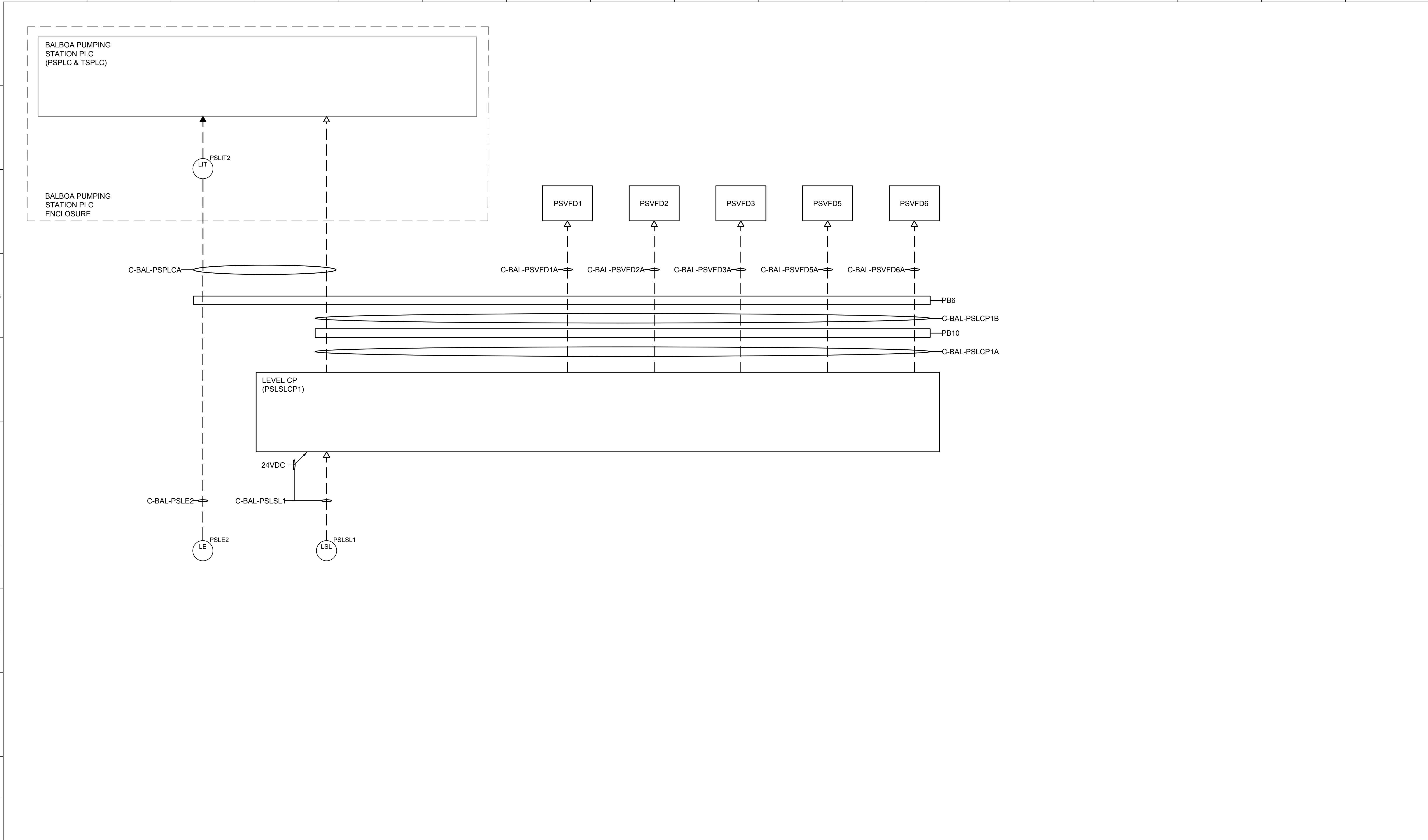
Number	Date	Initials	REVISIONS Description	Approved



LEE+RO
WATER INFRASTRUCTURE ENGINEERS

D-06100-E-520

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REVISIONS				
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		Designer	R UYEKAWA	09/02/2026	As to Design		
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		Drawn By	B DIETER	09/02/2026			
		Checked By	E LOVERING	09/02/2026	As to Distribution		
		Last Update	SGRIEBEL	09/02/2026			
		Recommended			Senior Assistant GM of Water		
		File Name					
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GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
FOREBAY INSTRUMENTATION CABLE BLOCK DIAGRAM

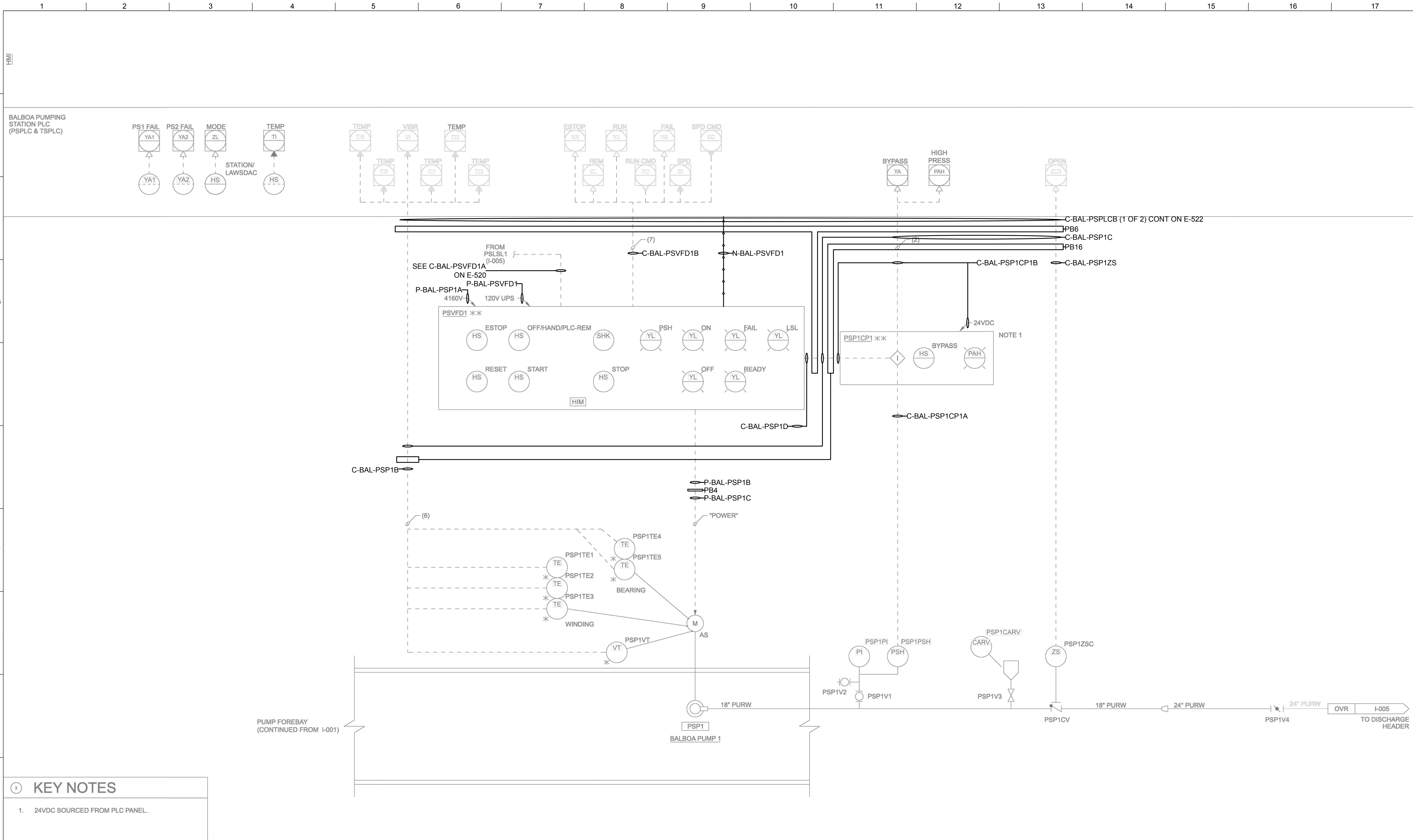
DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

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Designer R UYEKAWA 09/02/2026
Stamp R UYEKAWA 09/02/2026
Drawn By B DIETER 09/02/2026
Checked By E LOVERING 09/02/2026
Last Update SGRIEBEL 09/02/2026

Recommended

Senior Assistant GM of Water

APPROVED

DATE

As to Design
As to Operation
As to Distribution

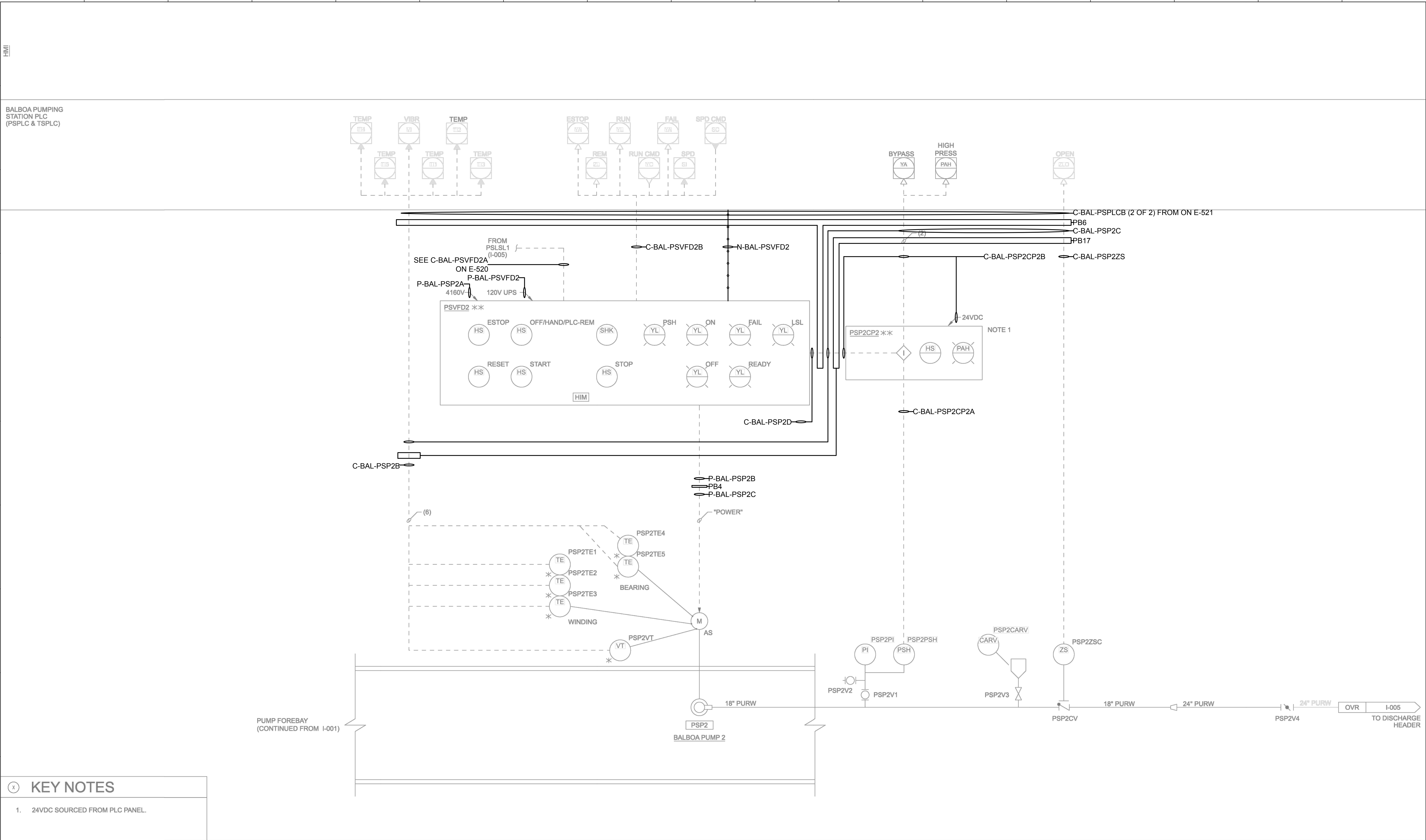
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GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PUMP 1 CABLE BLOCK DIAGRAM

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-E-521



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REVISIONS				
Number	Date	Initials	Description	Approved

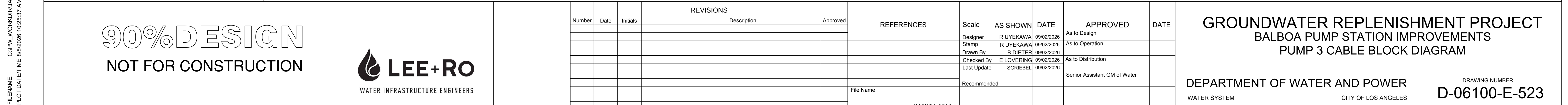
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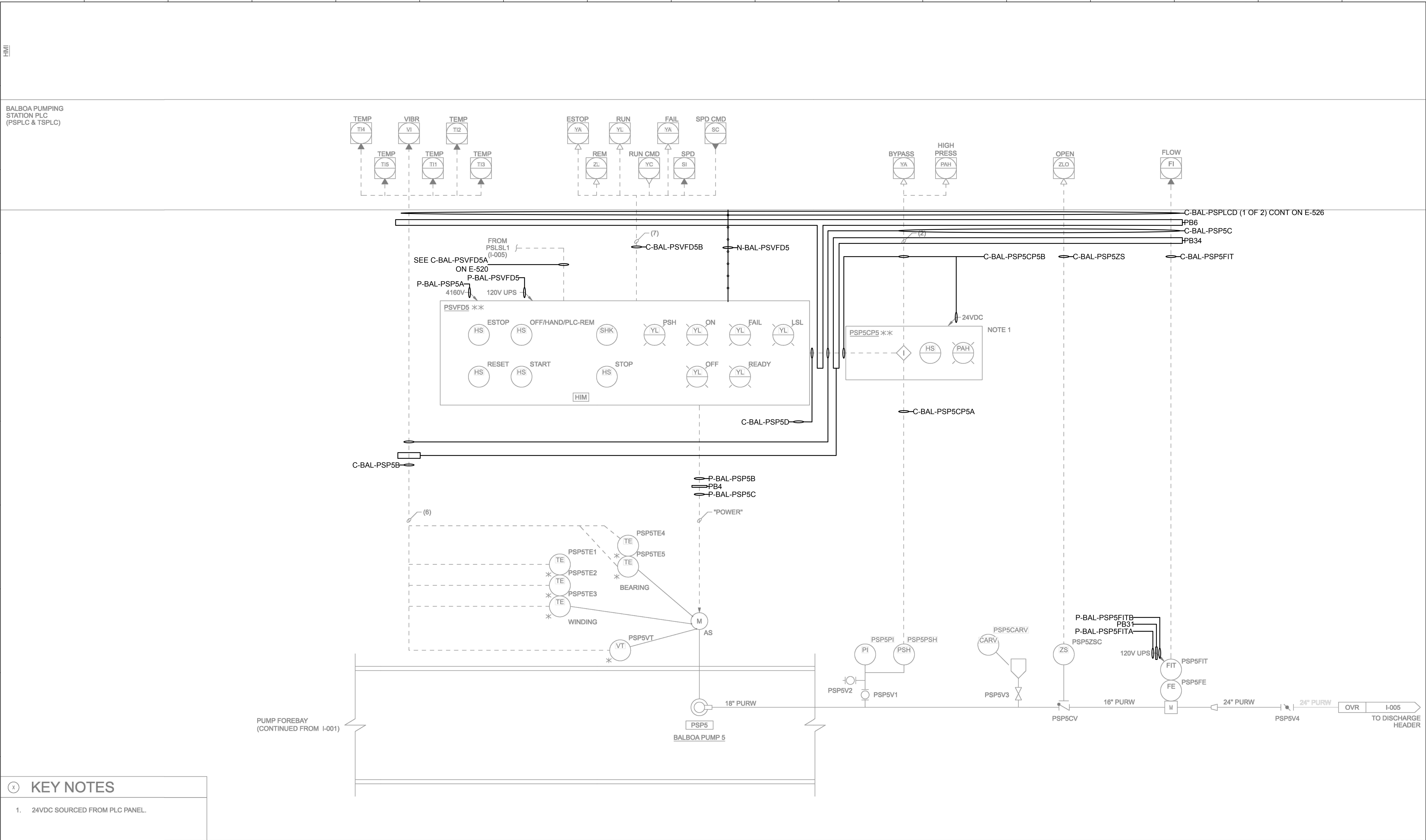
GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PUMP 2 CABLE BLOCK DIAGRAM

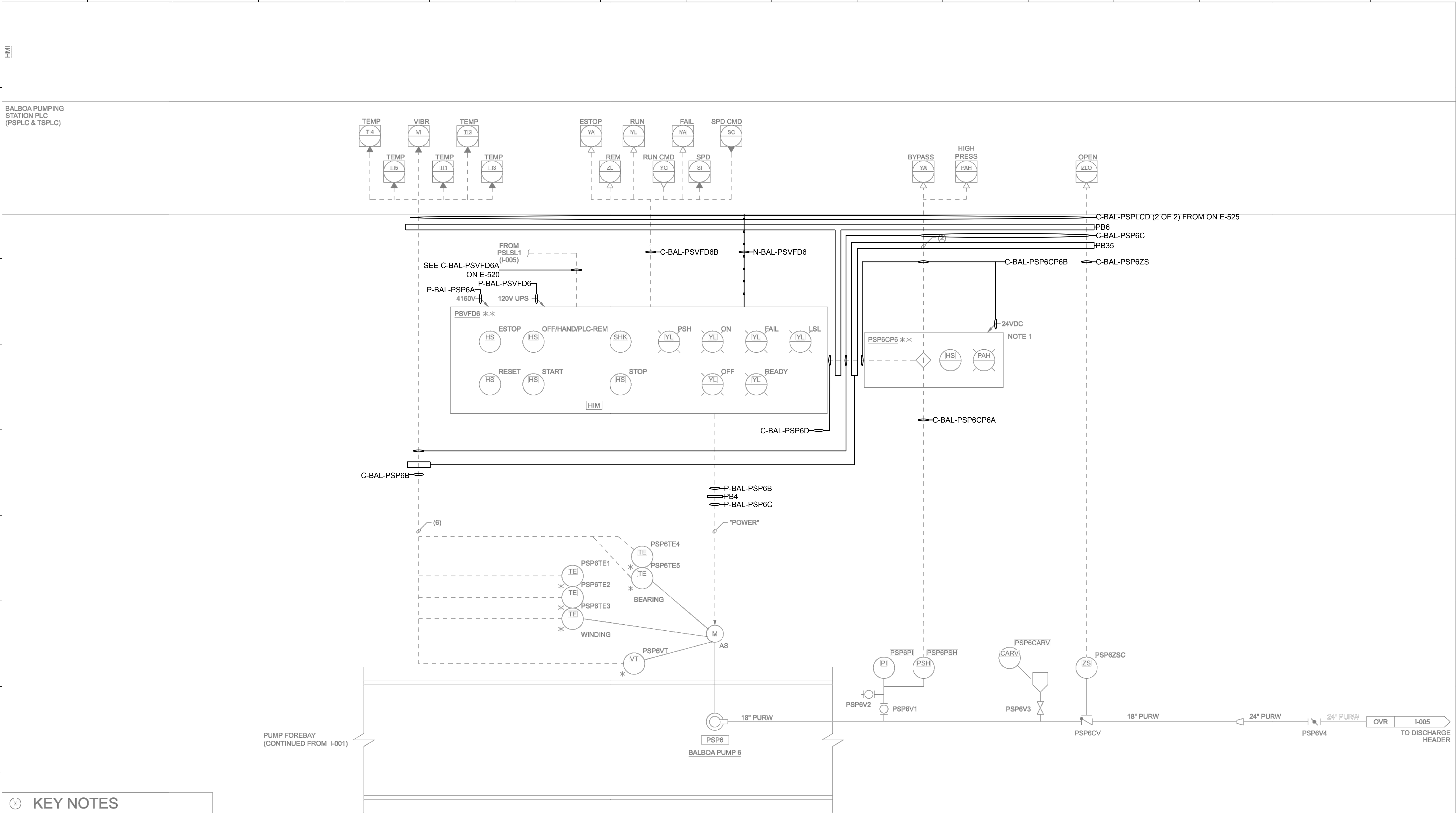
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WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
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Number	Date	Initials	Description	Approved

REFERENCES		Scale		DATE		APPROVED		DATE	
		AS SHOWN				As to Design			
						As to Operation			
						As to Distribution			
						Senior Assistant GM of Water			

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PUMP 6 CABLE BLOCK DIAGRAM

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

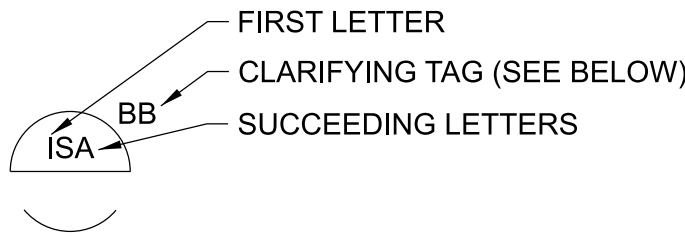
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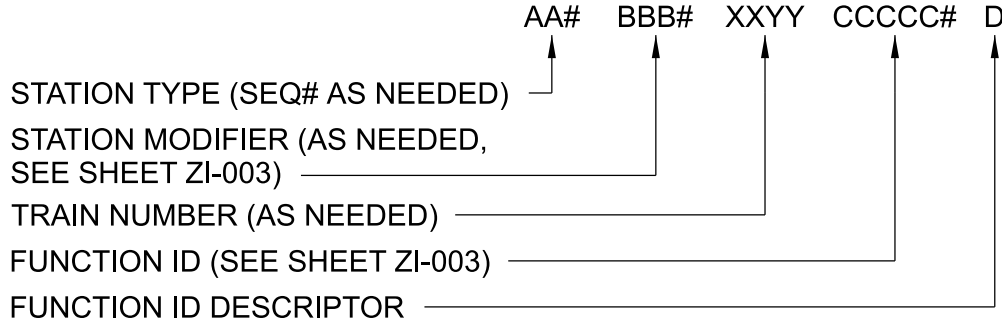
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INSTRUMENT IDENTIFICATION

EXAMPLE SYMBOLS



EQUIPMENT / INSTRUMENT TAGGING



DIGITAL SYSTEM INTERFACES

- ▲ ANALOG INPUT
- ▼ ANALOG OUTPUT
- △_x DISCRETE INPUT
- ▽_x DISCRETE OUTPUT

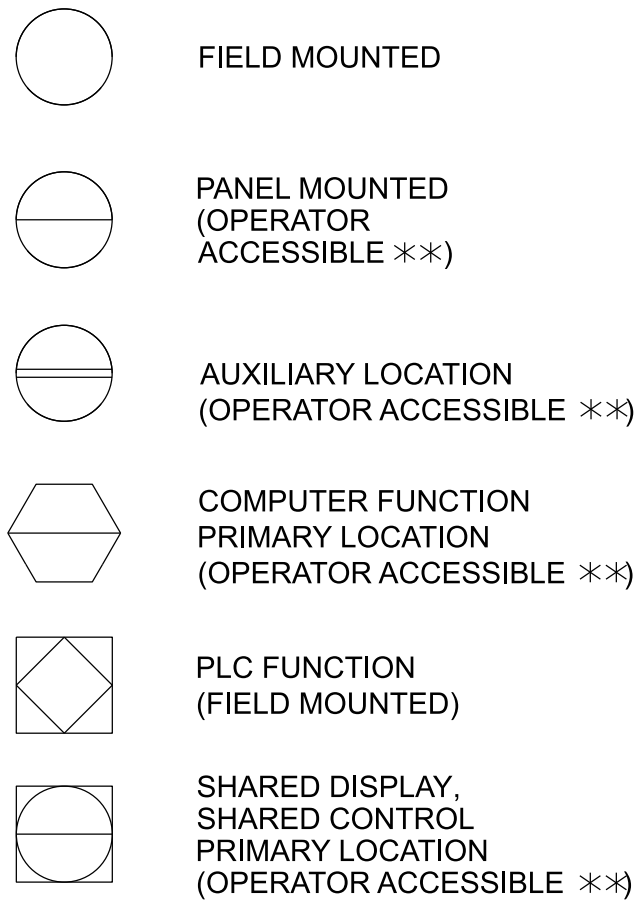
INSTRUMENT IDENTIFICATION LETTERS TABLE

LETTER	FIRST-LETTER		SUCCEEDING-LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	READOUT OR PASSIVE FUNCTION	READOUT OR PASSIVE FUNCTION
A	ANALYSIS (+)		ALARM	USER'S CHOICE (*)	USER'S CHOICE (*)
B	BURNER, COMBUSTION		USER'S CHOICE (*)		CLOSED
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	
D	DENSITY (MASS) OR S.G.	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT, SENSOR		
F	FLOW RATE	RATIO (FRACTION)			
G	GAUGING (DIMENSIONAL)		GLASS, GAUGE VIEWING DEVICE		
H	HAND (MANUAL INITIATION)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE, HUMIDITY	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		ISOLATOR (SIGNAL)	USER'S CHOICE (*)	USER'S CHOICE (*)
O	USER'S CHOICE (*)		ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTAL			
R	RADIATION, RESTRICTION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	TRIP
U	MULTI VARIABLE		MULTI FUNCTION	MULTI FUNCTION	MULTI FUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED STATUS	X AXIS	UNCLASSIFIED (*)	UNCLASSIFIED (*)	UNCLASSIFIED (*)
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVE, ACTUATOR, FINAL CONTROL ELEMENT	

TABLE BASED ON THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA) STANDARD.

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.
(*) WHEN USED, DEFINE THE MEANING HERE FOR THE PROJECT.

INSTRUMENT OR FUNCTIONAL SYMBOLS

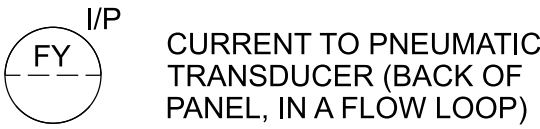


** NORMALLY INACCESSIBLE OR BEHIND-THE-PANEL DEVICES OR FUNCTIONS ARE DEPICTED BY USING THE SAME SYMBOLS BUT WITH DASHED HORIZONTAL BARS.

TRANSDUCERS

- | | | | |
|---|-----------|----|-----------------|
| A | ANALOG | P | PNEUMATIC |
| D | DIGITAL | PF | PULSE FREQUENCY |
| E | VOLTAGE | PD | PULSE DURATION |
| H | HYDRAULIC | R | RESISTANCE |
| I | CURRENT | | |

EXAMPLE



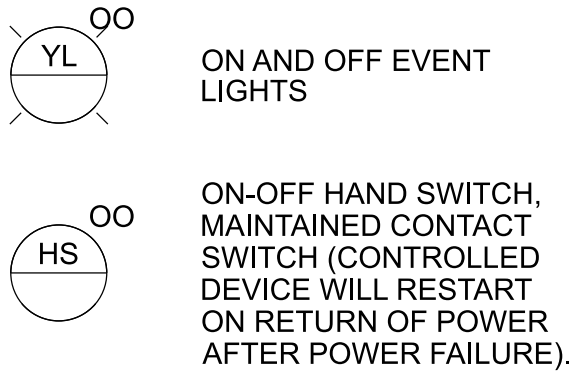
ACCESSORY DEVICES

- | | |
|---|--------------|
| A | ALARM |
| C | CONTROLLER |
| I | INDICATOR |
| R | RECORDER |
| S | SWITCH |
| T | TRANSMITTER |
| X | UNCLASSIFIED |

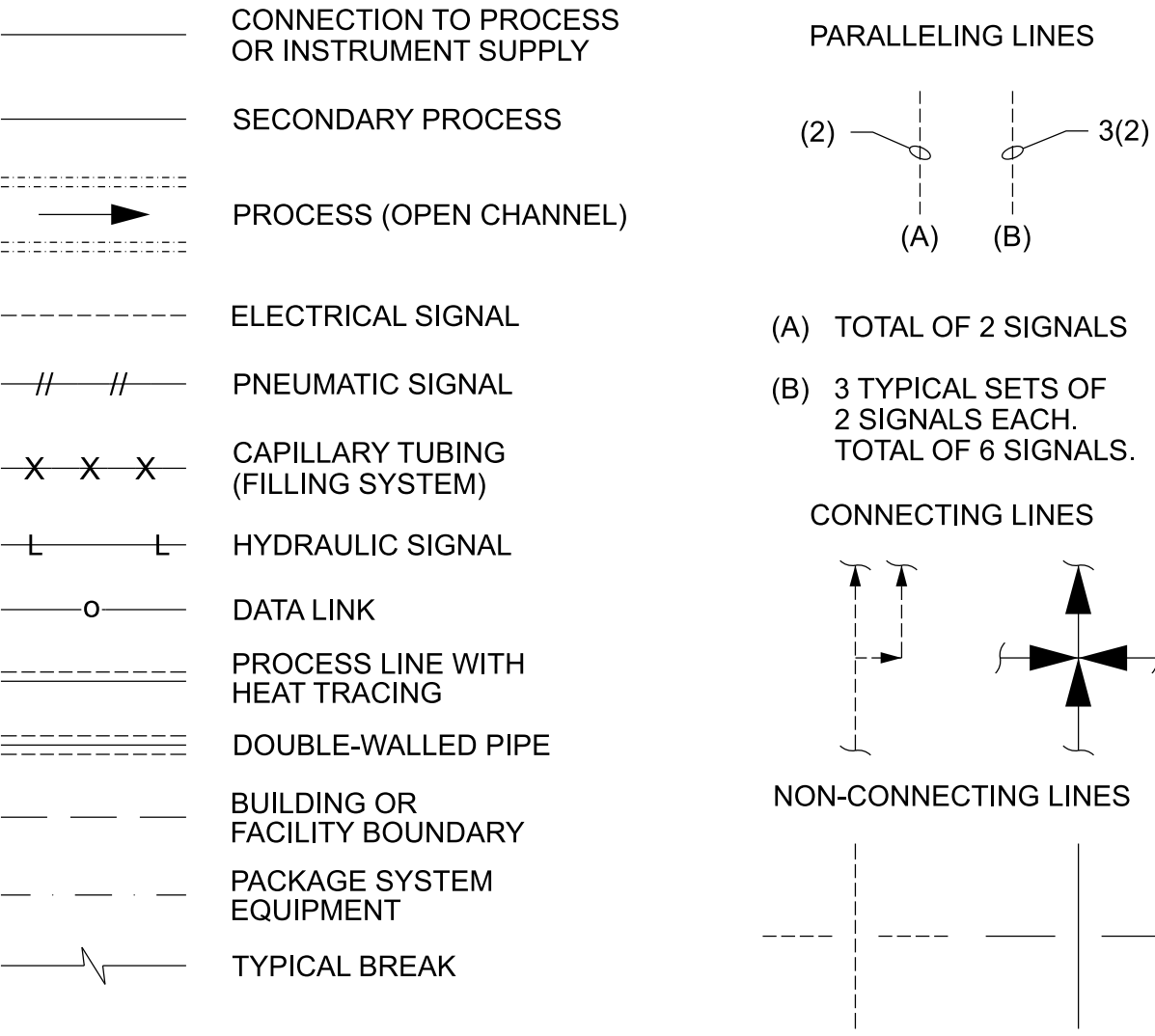
EXAMPLE



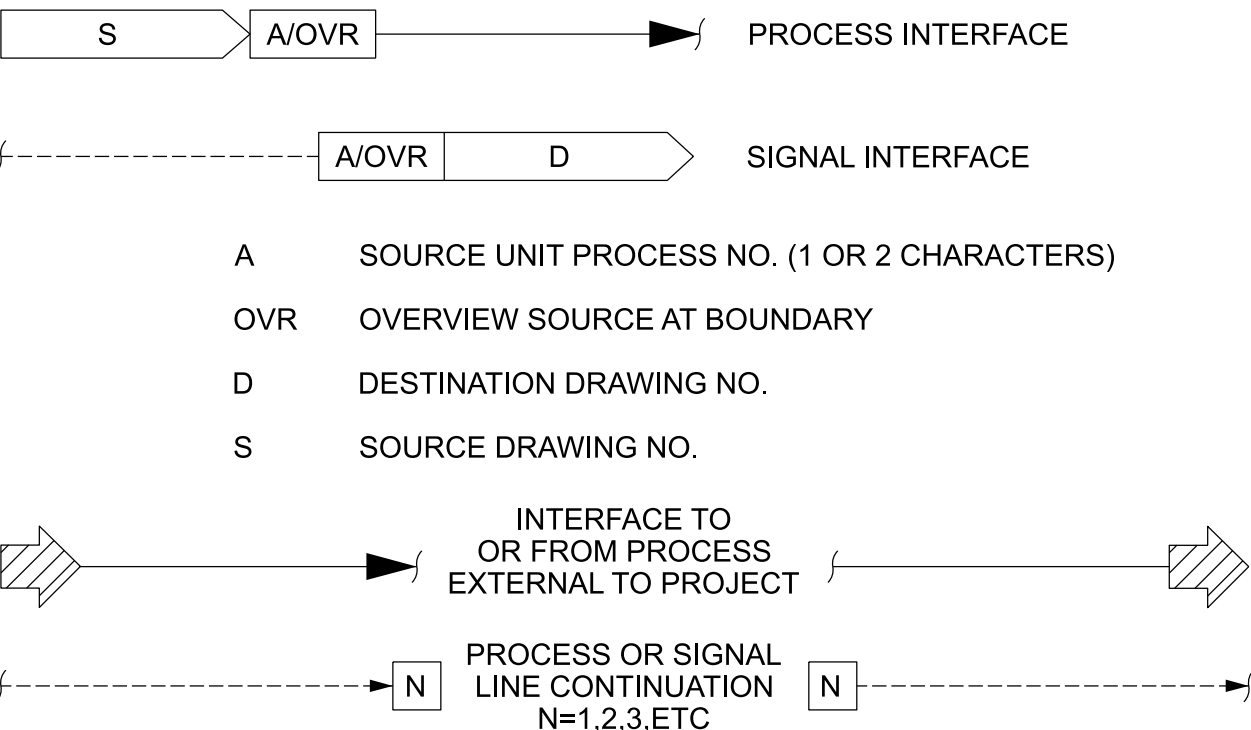
SPECIAL CASES



LINE LEGEND



INTERFACE SYMBOLS



GENERAL NOTES

- COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK (*) ARE SUPPLIED AS PART OF A VENDOR PACKAGE.
- COMPONENTS AND PANELS SHOWN WITH A DOTTED LINE AROUND THEM ARE TO BE PROVIDED AS PART OF A PACKAGE SYSTEM.
- COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK (**) ARE PROVIDED BY ELECTRICAL (DIVISION 26).
- THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THE PROJECT.
- INSTRUMENT INSTALLATION DETAILS ARE DIAGRAMMATIC AND SHALL NOT BE USED FOR PHYSICAL LOCATION OR ORIENTATION OF INSTRUMENTS, EXCEPT AS NOTED. CONTRACTOR SHALL MAKE NECESSARY ADJUSTMENTS TO AVOID OBSTRUCTIONS AND ENSURE ADEQUATE EQUIPMENT CLEARANCES.
- ALL MATERIAL QUANTITIES AND LENGTHS OF TUBING/PIPING REQUIRED SHALL BE DETERMINED BY THE CONTRACTOR, LENGTHS OF TUBING/PIPING SHALL BE KEPT TO A MINIMUM.
- ALL GAUGES AND INSTRUMENT READOUTS SHALL BE LOCATED SO THAT THEY ARE READABLE FROM POINT OF OPERATION ACCESSIBLE, AND AS FREE FROM VIBRATION AS POSSIBLE.
- ON CONDUIT AND PIPING, USE A MINIMUM OF ELBOWS, USE A MINIMUM OF 5 PIPE DIAMETERS (OR GREATER IF REQUIRED BY CODE) FOR BEND RADIUS. DO NOT BEND GALVANIZED PIPE.
- FOR ASSEMBLY OF THREADED AND SOCKETWELD CONNECTIONS, REFER TO THE PIPING MATERIAL SPECIFICATION.
- DO NOT CUT OR CRIMP CAPILLARY TUBING; TAPE, AND PROTECT EXCESS AMOUNT. CAPILLARY TUBING SHALL BE SUPPORTED IN RACEWAY.
- TO SEAL THREADED JOINTS USE A HIGH QUALITY WATERPROOF PIPE JOINT COMPOUND. TEFLON TAPE SHALL NOT BE USED ON ANY INSTRUMENT.
- SUPPORT AND PROTECT LENGTH OF TUBING RUNS IN AN APPROVED TUBING RACEWAY. DETERMINE SIZE, LENGTH AND SUPPORT REQUIREMENTS AND SUBMIT TO CITY FOR APPROVAL. THE MAXIMUM RACEWAY SPAN BETWEEN SUPPORTS SHALL NOT EXCEED 3'-0".
- SUPPORT INSTRUMENTS FROM STRUCTURAL MEMBERS WHENEVER POSSIBLE, OR UNLESS OTHERWISE INDICATED.

GENERAL NOTES

- ALL EXPOSED TUBING ENDS AND FITTINGS SHALL BE PROTECTED BY SPRAYING AFTER INSTALLATION WITH BLACK QUEL-COR.
- ALL INSTRUMENT SUPPORTS AND FASTENERS SHALL BE CONSTRUCTED FROM 316 STAINLESS STEEL. ALL TUBING/PIPING, FITTINGS, VALVES, CONNECTORS, FASTENERS, ADAPTERS AND OTHER ACCESSORIES AND APPURTENANCES USED FOR INSTALLATION OF INSTRUMENTS AND PANELS SHALL BE TYPE 316 STAINLESS STEEL.
- HORIZONTAL RUNS OF INSTRUMENT PROCESS (IMPULSE) TUBING SHALL BE SLOPED AT A MINIMUM OF 1-INCH PER FOOT IN THE DIRECTION SHOWN ON THE DETAIL DRAWINGS AND SHALL BE DESIGNED TO DRAIN CONTINUOUSLY IN THE DIRECTION INDICATED WITHOUT SAGS AND LOW SPOTS WHERE MOISTURE CAN COLLECT.
- ALL INSTRUMENT VALVES, TUBING, FITTINGS, AND PROCESS CONNECTIONS SHALL BE 316 STAINLESS STEEL.
- THE CONTRACTOR SHALL PROVIDE COUPLINGS AND/OR ADAPTORS TO MATCH ROOT VALVE CONNECTION SHOWN ON INSTRUMENTATION INSTALLATION DETAILS.
- INSTALL GROUNDING WIRES IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATION FOR METERS WITH GROUNDING RINGS.
- INSTRUMENTS AND EQUIPMENT SHALL BE SERVICEABLE WITHOUT DISASSEMBLY OF MOUNTING SYSTEM.
- INSTRUMENT WIRING, CONDUIT AND FITTINGS (NEMA 4X) SHALL BE SUPPLIED. INSTALLED AND TERMINATED AS PART OF THIS CONTRACT.
- WHERE INDICATED EXISTING MOUNTED SYSTEMS SHALL BE MODIFIED AS NEEDED TO SUPPORT INSTRUMENTS.
- MANUFACTURER SUPPLIED INSTRUMENT CABLES SHALL NOT BE SPLICED OR CUT. COIL EXTRA CABLE IN LCP AND CABLE TRAY JUNCTION BOX AND SIMILAR AREA APPROVED BY THE ENGINEER.
- ADDITIONAL INSTRUMENTATION AND CONTROL SYMBOLS MAY BE USED AS REQUIRED. SYMBOLS AND NOMENCLATURE ARE BASED ON ISA STANDARDS S5.1, S5.2 AND S5.4.
- THE CONTRACTOR SHALL FURNISH AND INSTALL ALL TRANSFORMERS, INTERPOSING RELAYS AND CONTACTS AS REQUIRED.
- DISCRETE CONTROL WIRES WITH OPERATING VOLTAGES HIGHER THAN 24 VDC SHALL BE IN SEPARATE CONDUITS.
- THE CONTRACTOR SHALL VERIFY ALL ELEVATIONS AND DIMENSIONS IN THE FIELD PRIOR TO ANY FABRICATION.
- UNLESS OTHERWISE NOTED, CONTROL PANELS AND CONTROL STATIONS SHALL BE NEMA 4X RATED.
- SEISMIC AND ANCHORAGE CALCULATIONS SHALL BE PROVIDED FOR LOCAL CONTROL PANELS (STANDS INCLUDED).
- ZONE 4 SEISMIC COMPLIANCE: CONTRACTOR SHALL PROVIDE STRUCTURAL ANALYSIS AND ADDITIONAL BRACING FOR ALL MAJOR ITEMS OF INSTRUMENTATION AND ACCESSORIES, INCLUDING THE EXISTING SUPPORT RACK, AS NEEDED TO ACHIEVE CONFORMANCE TO SEISMIC ZONE 4 REQUIREMENTS.
- DCT PLANT FACILITY AREA CODES ARE PROVIDED ON IG0003.
- REFER TO INSTRUMENT CODE TABLES ON IG0003. INSTRUMENT CODES ARE CONSISTENT WITH ISA TABLE SHOWN. MANUAL VALVE CODES ARE CLIENT SPECIFIC AND ALSO INCLUDED IN THE TABLE.
- REFER TO EQUIPMENT CODES USE A CLIENT-SPECIFIC 4-DIGIT CODE.

90%DESIGN
NOT FOR CONSTRUCTION

Jacobs

REVISIONS			Description	Approved
Number	Date	Initials		

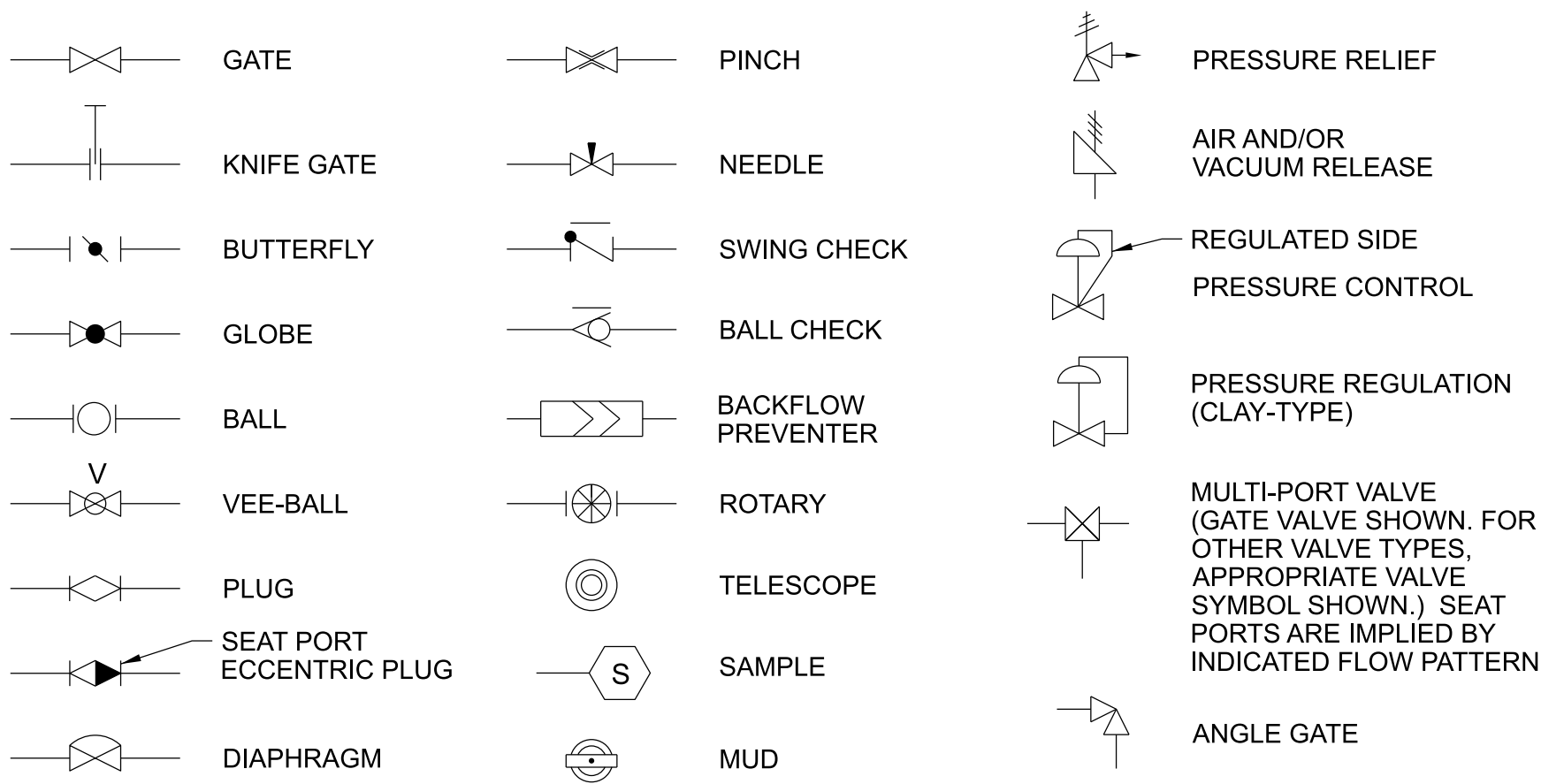
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Designer		D DUTCHER		09/02/2026	As to Design		
Stamp		E KRISTEL		09/02/2026	As to Operation		
Drawn By		D WATSON		09/02/2026	As to Distribution		
Checked By		SGRIEBEL		09/02/2026	Senior Assistant GM of Water		
Last Update							
File Name							

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
LEGEND 1

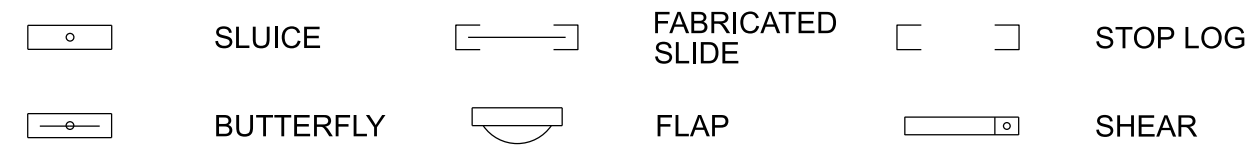
DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-001

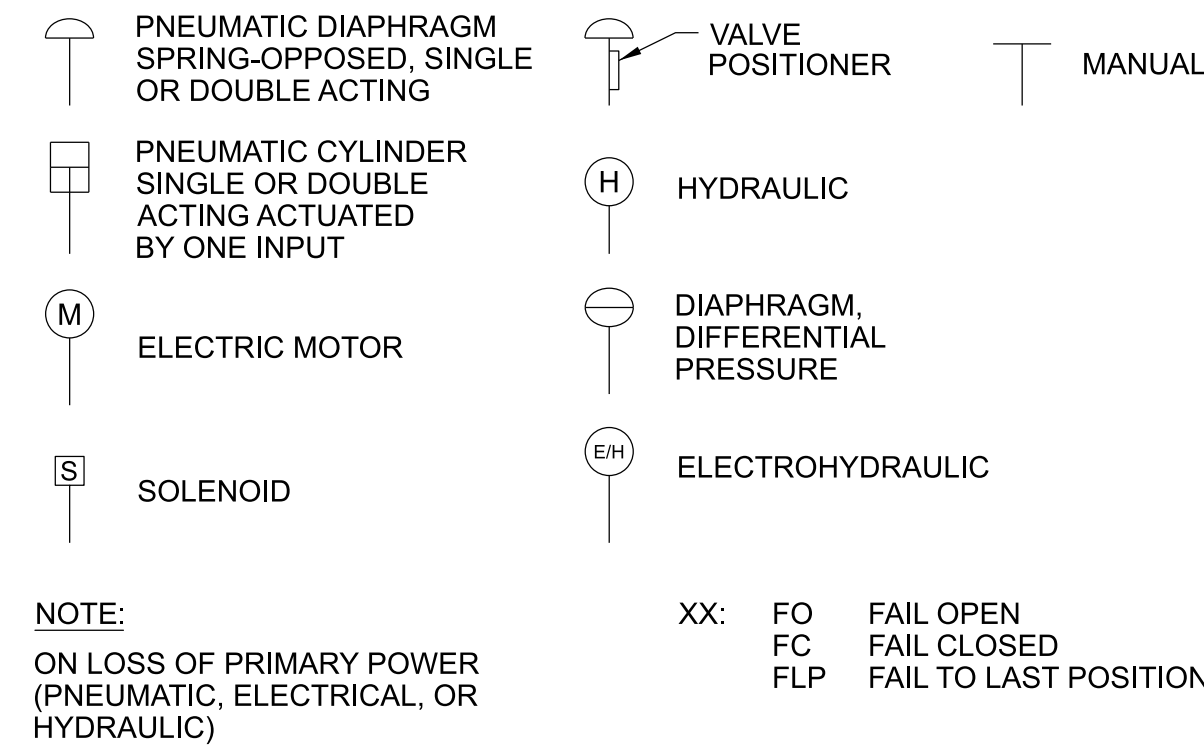
VALVE SYMBOLS



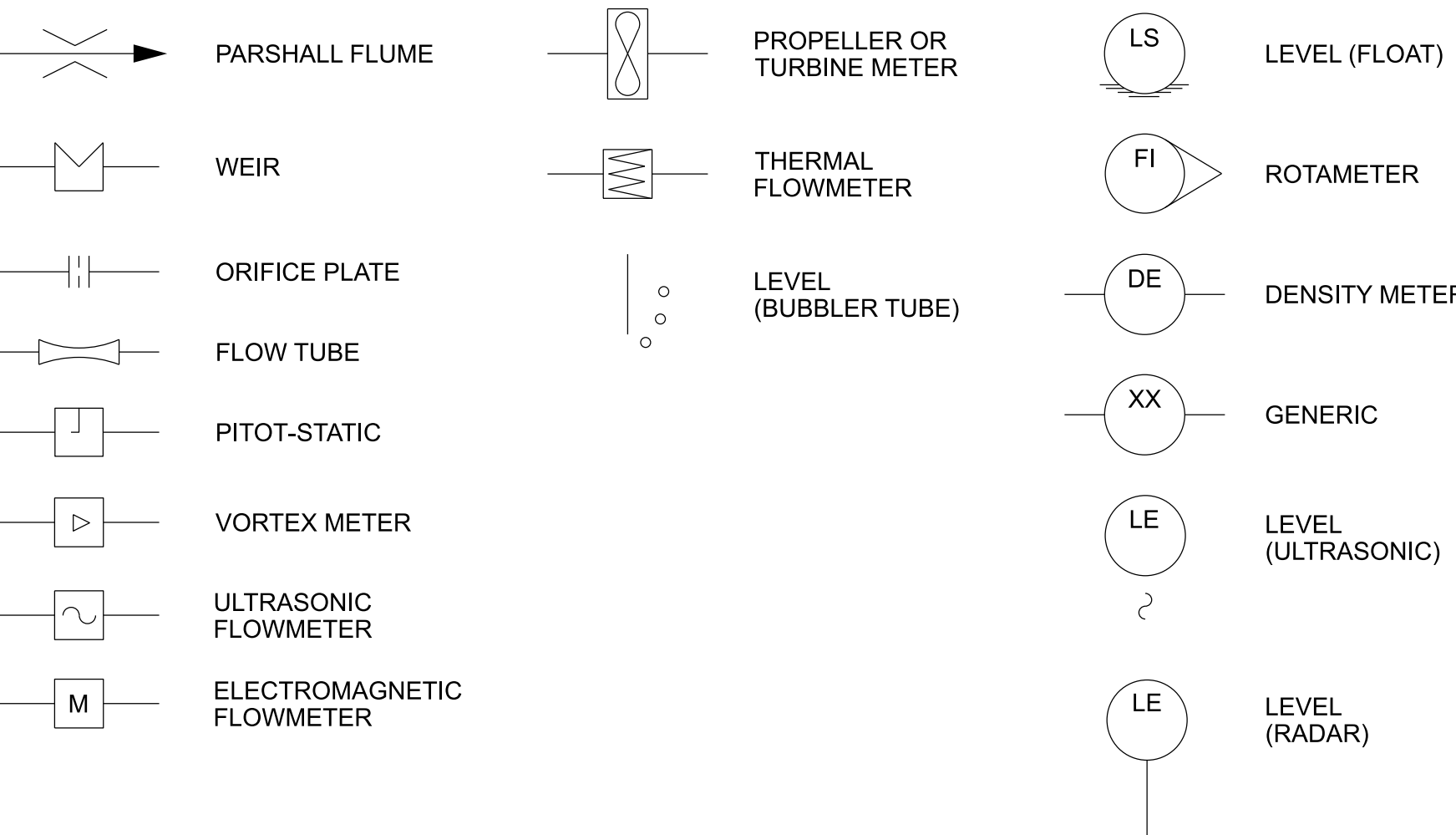
GATE SYMBOLS



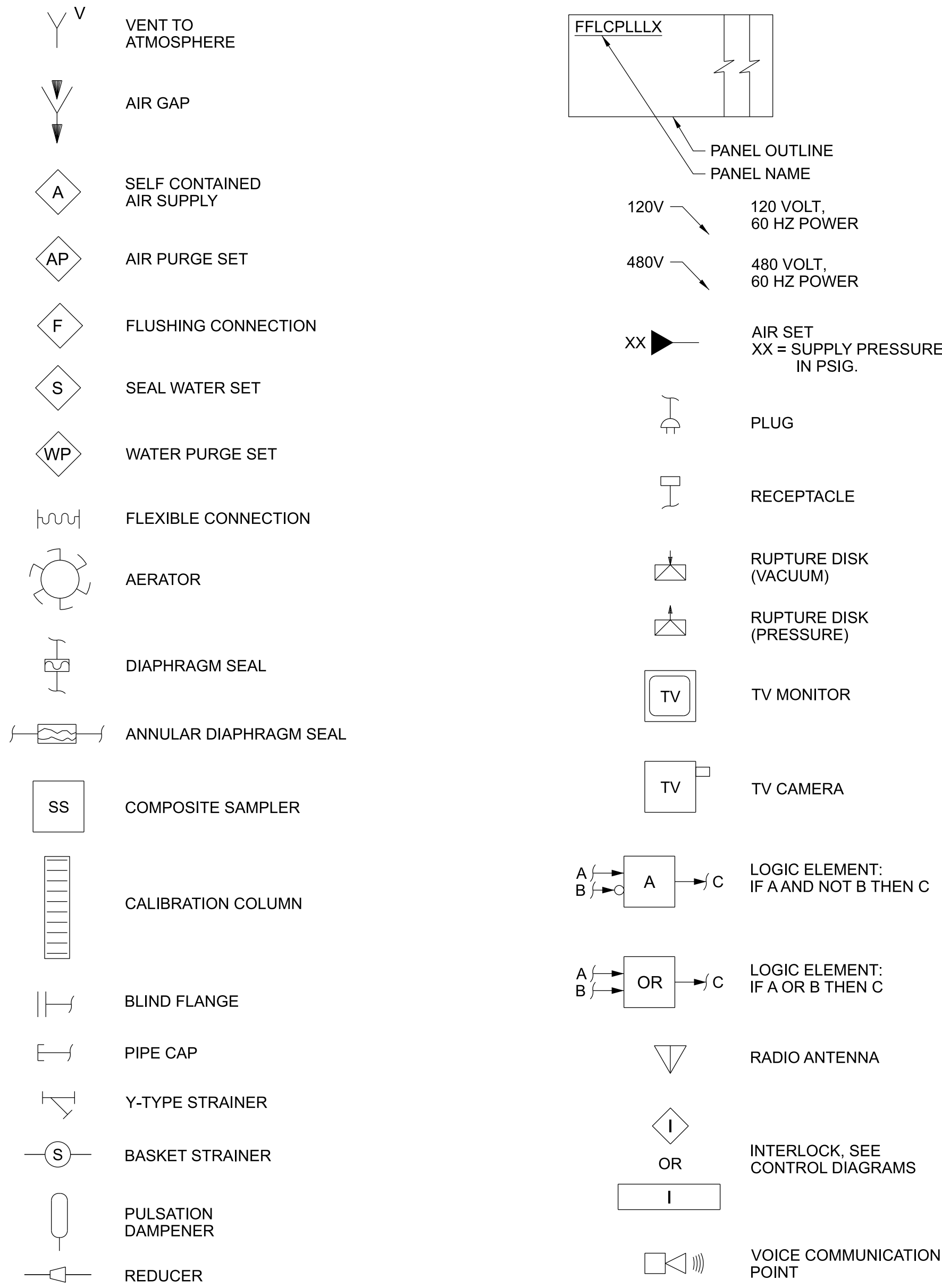
ACTUATOR SYMBOLS



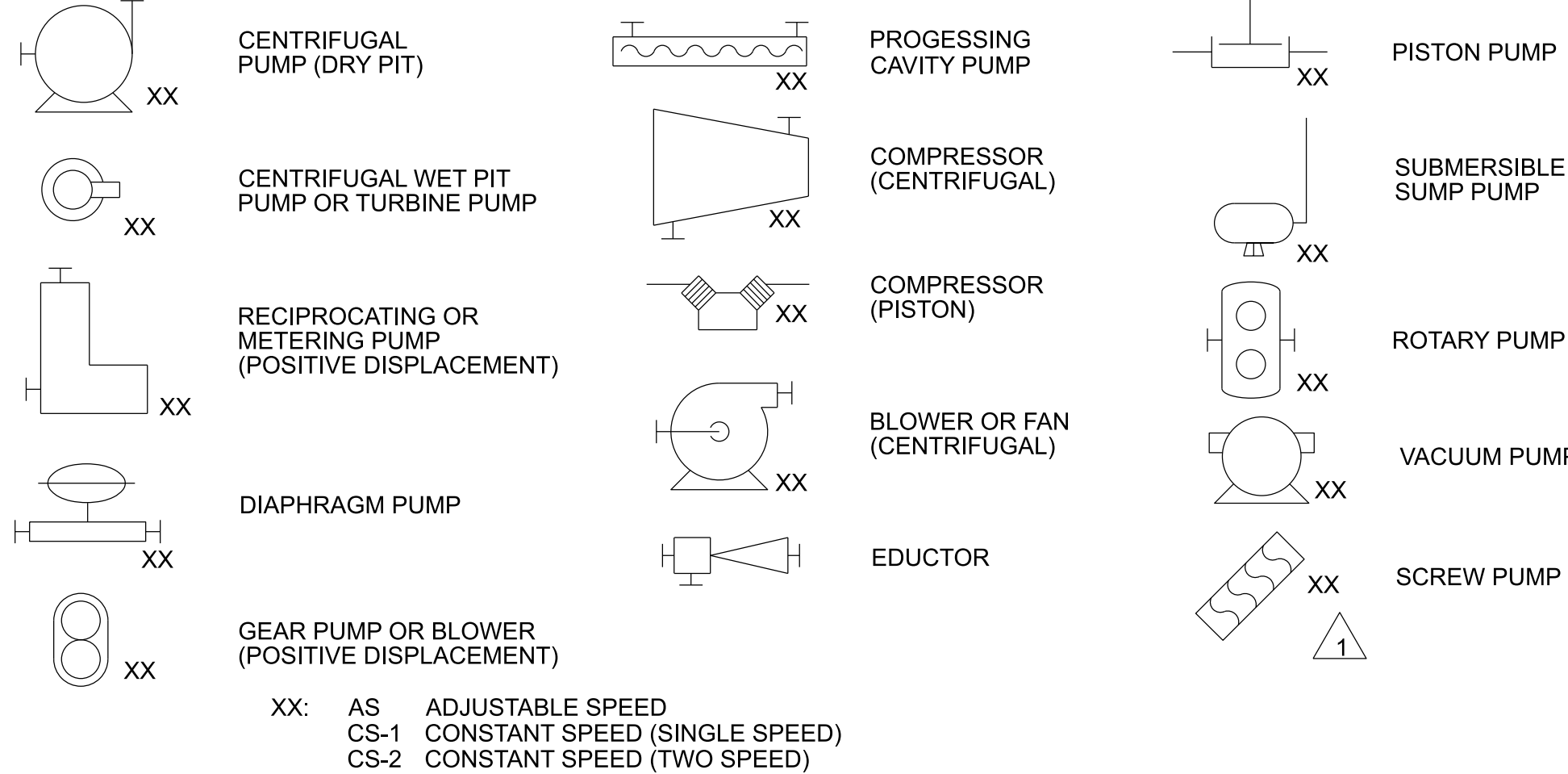
PRIMARY ELEMENT SYMBOLS



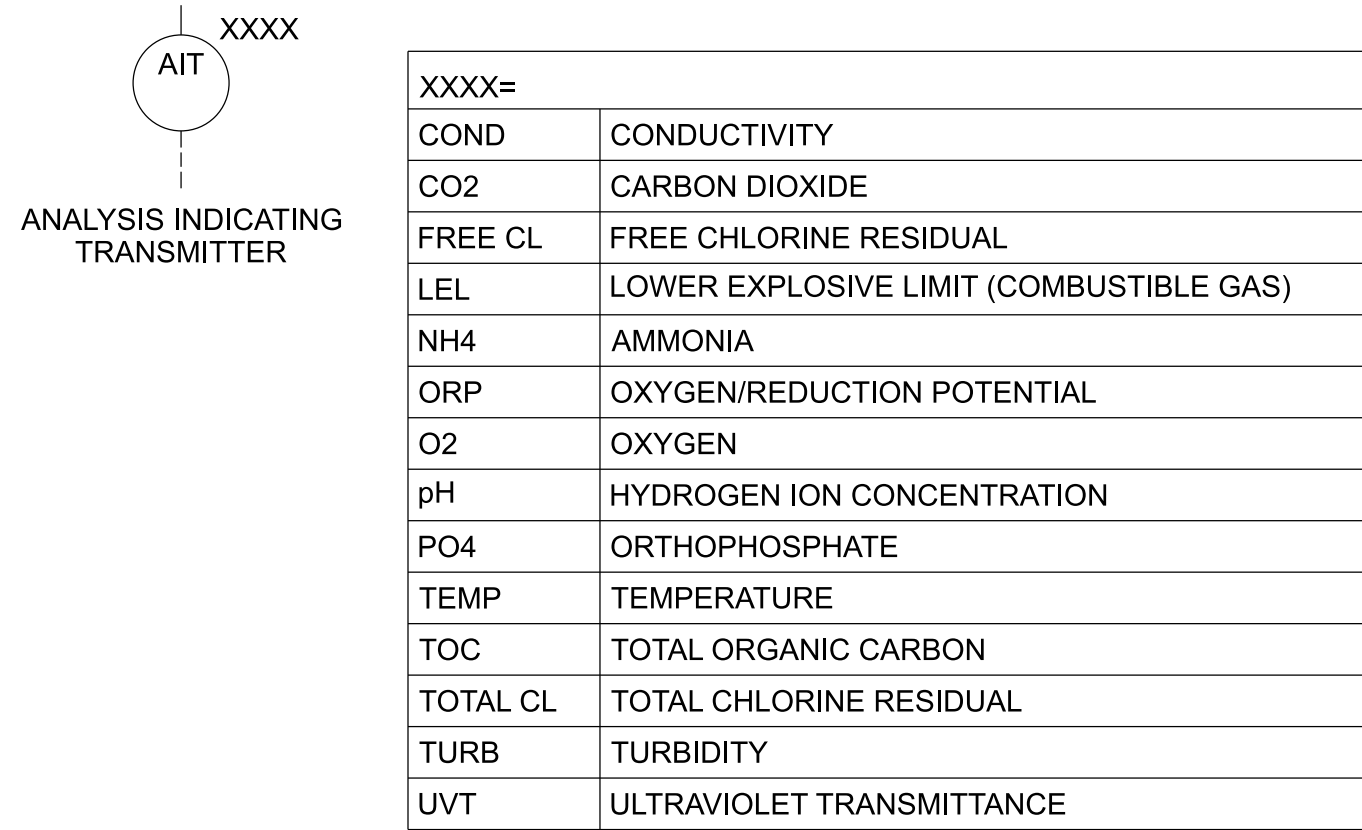
MISCELLANEOUS SYMBOLS



PUMP AND COMPRESSOR SYMBOLS

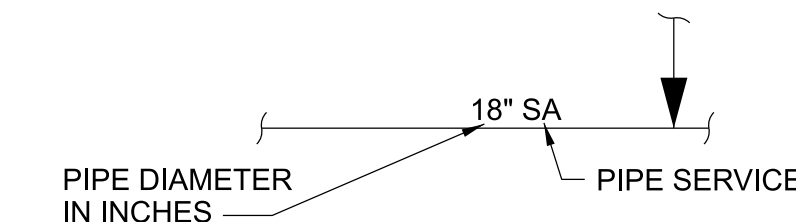


ANALYTICAL SYMBOLS

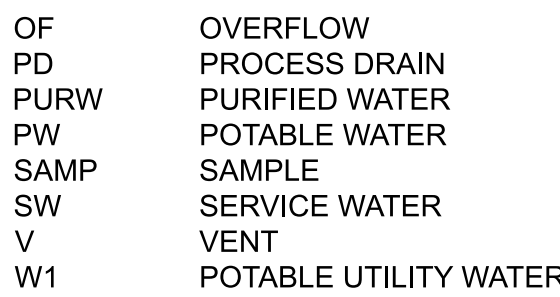


LINE SIZE AND MATERIAL IDENTIFICATION

(FOR REFERENCE ONLY. SEE SITE AND MECHANICAL DRAWINGS)



FLOW STREAM IDENTIFICATION



90%DESIGN
NOT FOR CONSTRUCTION

Jacobs

REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

Scale	AS SHOWN	DATE
Designer	D DUTCHER	09/02/2026
Stamp		09/02/2026
Drawn By	E KRISTEL	09/02/2026
Checked By	D WATSON	09/02/2026
Last Update	SGRIEBEL	09/02/2026
Recommended		
File Name		

APPROVED

DATE

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
LEGEND 2

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-002

STATION TYPE TABLE 4.1	Abbrev.
AIR CHAMBER	AC
AMMONIATION STATION	AS
BACKWASH STATION	BS
CONTROL CENTER	CC
CHLORINATION STATION*	CS
DEWATERING PROCESS/FACILITY	DW
DIVERSION STATION/STRUCTURE	DV
CORROSION CONTROL STATION	ZS
EFFLUENT CHANNEL	EC
FILTER AREA	FA
FOREBAY	FB
FLOW CONTROL STATION	FC
FERRIC CHLORIDE STATION	FE
FLOCCULATION PROCESS/STATION	FO
FILTRATION PLANT/STATION	FP
FLUORIDATION STATION	FS
GENERAL BUILDING (OFFICE, WAREHOUSE, LABORATORY, ETC. NOT PART OF WATER TREATMENT OR DISTRIBUTION)	GB
GRAVITY THICKENER	GVT
HYDROGEN PEROXIDE STATION	HS
UTILITY CUSTOMER STATION	IS
INTAKE STRUCTURE/FACILITY/INLET	IN
ION EXCHANGE	IX
LIFT STATION	LS
OXYGEN GENERATION STATION	OS
PUMPING STATION	PS
CATIONIC POLYMER STATION	PY
RECIRCULATION/RETURN/RECYCLE OF WATER	RC
REGULATOR STATION	RG
RESERVOIR	RS
SCREENED WATER CHANNEL	SWC
SEDIMENTATION PROCESS/STATION	SD
SODIUM HYDROXIDE	SH
SPREADING GROUND	SG
SULFURIC ACID STATION	SA
SURGE PROTECTION	SGP
TANK (STAND-ALONE)	TK
THICKENING PROCESS/STATION	TH
TRASH RAKE STATION	TR
TREATMENT STATION *	TS
TRAVELING WATER SCREEN STATION	TW
TRUNK LINE	TL
ULTRA VIOLET DISINFECTION STATION	UV
VAULT	VT
WELL (STAND-ALONE/INDIVIDUALS)	WL
WELL FIELD (INCLUDES WELLS AND WELL PUMPS)	WF

PUMP STATION EQUIPMENT TABLE 4.3	
EQUIPMENT	ID
AIR COMPRESSOR	AC#
AIR HANDLING UNIT	AHU#
FLOW CONTROL VALVE	FCV#
FULL VOLTAGE STARTER	FVS#
HEAT EXCHANGER	HX#
MOTOR (NO PUMP)	M#
PRESSURE RELIEF VALVE	PRV#
PRESSURE REGULATING VALVE	P#
PUMP (WATER OR CHEMICAL)	PTB#
PUMP TURBINE	RV#
REDUCED VOLTAGE STARTER	TK#
TANK (ISOLATED)	T#
TANK (PART OF A SYSTEM, I.E. SURGE TANK)	TR#
TRASH RAKE	TRB#
TURBINE	TW#
TRAVELING WATER SCREEN	V#
VALVE	VFD#
VARIABLE FREQUENCY DRIVE	

EQUIPMENT MODIFIER TABLE 4.2	
DESCRIPTIONS	TAGS
ACTUATOR	ACT#
AIR COMPRESSOR	AC#
AIR CONDITIONING CONDENSER	ACC#
AIR HANDLING UNIT	AHU#
AIR HANDLING UNIT CONTROL PANEL	AHCP#
AIR RELEASE VALVE	ARV#
ANALYZER	AIT#
ANALYZER ELEMENT	AE#
ARC FLASH RELAY	AFR#
AUTOMATIC TRANSFER SWITCH	ATS#
BASIN	BA#
BATTERY DISCONNECT	BD#
BLOWER # CONTROL PANEL	B#CP#
BREAKER	BKR#
CATHODIC PROTECTION CABINET	CPC#
COMMUNICATIONS CABINET	CC#
CONTAINER SHUTOFF VALVE	CS#
CONTROL PANEL (PLC OR RELAYS)	CP#
CRANE	CN#
CURRENT TRANSMITTER/ TRANSFORMER	CT#
CYLINDER OR CONTAINER	C#
DIFFERENTIAL PRESSURE INDICATING TRANSMITTER	DPIT#
DIFFERENTIAL PRESSURE INDICATOR	DPI#
DIFFERENTIAL PRESSURE SETPOINT INDICATOR	DSPI#
DIGITAL TO ANALOG SIGNAL CONVERTER	DAO#
DISCONNECT SWITCH	DS#
DOOR	DR#
ETHERNET ROUTER	ER#
ETHERNET SWITCH	ES#
EVAPORATOR	E#
EXHAUST FAN	EF#
EXHAUST FAN CONTROL PANEL	EFCP#
FIRE ALARM CONTROL PANEL	FACP#
FIRE ALARM INTERLOCKING PANEL	FAICP#
FLOW CONTROL VALVE	FCV#
FLOW CONTROLLER	FC#
FLOW ELEMENT	FE#
FLOW GAUGE	FG#
FLOW/INDICATOR	FI#
FLOW/INDICATOR CONTROLLER	FIC#
FLOW/INDICATOR TRANSMITTER	FIT#
FLOW/METER	FM#
FLOW SWITCH	FS#
FLOW TOTALIZER	FT#
FLOW TOTALIZER CONTROLLER	FQCC#
FLOW TRANSMITTER (NON INDICATING)	FT#
FOREBAY	FB#
FULL VOLTAGE STARTER	FVS#
GATE	GATE#
GENERATOR (POWER)	GEN#
HEAT PUMP	HP#
HEATER	H#
HORN/ STROBE	HS#
HUMAN MACHINE INTERFACE	HMI#
HYDRAULIC CONTROL PANEL	HCP#
INDICATING LIGHT	LI#
ISOLATION VALVE	IV#
LEAK DETECTOR PANEL	LDP#
LEVEL CONTROL VALVE	LCV#
LEVEL CONTROLLER	LC#
LEVEL ELEMENT	LE#
LEVEL GAUGE	LG#
LEVEL INDICATOR	LI#
LEVEL INDICATOR CONTROLLER	LIC#
LEVEL INDICATOR TRANSMITTER	LIT#
LEVEL SWITCH (FLOOD) (WHEN ONLY ONE LEVEL SWITCH IN A JUMP)	LS#
LEVEL SWITCH HIGH	LSH#
LEVEL SWITCH HIGH HIGH	LSHH#
LEVEL SWITCH LOW	LSL#
LEVEL SWITCH LOW LOW	LSLL#
LEVEL TRANSMITTER (NON INDICATING)	LT#
LIGHTING	LTG#
LIGHTING CONTROL PANEL	LCP#
LIGHTING EMERGENCY (LIGHTING/ EXIT SIGN)	LTGEM#
LOCAL CONTROL MODULE/ STATION (NOT ON THE PANEL, FOR EXAMPLE, LIMIT TORQUE OR BM FOR AN ACTUATOR)	LQM#
LOCAL CONTROL STATION	LCS#
MAIN SWITCHBOARD (SEE NOTE)	MSB#
MAIN SWITCHGEAR (SEE NOTE)	MSG#
MANUAL TRANSFER SWITCH	MTS#

METERING PUMP	MP#
METERING PUMP CONTROL PANEL	MPCP#
METERING PUMP# LEAK DETECTOR	MP#LK
MOTOR CONTROL CENTER	MCC#
MOTOR PROTECTION RELAY	MPR#
MOTORIZED DAMPER	MD#
PLC	PLC#
POSITION INDICATOR TRANSMITTER	ZIT#
POSITION SWITCH	ZS#
POSITION TRANSMITTER	ZT#
POWER DISTRIBUTION UNIT	PDC#
POWER MONITOR/ POWER ENERGY METER	PM#
POWER PANEL (120/ 208 OR 120/ 240V)	DP#
POWER PANEL (480V)	DP#
POWER SUPPLY (AC/ DC CONVERTER)	PS#
POWER TRANSMITTER	PT#
PRESSURE CONTROL VALVE	PCV#
PRESSURE CONTROLLER	PC#
PRESSURE DIFFERENTIAL CONTROLLER	PDC#
PRESSURE DIFFERENTIAL INDICATOR	PDI#
PRESSURE DIFFERENTIAL SWITCH	PDS#
PRESSURE GAUGE	PG#
PRESSURE INDICATOR	PI#
PRESSURE INDICATOR CONTROLLER	PIC#
PRESSURE INDICATOR SWITCH	PI#
PRESSURE INDICATOR TRANSMITTER	PIT#
PRESSURE RECORDER	PR#
PRESSURE RECORDER CONTROLLER	PRC#
PRESSURE REGULATING VALVE	PRV#
PRESSURE RELIEF VALVE	PRV#
PRESSURE SWITCH HIGH	PSH#
PRESSURE SWITCH LOW	PSL#
PRESSURE TRANSMITTER (NON INDICATING)	PT#
PROCESS CONTROL UNIT	PCU
PROTOCOL CONVERTER (DIGI)	PONV#
PUMP (WATER OR CHEMICAL)	P#
PUMP TURBINE	PTB#
PURGE DRAIN	PD#
PUSHBUTTON	PB#
RECEPTACLE	RCPIT#
RELAY (LOCATED INSIDE CP)	R#
REMOTE I/ O RACK (NOT WITH PLC)	RIO#
SAMPLE PUMP	SAP#
SAMPLE PUMP CONTROL PANEL	SAP#CP#
SECURITY CABINET	ACP#
SELECTOR SWITCH	SS#
SIGNAL CONVERTER/ SIGNAL CONDITIONER/ SIGNAL ISOLATOR/ SIGNAL SPLITTER	SC#
SOLENOID VALVE OR WATER SOFTENER SOLENOID VALVE	SV#
SPEED TRANSMITTER	ST#
STARTER	STR#
STRAINER (EXCEPT BASKET TYPE)	SP#
SUMP PUMP	SPP#
SUMP PUMP CONTROL PANEL	SPCP#
SUPPLY FAN	SF#
SWITCH	SV#
TANK (ISOLATED)	TK#
TANK (PART OF A SYSTEM, I.E. SURGE TANK)	T#
TANK# LEVEL ELEMENT	T#LE#
TANK# LEVEL SWITCH HIGH	T#LSH#
TANK# LEVEL SWITCH LOW	T#LSL#
TANK# LEVEL TRANSMITTER	T#LIT#
TELECOM PANEL (WTCS)	TCP#
TEMPERATURE ELEMENT	TE#
TEMPERATURE GAUGE	TG#
TEMPERATURE INDICATOR	TI#
TEMPERATURE INDICATOR CONTROLLER/ THERMOSTAT (USED FOR AC UNITS)	TIC#
TEMPERATURE INDICATOR TRANSMITTER	TIT#
TEMPERATURE METER	TM#
TEMPERATURE SWITCH (USED FOR EXHAUST FANS)	TS#
TEMPERATURE TRANSMITTER (NON INDICATING)	TT#
TERMINAL BLOCK	TB#
TERMINAL CABINET	TC#
TRANSFORMER	TFR#
UNINTERRUPTIBLE POWER SUPPLY	UPS#
UPS BATTERY DISCONNECT	UPSBD#
UPS BYPASS SWITCH	BS#
VALVE INCLUDING (TANK FILL VALVE (TANK 1 =V1, TANK 2 =V2)	V#
VARIABLE FREQUENCY DRIVE	VFD#
VIBRATION TRANSMITTER	VT#
VOLTAGE TRANSMITTER/ TRANSFORMER	ET#
WATER SOFTENER	WS#

TABLE 4.7 CONTROL PANELS	
EQUIPMENT	ID
AIR HANDLING CONTROL PANEL	AHCP#
CONTROL PANEL (PLC OR RELAYS)	CP#
FIRE ALARM CONTROL PANEL	FACP#
FIRE ALARM INTERLOCKING PANEL	FAICP#
SUMP PUMP CONTROL PANEL	SPCP#
TELECOM PANEL (WTCS)	TCP#

TABLE 4.8 CABINETS	
EQUIPMENT	ID
TERMINAL CABINET	TC#
COMMUNICATIONS CABINET	CC#
SECURITY CABINET	ACP#
CATHODIC PROTECTION CABINET	CPC#

TABLE 4.9 FLOW INSTRUMENTS EQUIPMENT	
EQUIPMENT	ID
FLOW CONTROLLER	FC#
FLOW CONTROL VALVE	FCV#
FLOW ELEMENT	FE#
FLOW GAUGE	FG#
FLOW INDICATOR	FI#
FLOW INDICATOR CONTROLLER	FIC#
FLOW INDICATOR TRANSMITTER	FIT#
FLOW INTEGRATOR	FX#
FLOW METER	FM#
FLOW RATIO CONTROLLER	FRC#
FLOW RECORDER	FR#
FLOW INDICATING RECORDER	FIR#
FLOW SWITCH	FS#
FLOW TOTALIZER	FQ#
FLOW TOTALIZER CONTROLLER	FQCC#
FLOW TRANSMITTER (NON INDICATING)	FT#

TABLE 4.10 LEVEL INSTRUMENTS EQUIPMENT	
EQUIPMENT	ID
LEVEL CONTROLLER	LC#
LEVEL CONTROL VALVE	LCV#
LEVEL ELEMENT	LE#
LEVEL GAUGE	LG#
LEVEL INDICATOR	LI#
LEVEL INDICATOR CONTROLLER	LIC#
LEVEL INDICATOR TRANSMITTER	LIT#
LEVEL METER	LM#
LEVEL RECORDER	LR#
LEVEL INDICATING RECORDER	LIR#
LEVEL SWITCH	LS#
LEVEL TRANSMITTER (NON INDICATING)	LT#

TABLE 4.11 PRESSURE INSTRUMENTS EQUIPMENT	
EQUIPMENT	ID
DIFFERENTIAL PRESSURE INDICATOR	DPI#
DIFFERENTIAL PRESSURE SETPOINT INDICATOR	DSPI#
PRESSURE CONTROLLER	PC#
PRESSURE CONTROL VALVE	PCV#
PRESSURE DIFFERENTIAL CONTROLLER	PDC#
PRESSURE DIFFERENTIAL INDICATOR	PDI#
PRESSURE DIFFERENTIAL SWITCH	PDS#
PRESSURE GAUGE	PG#
PRESSURE HAND CONTROL	PHC#
PRESSURE INDICATOR	PI#
PRESSURE INDICATOR CONTROLLER	PIC#
PRESSURE INDICATOR SWITCH	PIS#
PRESSURE INDICATOR TRANSMITTER	PIT#
PRESSURE TRANSMITTER (NON INDICATING)	PT#
PRESSURE RECORDER	PR#
PRESSURE RECORDER CONTROLLER	PRC#
PRESSURE SWITCH HIGH	PSH#
PRESSURE SWITCH LOW	PSL#

TABLE 4.12 TEMPERATURE INSTRUMENTS EQUIPMENT	
EQUIPMENT	ID
TEMPERATURE CONTROLLER	TC#
TEMPERATURE CONTROLLER VALVE	TCV#
TEMPERATURE ELEMENT	TE#
TEMPERATURE GAUGE	TG#
TEMPERATURE INDICATOR	TI#
TEMPERATURE INDICATOR CONTROLLER/THERMOSTAT FOR AC UNITS	TIC#
TEMPERATURE INDICATOR TRANSMITTER	TIT#
TEMPERATURE TRANSMITTER (NON INDICATING)	TT#
TEMPERATURE METER	TM#
TEMPERATURE INDICATING RECORDER	TIR#
TEMPERATURE SWITCH	TS#

TABLE 4.13 POWER DISTRIBUTION EQUIPMENT	
EQUIPMENT	ID
AUTOMATIC TRANSFER SWITCH	ATS#
MANUAL TRANSFER SWITCH	MTS#
CURRENT TRANSFORMER	CT#
BATTERY DISCONNECT	BD#
DISCONNECT SWITCH	DS#
MAIN SWITCHBOARD (SEE NOTE)	MSB#
MAIN SWITCHGEAR (SEE NOTE)	MSG#
MOTOR CONTROL CENTER	MCC#
POWER PANEL (120V)	LP#
POWER PANEL (480V)	DP#
POWER SUPPLY (AC/DC CONVERTER)	PS#
TRANSFORMER	TFR#
UNINTERRUPTIBLE POWER SUPPLY	UPS#
UPS BATTERY DISCONNECT	UPSBD#
UPS BYPASS SWITCH	BS#
VOLTAGE TRANSFORMER	ET#
MOTOR PROTECTION RELAY	MPR#
POWER MONITOR	PM#
POWER DISTRIBUTION UNIT	PDU#

TABLE 4.14 CONTROL DEVICE EQUIPMENT	
EQUIPMENT	ID
HUMAN MACHINE INTERFACE	HMI#
INDICATING LIGHT	LI#
PLC	PLC#
PLC IFM ANALOG INPUTS	TAI#
PLC IFM ANALOG OUTPUTS	TAO#
PLC IFM DIGITAL INPUTS	TDI#
PLC IFM DIGITAL OUTPUTS	TDO#
PUSHBUTTON	PB#
RELAY	R#
REMOTE (PLC) RACK (I/O)	RIO#
SELECTOR SWITCH	SS#
SWITCH	SW#

TABLE 4.15 OTHER INSTRUMENTS EQUIPMENT	
EQUIPMENT	ID
ANALYZER ELEMENT	AE#
ANALYZER INDICATOR TRANSMITTER	AIT#
CURRENT TRANSMITTER	CT#
MULTIVARIABLE INDICATOR RECORDER	UIR#
MULTIVARIABLE INDICATOR TRANSMITTER	UIT#
POSITION SWITCH	ZS#
POWER TRANSMITTER	JT#
SPEED TRANSMITTER	ST#
VIBRATION TRANSMITTER	VT#
VOLTAGE TRANSMITTER	ET#
WEIGHT TRANSMITTER	WT#
POSITION INDICATOR TRANSMITTER	ZIT#
POSITION TRANSMITTER	ZT#

90%DESIGN
NOT FOR CONSTRUCTION

Jacobs

REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

Scale	AS SHOWN	DATE
Designer	D DUTCHER	09/02/2026
Stamp		09/02/2026
Drawn By	E KRISTEL	09/02/2026
Checked By	D WATSON	09/02/2026
Last Update	SGRIEBEL	09/02/2026

APPROVED	DATE
As to Design	
As to Operation	
As to Distribution	
Senior Assistant GM of Water	

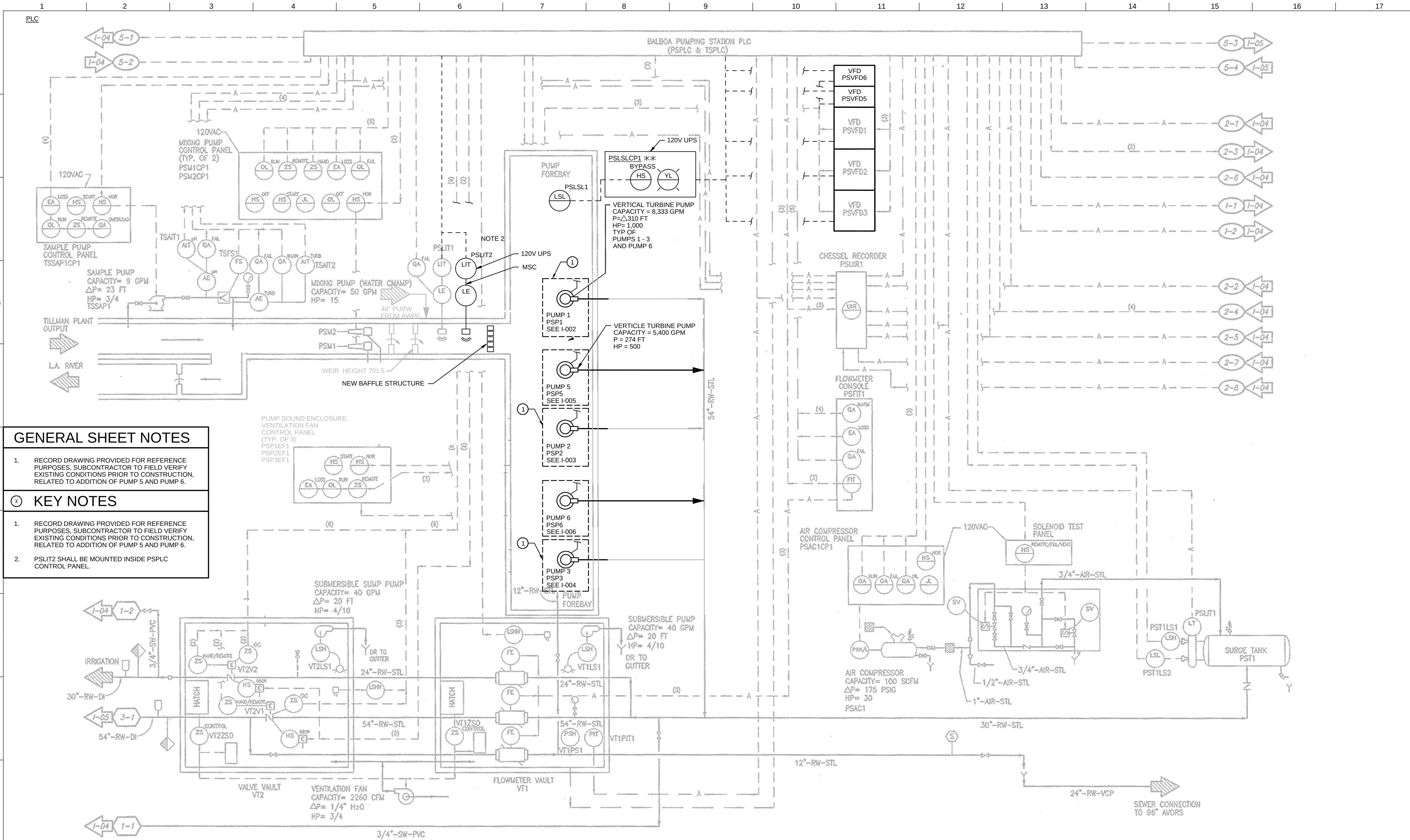
GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
LEGEND 3

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-003

D-06100-I-005



- GENERAL SHEET NOTES
1.

RECORD DRAWING PROVIDED FOR REFERENCE PURPOSES. SUBCONTRACTOR TO FIELD VERIFY EXISTING CONDITIONS PRIOR TO CONSTRUCTION, RELATED TO ADDITION OF PUMP 5 AND PUMP 6.
- KEY NOTES
1.

RECORD DRAWING PROVIDED FOR REFERENCE PURPOSES. SUBCONTRACTOR TO FIELD VERIFY EXISTING CONDITIONS PRIOR TO CONSTRUCTION, RELATED TO ADDITION OF PUMP 5 AND PUMP 6.
2.

PSLIT2 SHALL BE MOUNTED INSIDE PSPLC CONTROL PANEL.

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Jacobs

REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES		Scale		DATE		APPROVED		DATE	
		AS SHOWN				As to Design			
		D DUTCHER		09/02/2026		As to Operation			
		Stamp		09/02/2026					
		E KRISTEL		09/02/2026		As to Distribution			
		D WATSON		09/02/2026					
		SGRIEBEL		09/02/2026		Senior Assistant GM of Water			
		Recommended							
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D-06100-I-005.dwg									

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PUMP STATION OVERVIEW

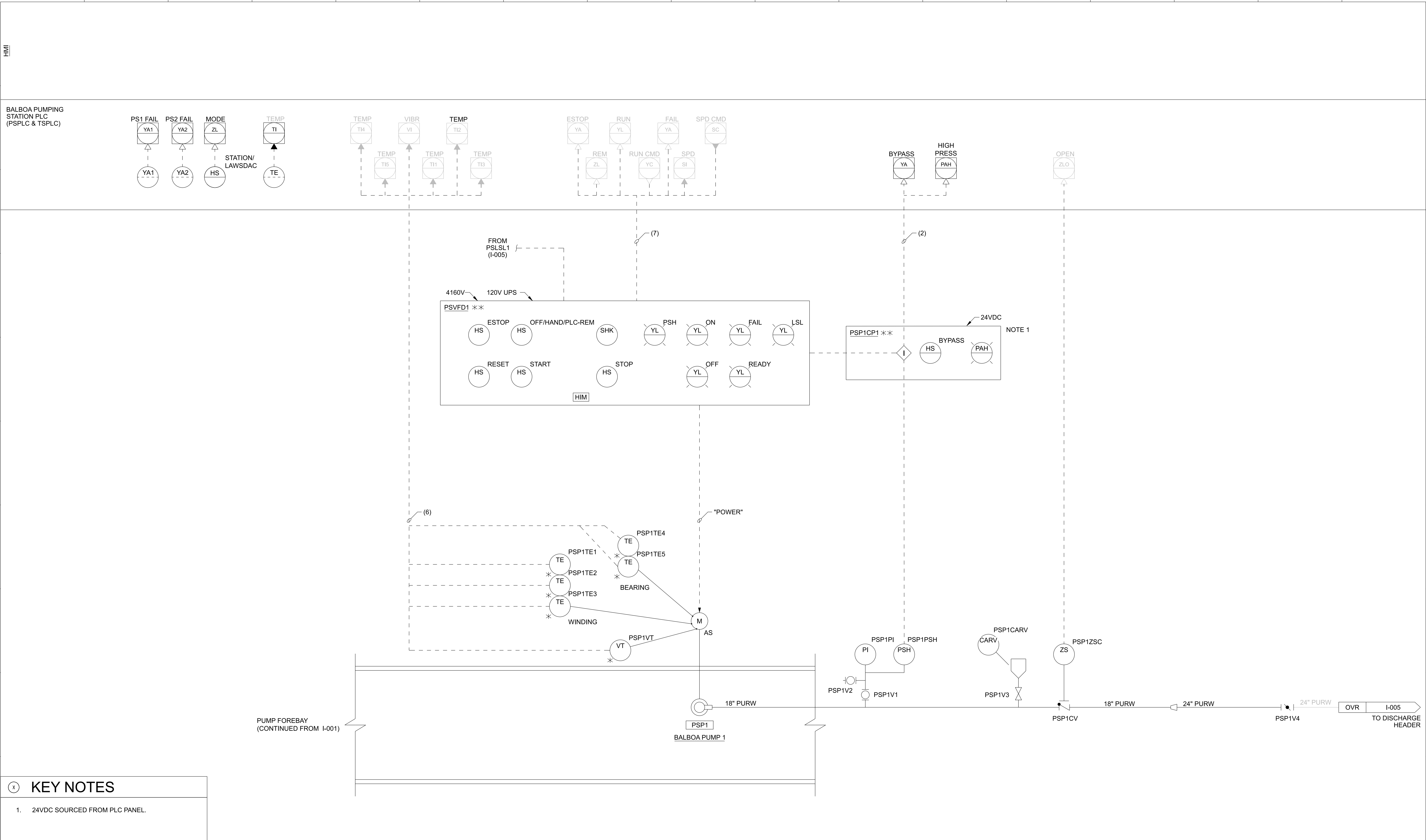
DEPARTMENT OF WATER AND POWER
CITY OF LOS ANGELES

DRAWING NUMBER
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D-06100-I-007

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

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Designer D DUTCHER
Stamp
Drawn By E KRISTEL
Checked By D WATSON
Last Update SGRIEBEL

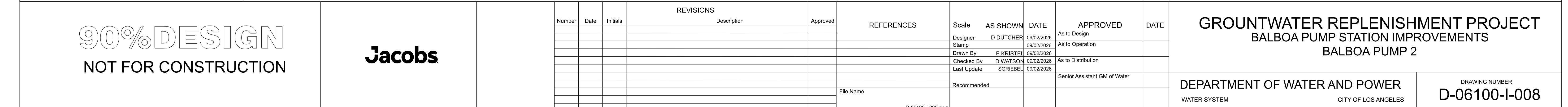
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APPROVED

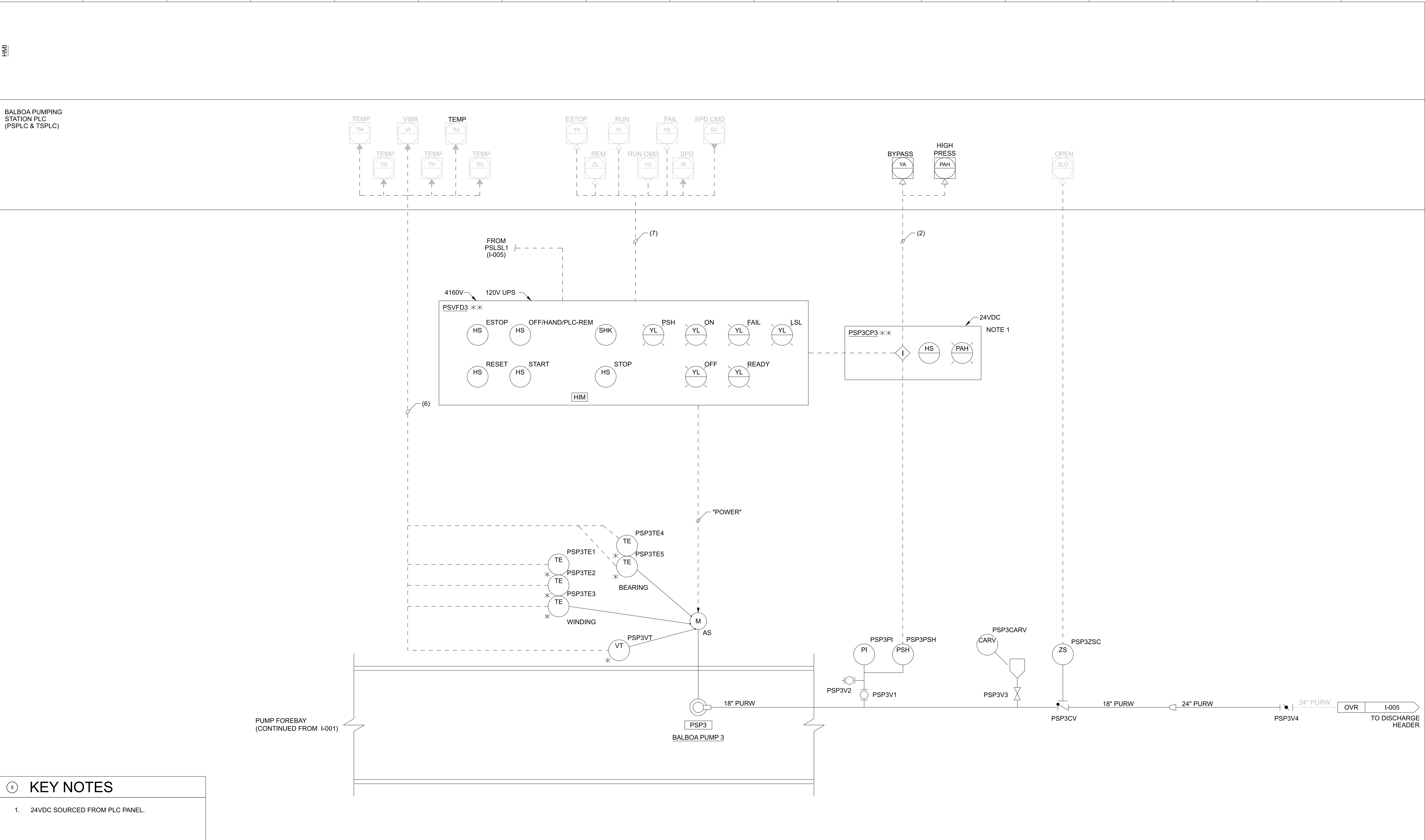
As to Design
As to Operation
As to Distribution
Senior Assistant GM of Water

DATE



D-06100-I-009

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KEY NOTES

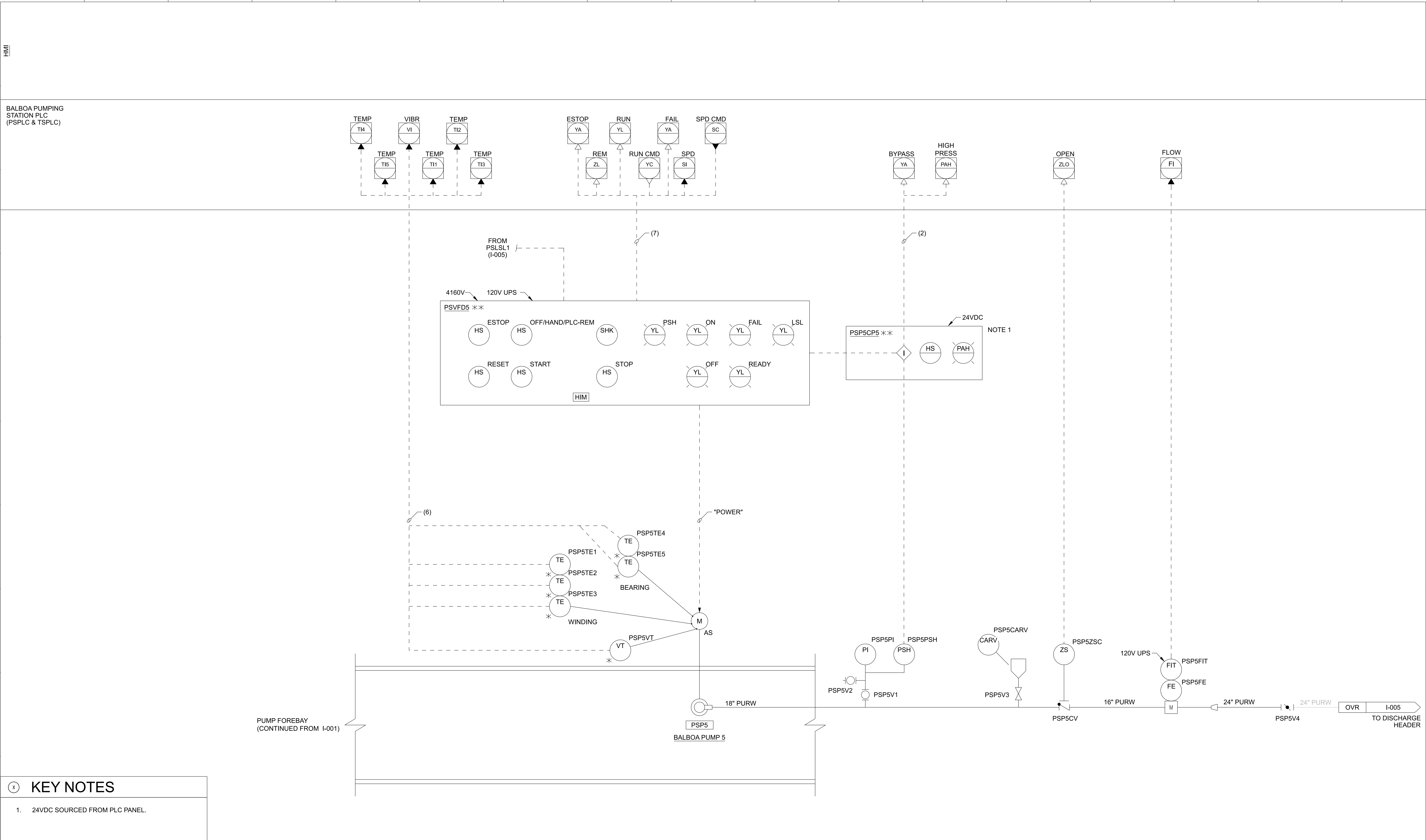
1.

24VDC SOURCED FROM PLC PANEL.

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90%DESIGN
NOT FOR CONSTRUCTION

Jacobs

REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

Scale	AS SHOWN	DATE
Designer	D DUTCHER	09/02/2026
Stamp		09/02/2026
Drawn By	E KRISTEL	09/02/2026
Checked By	D WATSON	09/02/2026
Last Update	SGRIEBEL	09/02/2026
Recommended		

APPROVED		DATE
As to Design		
As to Operation		
As to Distribution		
Senior Assistant GM of Water		

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
BALBOA PUMP 5

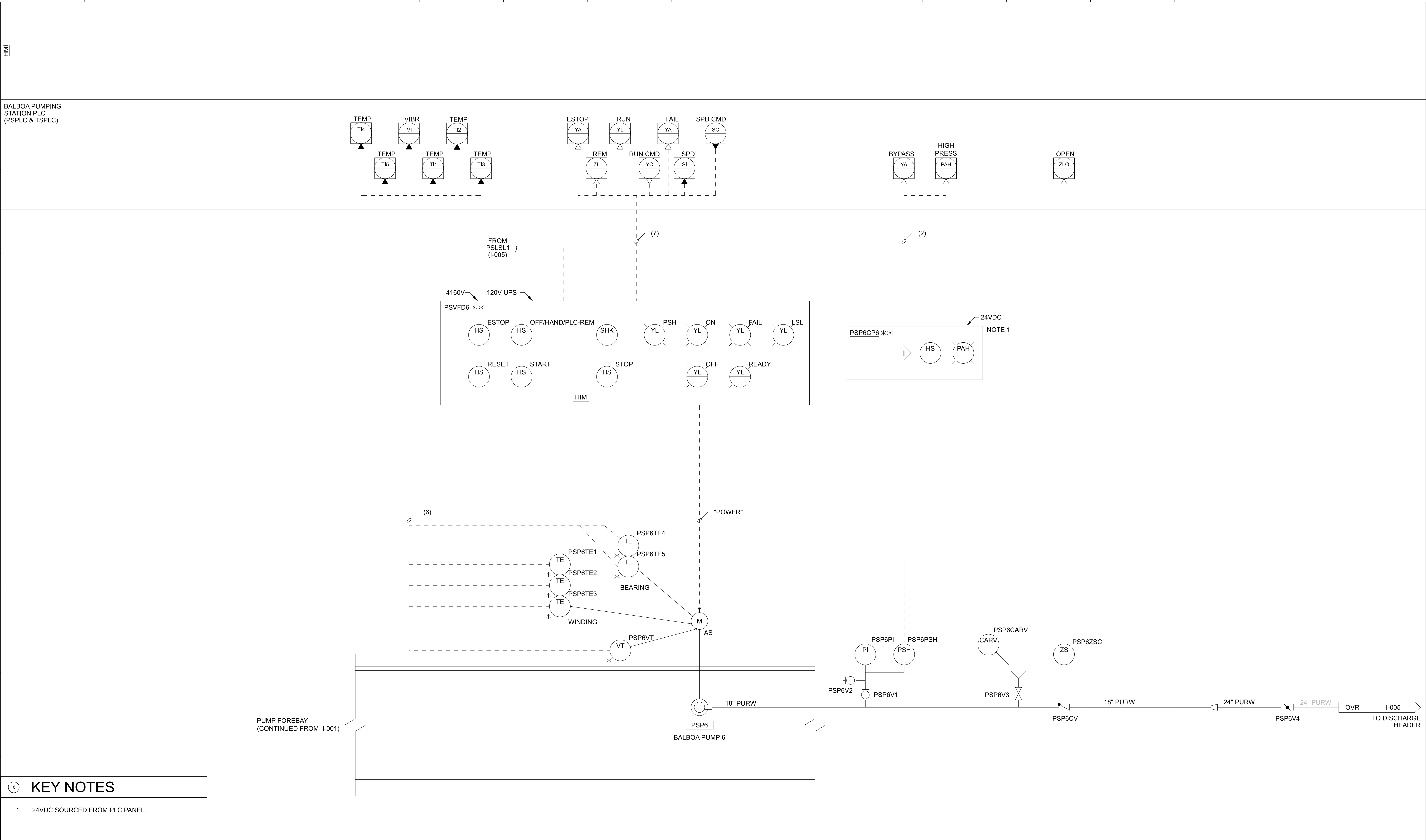
DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-010

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PLOT DATE/TIME: 8/8/2026 8:34:42 PM

D-06100-I-011



90%DESIGN
NOT FOR CONSTRUCTION

Jacobs

REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

File Name
D-06100-I-011.dwg

Scale	AS SHOWN	DATE	APPROVED	DATE
Designer	D DUTCHER	09/02/2026	As to Design	
Stamp		09/02/2026	As to Operation	
Drawn By	E KRISTEL	09/02/2026		
Checked By	D WATSON	09/02/2026	As to Distribution	
Last Update	SGRIEBEL	09/02/2026		
Recommended			Senior Assistant GM of Water	

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
BALBOA PUMP 6

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-011



90%DESIGN
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REFERENCES	Scale	AS SHOWN	DATE	APPROVED	DATE
	Designer	D DUTCHER	09/02/2026	As to Design	
	Stamp		09/02/2026	As to Operation	
	Drawn By	E KRISTEL	09/02/2026		
	Checked By	D WATSON	09/02/2026	As to Distribution	
	Last Update	SGRIEBEL	09/02/2026		
				Senior Assistant GM of Water	
File Name	Recommended				

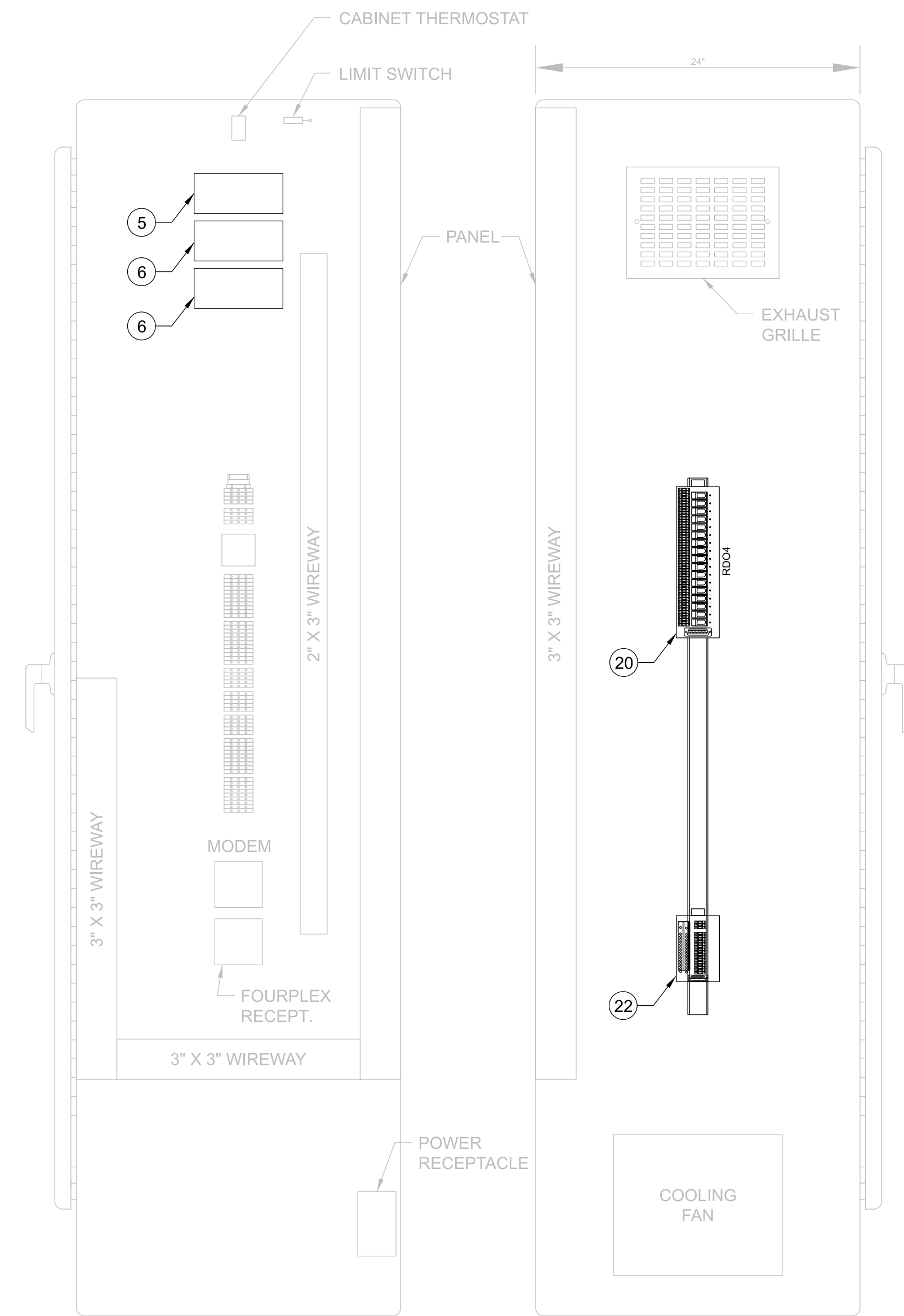
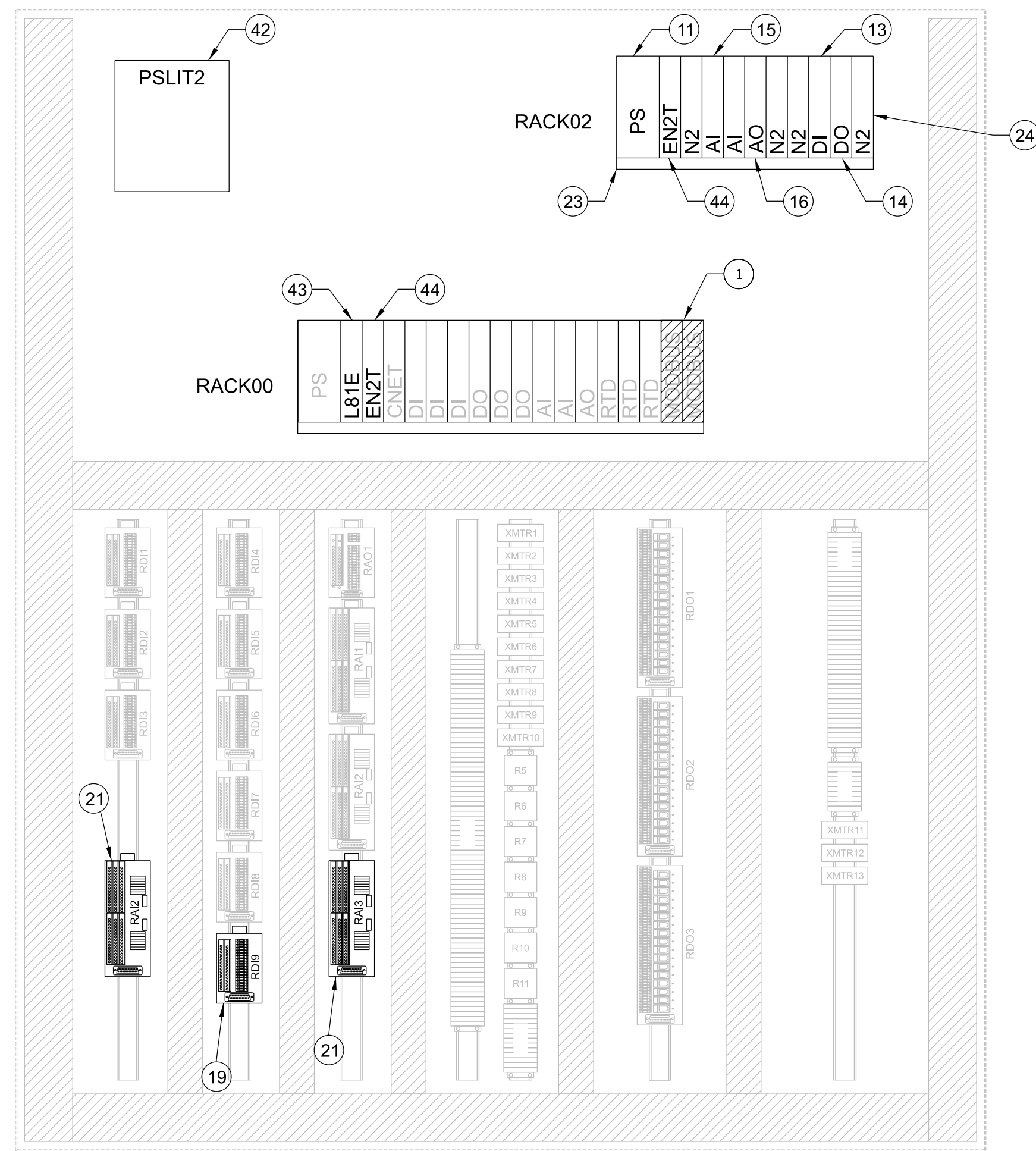
GROUNDWATER REPLENISHMENT PROJECT

BALBOA PUMP STATION IMPROVEMENTS

NETWORK DIAGRAM

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-012



CIRCLE AROUND
THE NUMBERS

- ➔ 1. DEMO THE MODBUS MODULES IN SLOTS 15 AND 16.
ADD A NEW RTD MODULE IN SLOT 15.

Jacobs.

[illegible]

REFERENCES	Scale	AS SHOWN	DATE	APPROVED	DATE
	Designer	D DUTCHER	09/02/2026	As to Design	
	Stamp		09/02/2026	As to Operation	
	Drawn By	J EARNHART	09/02/2026		
	Checked By		09/02/2026	As to Distribution	
	Last Update	SGRIEBEL	09/02/2026		
				Senior Assistant GM of Water	
File Name		Recommended			

GROUNDWATER REPLENISHMENT PROJECT

BALBOA PUMP STATION IMPROVEMENTS

PSPLC1 CONTROL PANEL ELEVATION

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-013

D-06100-I-014

FILENAME: C:\PW_WORLD\JACOBS-AMER-WTR\0349655-D-06100-I-014.DWG
PLOT DATE/TIME: 9/9/2026 8:39:22 PM

BILL OF MATERIALS				
ITEM	QTY	MODEL	DESCRIPTION	MANUFACTURER
1	1	A907224SSFSD	EXISTING ENCLOSURE, 90"W X 72"H X 24"D	HOFFMAN
2	1		EXISTING PANEL, 80"H X 68"H	HOFFMAN
3	1	2711-T19C22A9P	PANEL VIEW PLUS 7 PERFORMANCE, 19 INCH	ALLEN-BRADLEY
4	1	5180V	CHEssel RECORDER	EUROTHERM 5180V
5	1	1088206	POWER SUPPLY REDUNDANCY DIODE MODULE, 24VDC, 10A	PHOENIX CONTACT
6	2	2866750	POWER SUPPLY, 24VDC, 10A	PHOENIX CONTACT
7	1	700-HA33Z24-4	RELAY, 24V, 3PDT, 10A, PLUG-IN, PILOT LIGHT	ALLEN-BRADLEY
8	6	700-HA33A1	RELAY,120V, 3PDT, 10A, PLUG-IN, PILOT LIGHT	ALLEN-BRADLEY
9	7	700-HN126	SOCKET, 11 PIN, FOR THE ABOVE RELAYS, DIN RAIL	ALLEN-BRADLEY
10	10	DIN4000-5	DC TO DC CONVERTER, ISOLATED, ANY INPUT, DUAL DC OUTPUT	AGM
11	2	1756-PA75	POWER SUPPLY, 120VAC	ALLEN-BRADLEY
12	1	1756-A17	17-SLOT PLC CHASSIS, PANEL MOUNT	ALLEN-BRADLEY
13	5	1756-IB32	MODULE, DIGITAL INPUT, 24VDC, 32PT	ALLEN-BRADLEY
14	4	1756-OB16E	MODULE, DIGITAL OUTPUT, 24VDC, 32PT	ALLEN-BRADLEY
15	4	1756-IF16	MODULE, ANALOG INPUT, 8PT (DIFFERENTIAL)	ALLEN-BRADLEY
16	2	1756-OF8	MODULE, ANALOG OUTPUT, 8PT	ALLEN-BRADLEY
17	4	1756-IR8I	MODULE, RTD INPUT, 8PT	ALLEN-BRADLEY
18	1	1756-CNB	MODULE, CONTROLNET	ALLEN-BRADLEY
19	9	1492-IFD20K-2	16 INPUT DIGITAL IFM MODULE	ALLEN-BRADLEY
20	4	1492-XID2024-16RK	16 OUTPUT DIGITAL IFM MODULE	ALLEN-BRADLEY
21	4	1492-AIFM16FK-5	16 INPUT ANALOG IFM MODULE	ALLEN-BRADLEY
22	2	1492-AIFMK8K-3	8 OUTPUT ANALOG IFM MODULE CABLE	ALLEN-BRADLEY
23	1	1756-A10	10-SLOT PLC CHASSIS, PANEL MOUNT	ALLEN-BRADLEY
24	4	1756-N2	BLANK SLOT FILLERS	ALLEN-BRADLEY
25	AS REQ'D	234041.26	TERMINAL BLOCK NUMBERS (1-10)	ENTRELEC
26	AS REQ'D	234042.27	TERMINAL BLOCK NUMBERS (11-20)	ENTRELEC
27	AS REQ'D	234043.2	TERMINAL BLOCK NUMBERS (21-30)	ENTRELEC
28	AS REQ'D	173.220.05	MOUNTING RAIL, SYMETRICAL DIN-3	ENTRELEC
29	AS REQ'D		PANDUIT, 2" X 1.5"	ENTRELEC
30	AS REQ'D	115.277.20	TERMINAL BLOCKS, HEAVY DUTY, SWITCH TYPE, FOR GENERAL USE	ENTRELEC
31	AS REQ'D	113.137.02	END SECTION, GREY, TYPE FRMT1, FOR UNDER GENERAL TERM BLOCK	ENTRELEC
32	AS REQ'D	165.144.17	TERMINAL BLOCK, ELEC CONN TO RAIL, GREEN/YELLOW, FOR SHEILDS	ENTRELEC
33	AS REQ'D	GMU15D	CIRCUIT BREAKER, 15AMPS, FOR AC-L FEED	ENTRELEC
34	AS REQ'D	199.168.00	TERMINAL BLOCK, FUSE HOLDER, BLACK, FOR DC+	ENTRELEC
35	AS REQ'D	168.556.05	FUSE, 1A, TYPE FU 633, FOR DC POWER	ENTRELEC
36	AS REQ'D	199.635.24	END SECTION, TYPE FEMU, FOR BLOW FUSE HOLDER	ENTRELEC
37	AS REQ'D	115.118.11	TERMINAL BLOCK, SINGLE POLE, GREY, FOR AC-N AND DC-	ENTRELEC
38	AS REQ'D	103.002.26	END STOP, TYPE BAM, FOR ABOVE AND BELOW TERMINAL GROUPS	ENTRELEC
39	AS REQ'D	113.084.01	MARKER HOLDER FOR END STOP, TYPE PEMB	ENTRELEC
40	1	800T-H2A	TWO-POSITION SWITCH, MAINTAINED, 30MM	ALLEN-BRADLEY
41	2	800T-QTH2A	PILOT LIGHT, 30MM, LED, YELLOW	ALLEN-BRADLEY
42	1		ULTRASONIC LEVEL TRANSMITTER	REFER TO INSTRUMENT LIST
43	1	1756-L81E	CONTROLLOGIX L81E PROCESSOR	ALLEN-BRADLEY
44	2	1756-EN2TR	CONTROLLOGIX ETHERNET COMM. MODULE, DUAL-PORT	ALLEN-BRADLEY

90%DESIGN
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REVISIONS			Description	Approved
Number	Date	Initials		

REFERENCES	Scale	AS SHOWN	DATE	APPROVED	DATE
	Designer	D DUTCHER	09/02/2026	As to Design	
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	Checked By	—	09/02/2026	As to Distribution	
	Last Update	SGRIEBEL	09/02/2026		
				Senior Assistant GM of Water	
	Recommended				
File Name					
D-06100-I-014.dwg					

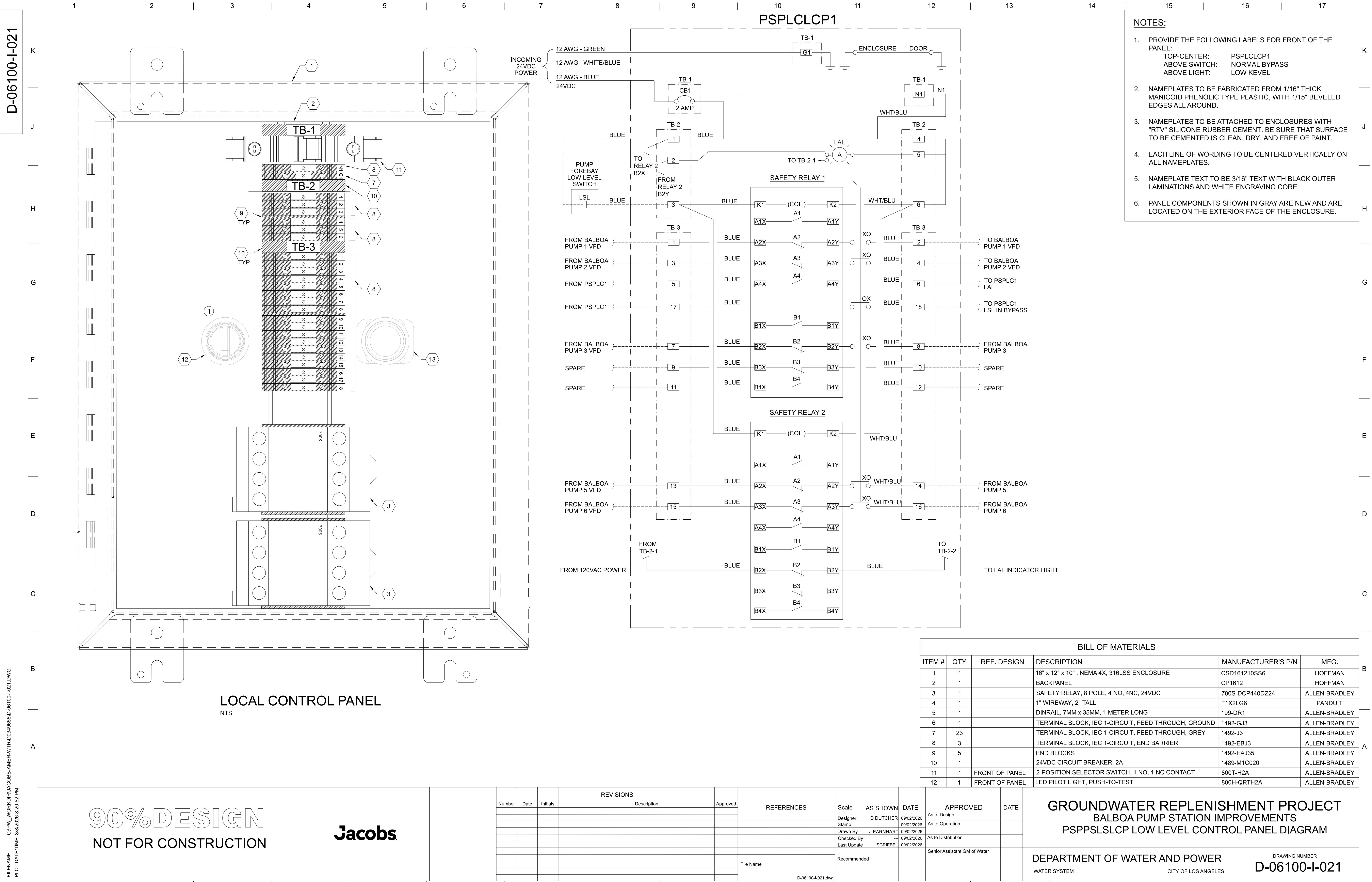
GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PSPLC1 CONTROL PANEL ELEVATION BILL OF MATERIALS

DEPARTMENT OF WATER AND POWER
WATER SYSTEMCITY OF LOS ANGELES

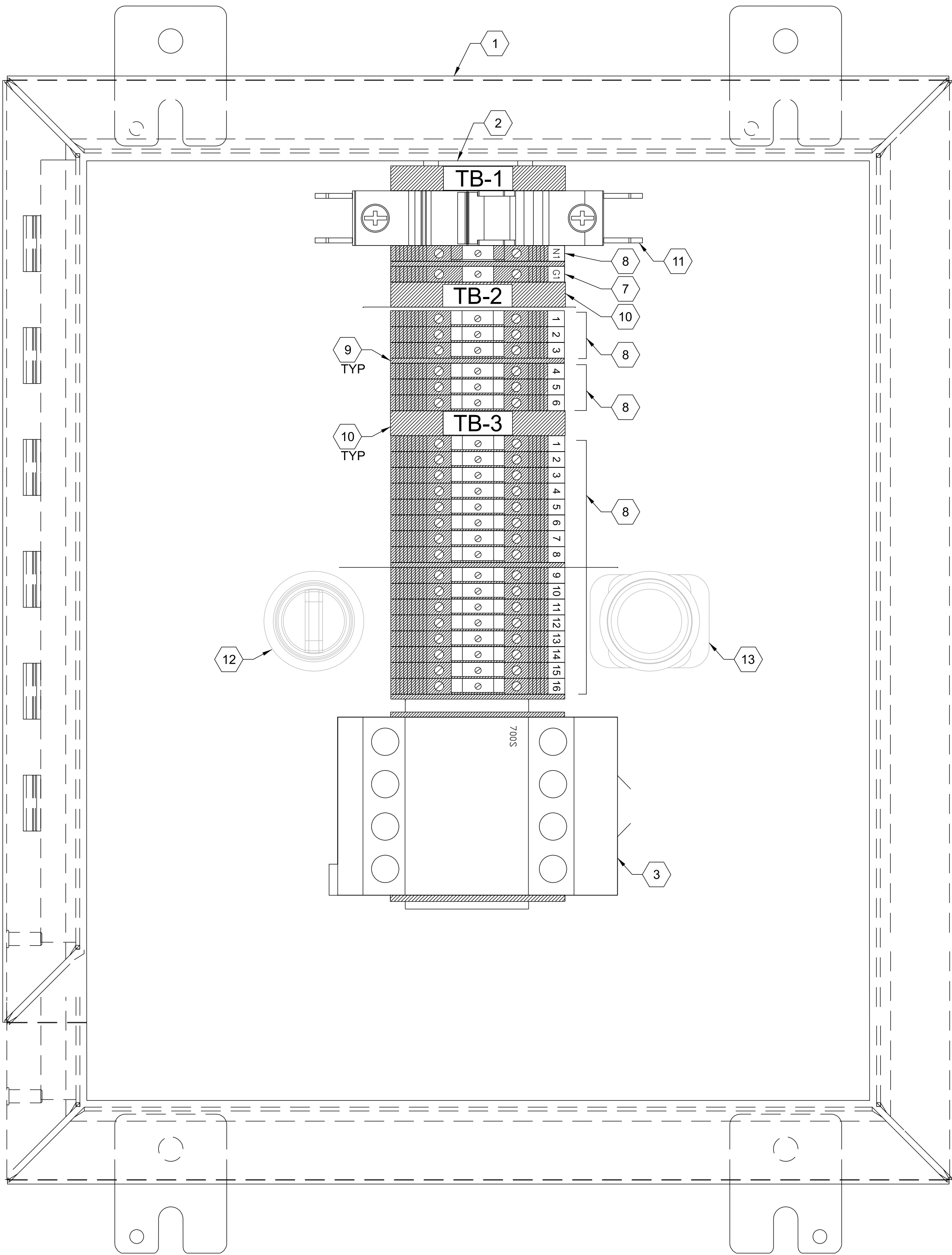
DRAWING NUMBER
D-06100-I-014

D-06100-I-021

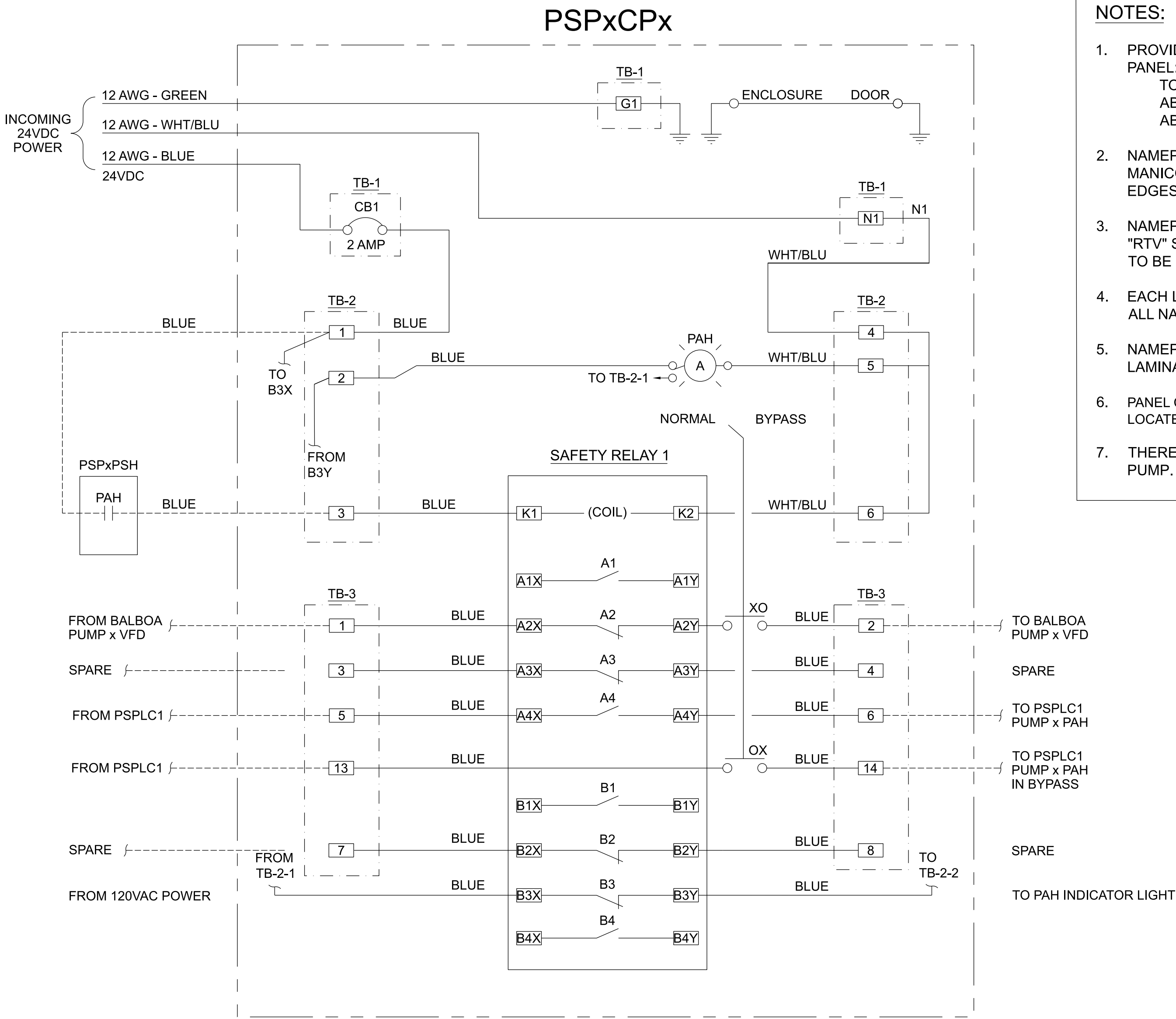
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PLOT DATE/TIME: 9/8/2026 8:20:52 PM



D-06100-I-022



LOCAL CONTROL PANEL
NTS



- NOTES:**
1. PROVIDE THE FOLLOWING LABELS FOR FRONT OF THE PANEL:
TOP-CENTER: PSPxCPx
ABOVE SWITCH: NORMAL BYPASS
ABOVE LIGHT: HIGH PRESSURE
 2. NAMEPLATES TO BE FABRICATED FROM 1/16" THICK MANICOID PHENOLIC TYPE PLASTIC, WITH 1/16" BEVELED EDGES ALL AROUND.
 3. NAMEPLATES TO BE ATTACHED TO ENCLOSURES WITH "RTV" SILICONE RUBBER CEMENT. BE SURE THAT SURFACE TO BE CEMENTED IS CLEAN, DRY, AND FREE OF PAINT.
 4. EACH LINE OF WORDING TO BE CENTERED VERTICALLY ON ALL NAMEPLATES.
 5. NAMEPLATE TEXT TO BE 3/16" TEXT WITH BLACK OUTER LAMINATIONS AND WHITE ENGRAVING CORE.
 6. PANEL COMPONENTS SHOWN IN GRAY ARE NEW AND ARE LOCATED ON THE EXTERIOR FACE OF THE ENCLOSURE.
 7. THERE ARE FIVE TOTAL PANELS, ONE FOR EACH BALBOA PUMP. PANEL NAMES: PSPxCPx, x = 1,2,3,5,6.

BILL OF MATERIALS					
ITEM #	QTY	REF. DESIGN	DESCRIPTION	MANUFACTURER'S P/N	MFG.
1	1		16" x 12" x 10", NEMA 4X, 316LSS ENCLOSURE	CSD161210SS6	HOFFMAN
2	1		BACKPANEL	CP1612	HOFFMAN
3	1		SAFETY RELAY, 8 POLE, 4 NO, 4NC, 24VDC	700S-DCP440DZ24	ALLEN-BRADLEY
4	1		1" WIREWAY, 2" TALL	F1X2LG6	PANDUIT
5	1		DINRAIL, 7MM x 35MM, 1 METER LONG	199-DR1	ALLEN-BRADLEY
6	1		TERMINAL BLOCK, IEC 1-CIRCUIT, FEED THROUGH, GROUND	1492-GJ3	ALLEN-BRADLEY
7	23		TERMINAL BLOCK, IEC 1-CIRCUIT, FEED THROUGH, GREY	1492-J3	ALLEN-BRADLEY
8	3		TERMINAL BLOCK, IEC 1-CIRCUIT, END BARRIER	1492-EBJ3	ALLEN-BRADLEY
9	5		END BLOCKS	1492-EAJ35	ALLEN-BRADLEY
10	1		24VDC CIRCUIT BREAKER, 2A	1489-M1C020	ALLEN-BRADLEY
11	1	FRONT OF PANEL	2-POSITION SELECTOR SWITCH, 1 NO, 1 NC CONTACT	800T-H2A	ALLEN-BRADLEY
12	1	FRONT OF PANEL	LED PILOT LIGHT, PUSH-TO-TEST	800H-QRTH2A	ALLEN-BRADLEY

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REVISIONS			Description	Approved
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REFERENCES

Scale	AS SHOWN	DATE
Designer	D DUTCHER	09/02/2026
Stamp		09/02/2026
Drawn By	J EARNHRT	09/02/2026
Checked By	D WATSON	09/02/2026
Last Update	SGRIEBEL	09/02/2026
Recommended		

APPROVED		DATE
As to Design	As to Operation	

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PSPXCP HIGH PRESSURE CONTROL PANEL DIAGRAM

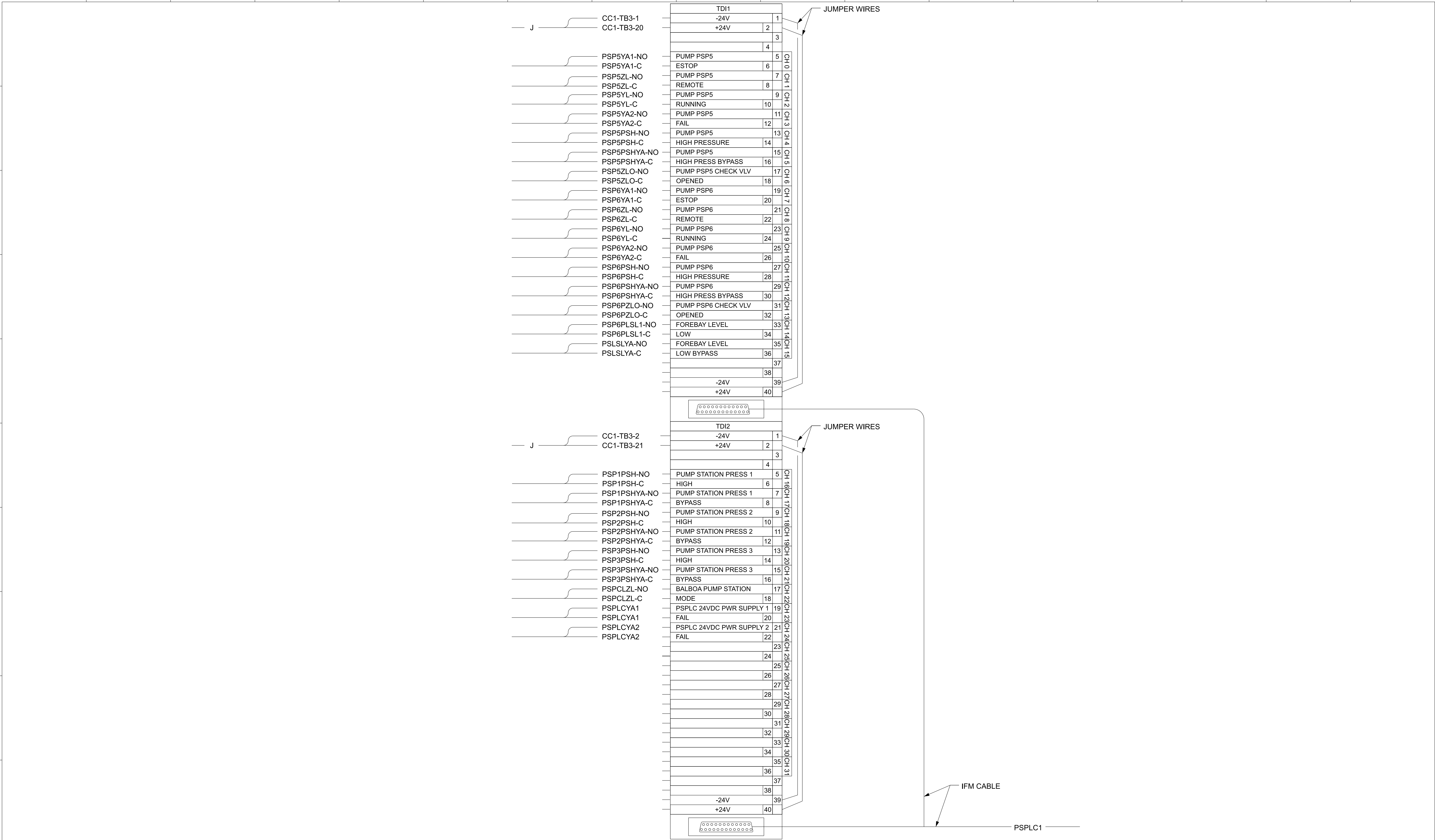
DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

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REVISIONS				
Number	Date	Initials	Description	Approved

REFERENCES

Scale	AS SHOWN	DATE
Designer	D DUTCHER	09/02/2026
Stamp		09/02/2026
Drawn By	E KRISTEL	09/02/2026
Checked By	D WATSON	09/02/2026
Last Update	SGRIEBEL	09/02/2026

APPROVED	DATE
As to Design	
As to Operation	
As to Distribution	
Senior Assistant GM of Water	

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PSPLC1 DI DIAGRAM

DEPARTMENT OF WATER AND POWER
WATER SYSTEMCITY OF LOS ANGELES

DRAWING NUMBER
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REVISIONS				
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Last Update	SGRIEBEL	09/02/2026

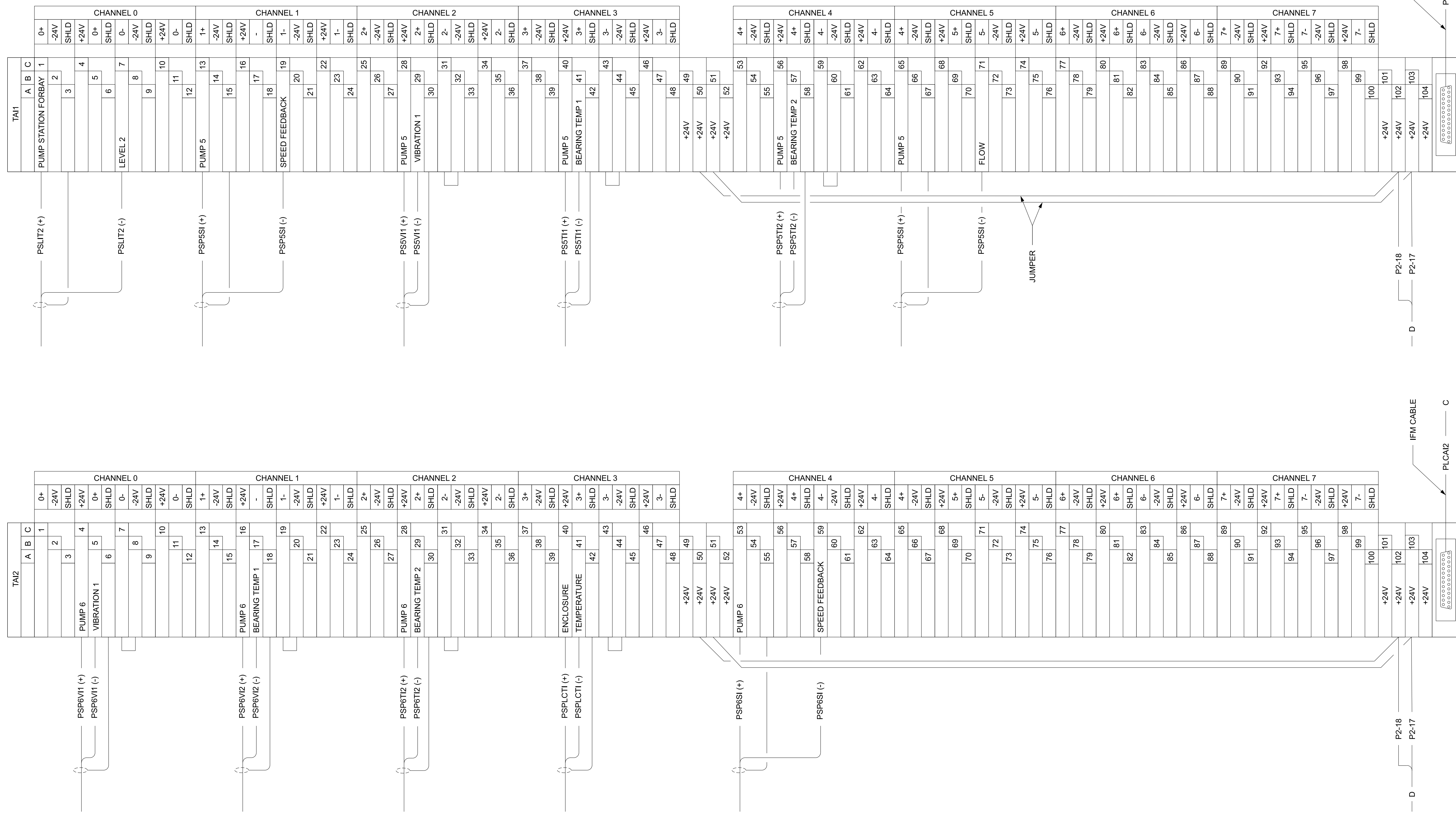
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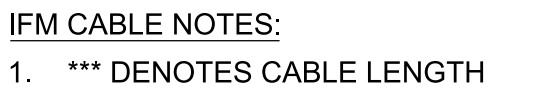
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As to Design		
As to Operation		
As to Distribution		
Senior Assistant GM of Water		

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PSPLC1 PLC AI DIAGRAMS

DEPARTMENT OF WATER AND POWER
CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-033





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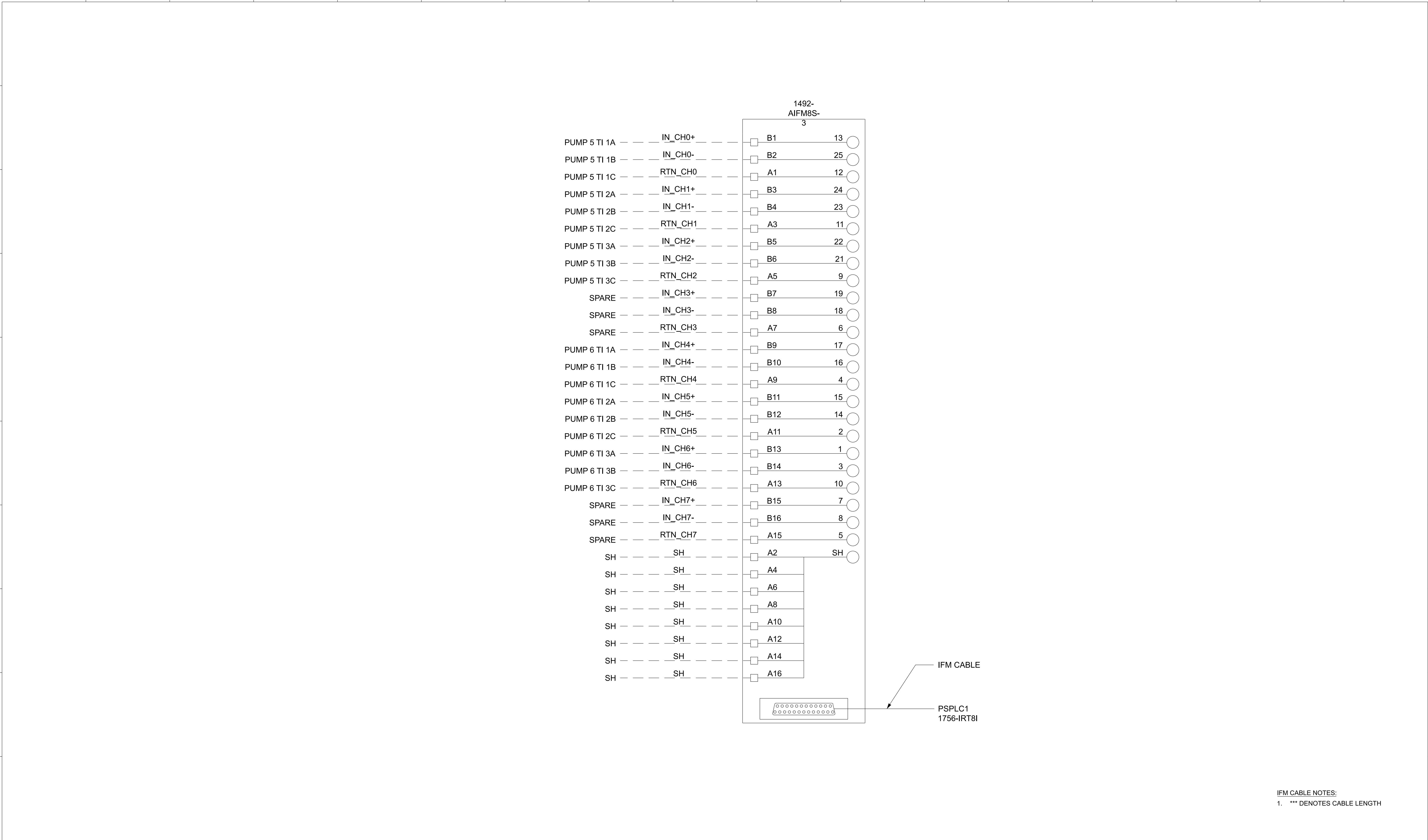
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	Drawn By	E KRISTEL	09/02/2026		
	Checked By	D WATSON	09/02/2026	As to Distribution	
	Last Update	SGRIEBEL	09/02/2026		
				Senior Assistant GM of Water	
File Name	Recommended				

DEPARTMENT OF WATER AND POWER
WATER SYSTEM CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-034

D-06100-I-035

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IFM CABLE NOTES:
1. *** DENOTES CABLE LENGTH

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REVISIONS			
Number	Date	Initials	Description

REFERENCES		Scale		DATE		APPROVED		DATE	
		AS SHOWN							
		Designer		D DUTCHER		09/02/2026		As to Design	
		Stamp				09/02/2026		As to Operation	
		Drawn By		J EARNHART		09/02/2026		As to Distribution	
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		Last Update		SGRIEBEL		09/02/2026		Senior Assistant GM of Water	
		Recommended							
		File Name							

GROUNDWATER REPLENISHMENT PROJECT
BALBOA PUMP STATION IMPROVEMENTS
PSPLC1 RTD DIAGRAM

DEPARTMENT OF WATER AND POWER
WATER SYSTEM

CITY OF LOS ANGELES

DRAWING NUMBER
D-06100-I-035