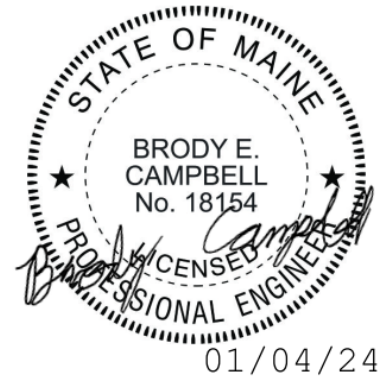


Date: 1/4/2024
Project No.: 21548/A.10/WWME
To: Shawn Johansen, Facilities Director, MSAD 75
From: Brody Campbell, P.E., Wright-Pierce
Subject: MSAD 75 CMP Transformer Support Evaluation



Introduction

The purpose of this memorandum is to summarize the evaluation of the existing electrical transformer pad at the Bowdoin Community School and to document the proposed recommendations to prevent future settlement. The 9'x9' precast concrete pad was installed in 2001 as part of the original school construction project. In recent years, the pad has shown signs of considerable settlement (approximately 2-4 inches). The reason for the settlement has not been determined and is outside the scope of this evaluation. However, the settlement could be caused by one or more of the following: frost action, lack of suitable base materials underneath the structure, poor soil compaction, groundwater, water runoff/drainage or another reason.

Note that this evaluation does not include a cost estimate or a subsurface investigation to determine specific reason for settlement, soil bearing capacity, existing conduit, or concrete pad bedding conditions, etc. This effort provides conceptual level analysis and a recommended repair with construction details. This technical memorandum is not intended to be used as final stamped design drawings and specifications for bidding purposes but should give the District adequate information to work with a local contractor to determine an estimated cost to complete the work to allow MSAD 75 to budget for the work.

Summary of Existing Conditions

The 2001 Bowdoin Central School construction drawings were reviewed to determine the size of the transformer pad installed, scope of underground electrical wires installed, and locations of other underground infrastructure. Power is provided by overhead electrical wires to the east side of the school parking lot. From there the power feed goes underground to the north side of the building where it enters the 9'x9' precast concrete transformer pad. The pad includes a vault below which acts as a handhole for the incoming power feed cables to be coiled below.

Wright-Pierce, MSAD 75, and Central Maine Power (CMP, local electrical company) met on site on 9/19/23 to review the transformer pad condition. The transformer has settled approximately 2 to 4 inches. The area around the transformer is sloped towards the transformer pad, which is contributing to the vault beneath the transformer being full of water, as was noted during the visit. Refer to Figures 1 through 4 for photos of the transformer and generator. Figures 5 and 6 are the civil site and electrical plans from the 2001 drawings for reference.

Drainage from the roof of the school goes through roof leaders that lead away from the foundation of the building. There is an underdrain installed north of the school and the paved area around the transformer. This underdrain directs water east to a detention pond. A catch basin is installed west of the transformer in the grass area off the pavement. The catch basin drains south underneath the school to the detention pond south of the school. Drainage around the site is depicted in Figure 5.

The standby power generator for the school, was installed after the original 2001 construction and sits west of the transformer, is not elevated above grade and the base of the generator sits directly on the pavement, refer to Figure 3. A manual transfer switch in the electrical room is used to transfer from CMP normal line power to standby power from the generator. MSAD75 is planning to replace the manual transfer switch with an automated transfer switch in the Fall/Winter of 2023/24.

Figure 1 Transformer Interior



Figure 2 Generator and Transformer Layout



Figure 3 Transformer Exterior



Figure 4 Standby Power Generator



Figure 5 2001 Civil Site Plan

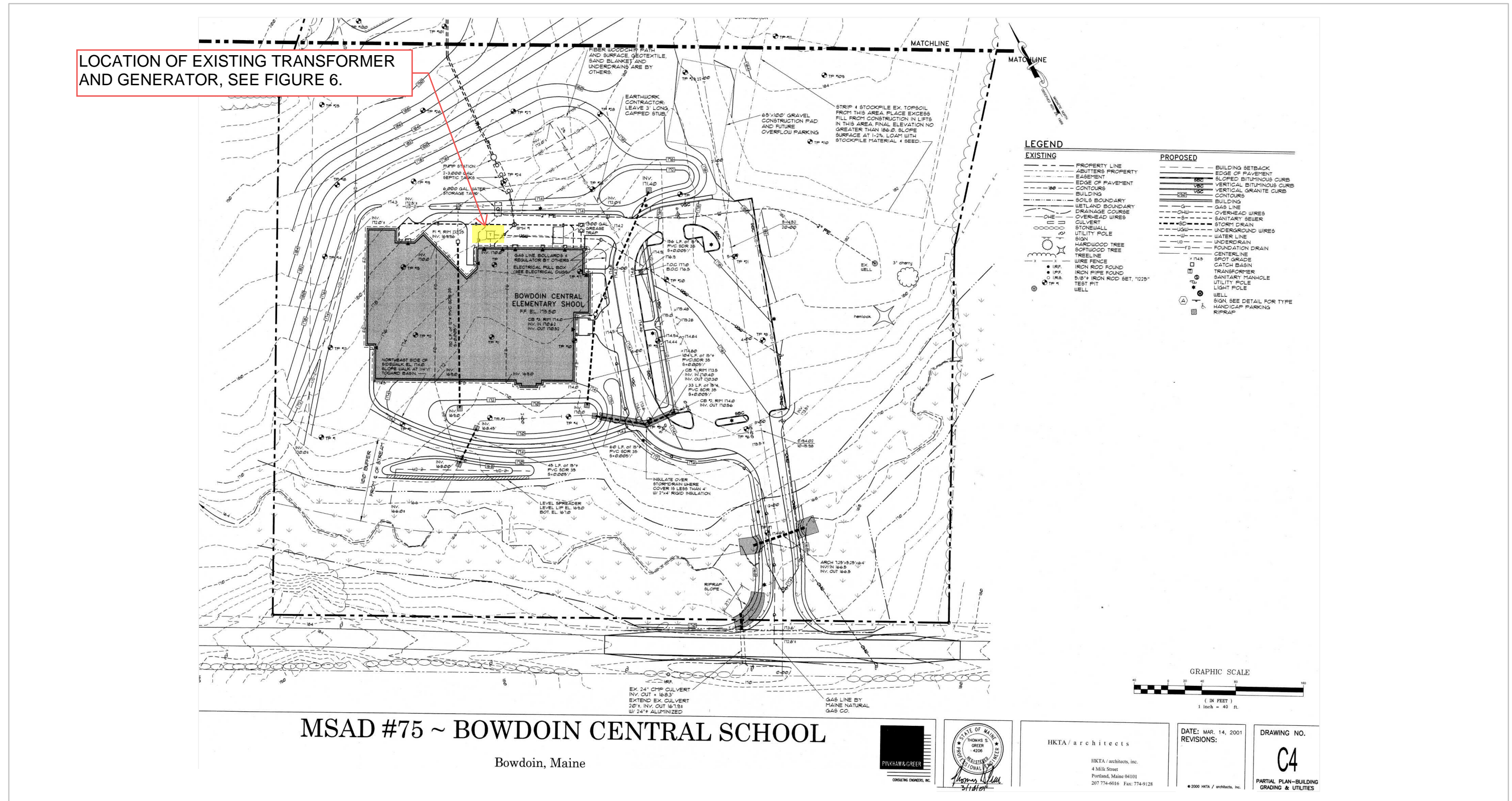
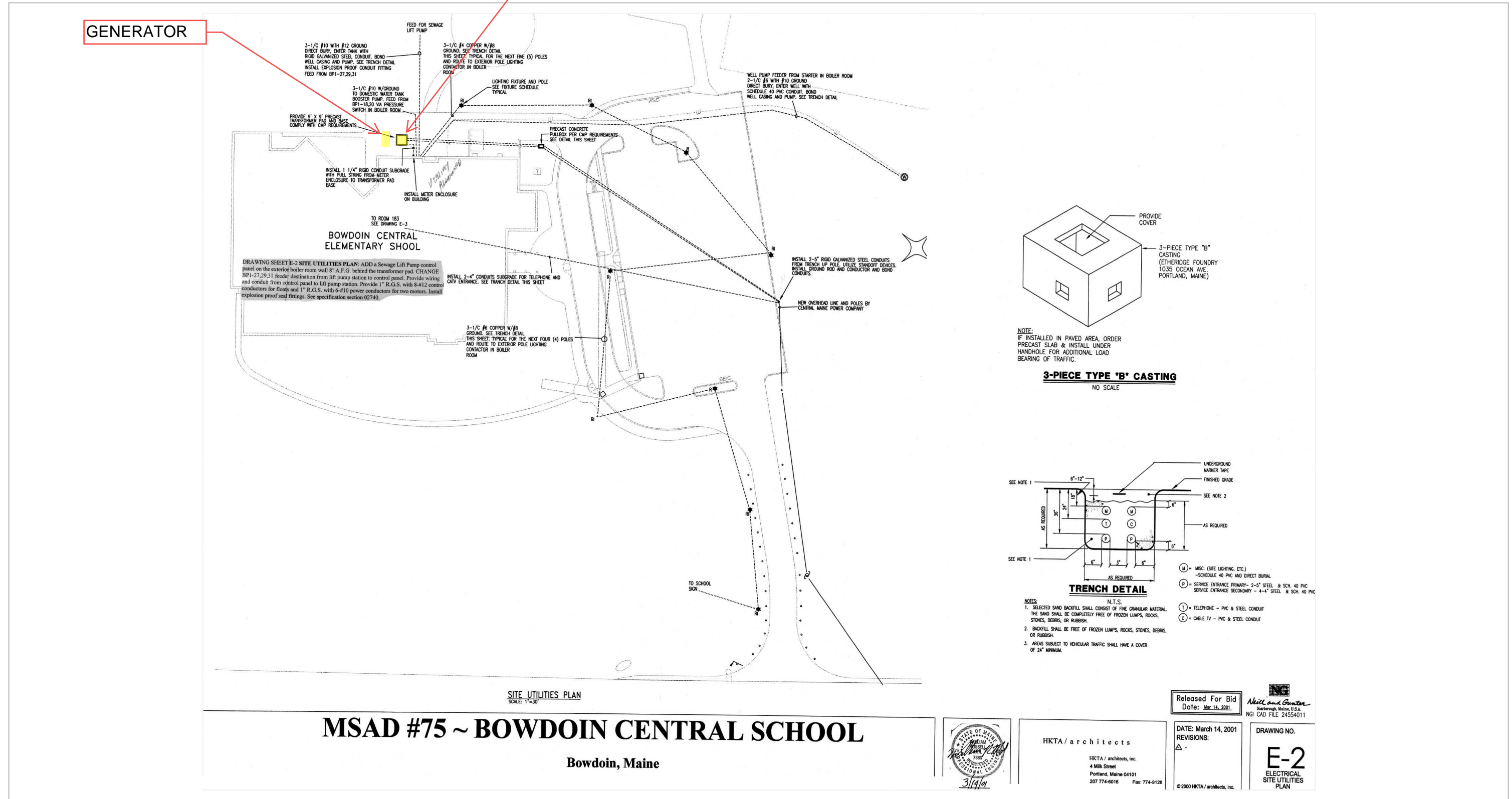


Figure 6 2001 Electrical Site Plan



Recommendations on Repairs/Replacement

This section documents our recommended repairs, proposed construction details, and proposed construction sequence for the transformer pad and associated infrastructure improvements to prevent future settlement and maintain reliable electrical service to the school. These recommendations are based on our visual observations and review of plans for the school. Subsurface investigations were not performed to determine the root cause of the settlement. Visual observations of the area around and below the transformer during repairs should be conducted by a qualified geotechnical engineer to determine if changes to the repair recommendations below are needed during construction. Implementing the following recommendations will result in interruption of electrical service to the school, and may want to be planned for summer vacation.

- Advanced planning is essential to ensure the following recommended repairs are completed in a timely manner. This includes coordinating the CMP and ordering the precast structure.
- CMP to shut off electrical service to the school. CMP to disconnect wires from the transformer and pull wires out of vault below transformer pad. CMP owns the transformer and will remove it from the pad. The transformer will be stored on site or CMP will store it at their facility temporarily during construction. CMP noted during the 9/19/23 site visit that they would complete this scope of work for no charge.
- MSAD 75 to hire local contractor to demolish and remove the existing transformer box/pad. Special care shall be taken not to disturb other underground infrastructure during the demolition process. Vacuum excavation may be needed to minimize the potential for damaging underground conduit and wires. The standby power generator that sits approximately 10-feet to the west of the transformer should also be disconnected by the contractor at this time and temporarily relocated. A temporary generator may be needed to provide power to the school during the construction process.
- During the excavation process the contractor and MSAD 75 should over excavate the area and evaluate the condition of the subgrade soil and underground conduits in the area. For conduits, this includes the generator feed conduit, the transformer service line conduit to the school, the site pump station conduit, site lighting conduit, fire suppression pump tank conduit, and any other conduits exposed during excavation. If the condition of the existing conduits is poor they should be replaced. New conduits should be installed in a concrete or sand encased ductbank, see Details 04 and 05. It is recommended that the condition of the subgrade soil and any other exposed pipes in the excavation area should be visually evaluated by a qualified geotechnical engineer to determine if any additional recommendations are needed to prevent future settlement in this area.
- Once the electrical equipment is removed the contractor should excavate down to native, in-situ soil and install a new 9' by 9' below grade, pre-cast transformer vault and pre-cast top pad cover (see Detail 07). The excavation will be approximately 7 to 8 feet deep. Care should also be taken to provide good soil compaction below the proposed pad. There should be a 2'-3" minimum layer of crushed stone installed and compacted to provide a structural base. Compaction testing of native soil, structural base and other fill is recommended. The contractor can then install a 3" leveling concrete pad (mud pad) over the crushed stone. The transformer vault will be set on the leveling pad. The top of the vault pad cover should be installed such that it is raised 6-inches to 8-inches above the surrounding grade. A separate cast in place slab should be installed for the generator adjacent to the transformer, see Detail 06.

- The contractor should install an underdrain (see Detail 01) around and underneath the open bottom of the proposed precast concrete transformer foundation. This proposed underdrain should be connected to the existing underdrain that is installed north of the paved area and transformer or to the catch basin west of the transformer. This proposed underdrain should help reduce the amount of groundwater in the area.
- Once the new vault and generator pads are in place the generator can be reset and reconnected by the contractor. CMP will return once the new concrete transformer foundation is in place to place the transformer and reconnect the underground service wiring.
- The contractor should regrade the immediate area surrounding the electrical gear and slope the pavement to shed water away from the building and proposed transformer and generator pad.
- The contractor should install new bollards (see Detail 02) on all four corners of the proposed concrete pad and install a fence (see Detail 03) around the entire generator and transformer area with an access gate to keep people away from the equipment. Care should be taken to avoid the underground conduits during the installation of the bollards and fence posts. In addition, the fence will need to be bonded and grounded.
- The estimated duration for this scope of work is 2 to 4 weeks depending on the condition of the existing underground conduit, contractor availability, and soil conditions. A larger, cast in place slab could also be installed underneath both the generator and transformer, but using cast in place concrete would likely extend the period of time the electrical service is offline at the school.

Proposed construction details are included as attachments at the end of this memorandum.

Conclusion

The construction details and proposed construction details above can be discussed with a qualified local contractor to determine an estimated construction cost and availability to complete the work.

As a separate task order, we would be happy to assist with developing complete construction drawings and specifications, bidding services, or construction administration services as needed. Observation of the soil conditions under the transformer box/pad during construction may better reveal the root cause of the settlement issue.

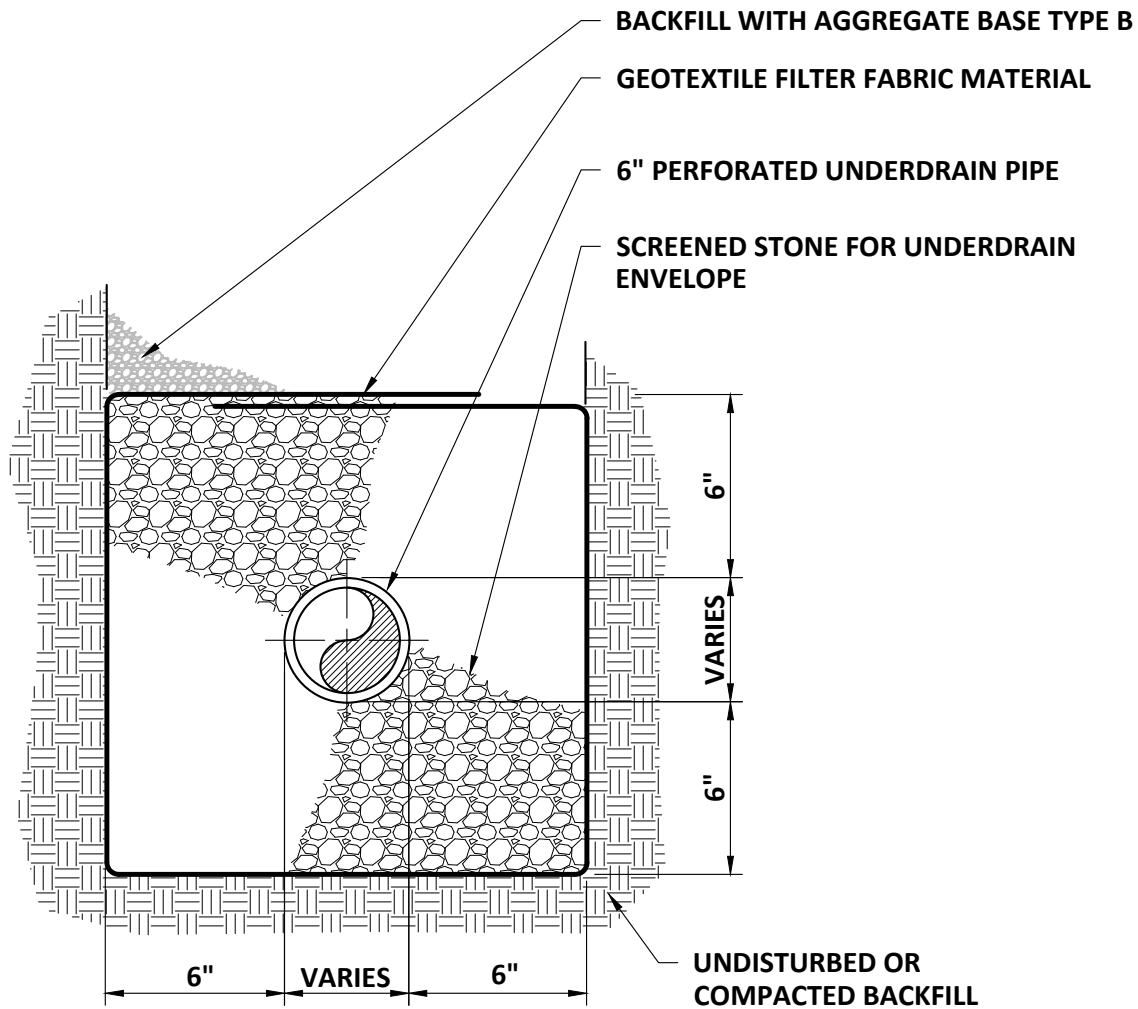
Attachments

- Detail 01 - Underdrain detail
- Detail 02 - Bollard detail
- Detail 03 - Chain link fence and gate detail
- Detail 04 & 05 - Ductbank details
- Detail 06 - Concrete generator pad detail
- Detail 07 - Concrete transformer foundation detail (CMP)

ATTACHMENTS



Detail 01
Underdrain detail

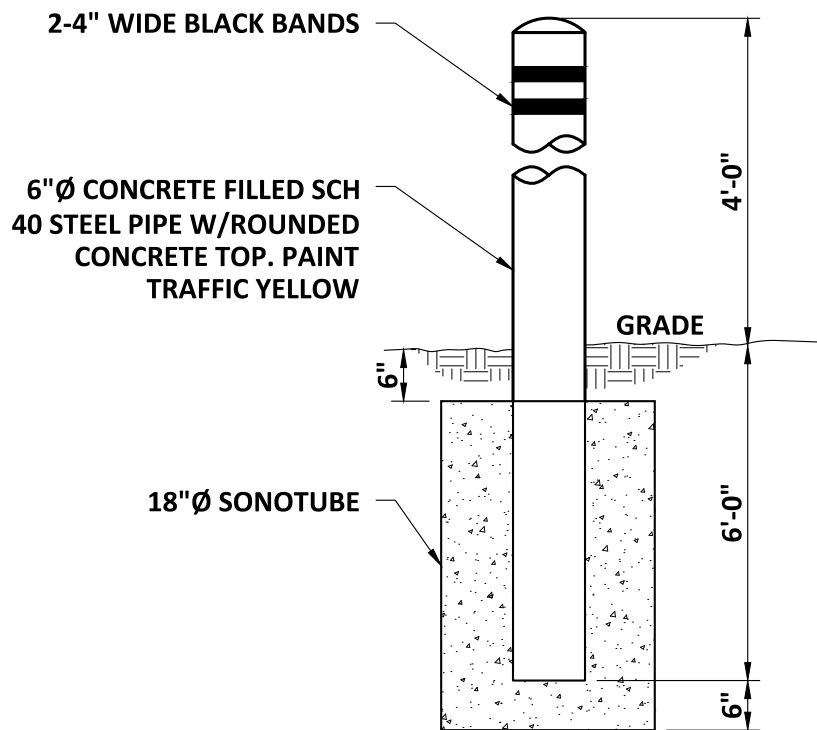


UNDERDRAIN BEDDING

SCALE: NTS



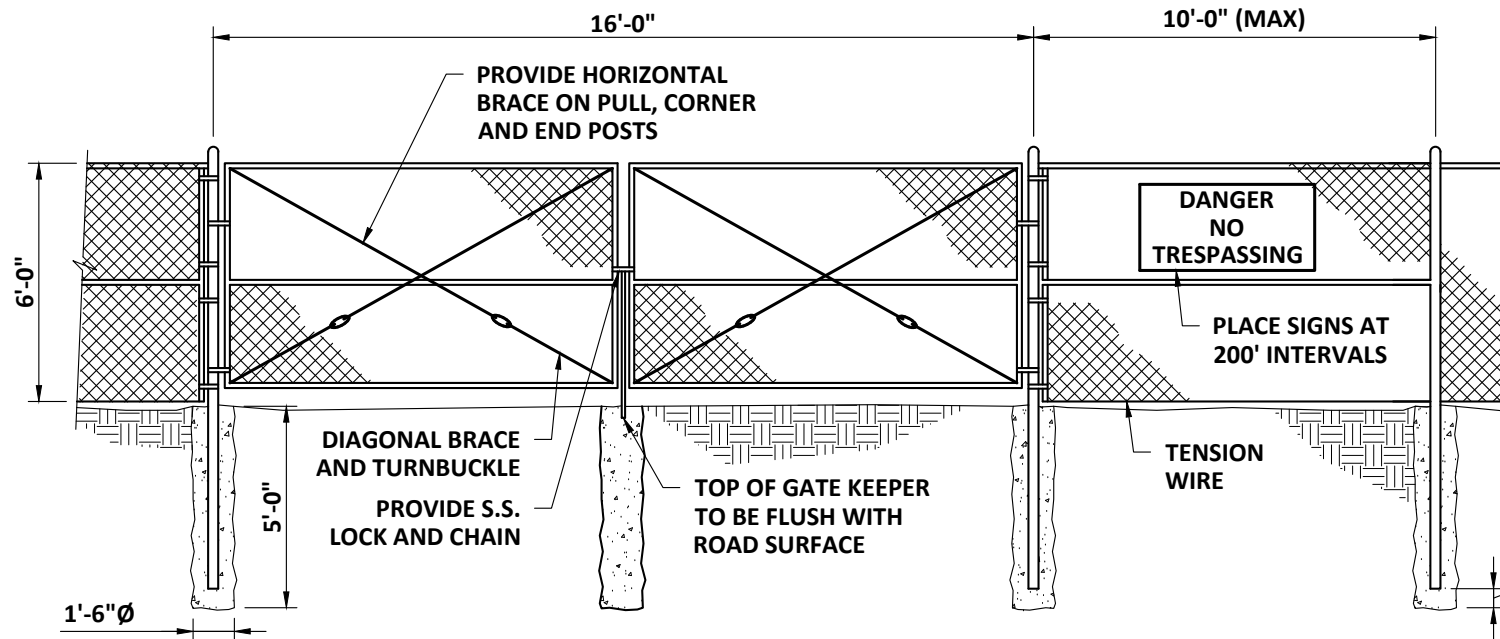
Detail 02
Bollard detail



BOLLARD
 SCALE: NTS

Detail 03
Chain link fence and gate detail





NOTES:

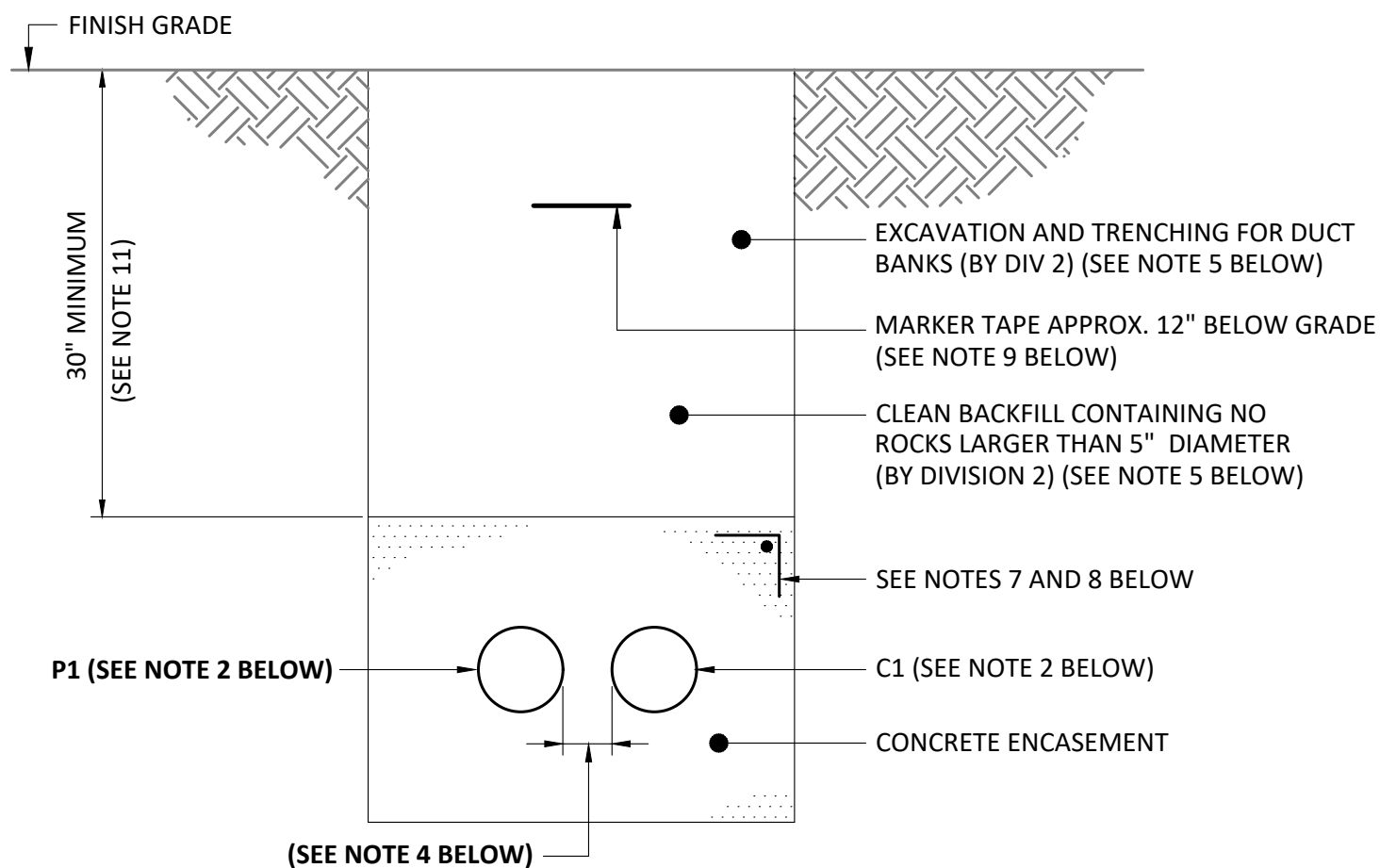
1. SECURE POSTS IN CONCRETE AS SHOWN AT PULL, CORNER AND END POSTS (INCLUDING GATE POSTS)
2. IF CHAINLINK FENCE IS INSTALLED IN UNFRACTURED LEDGE, POST SHALL PENETRATE 2'-0" INTO THE LEDGE AND SHALL BE GROUTED INTO 6" Ø HOLE.

CHAINLINK FENCE AND LOCKING DOUBLE GATE

SCALE: "NTS"



Detail 04 & 05
Ductbank details

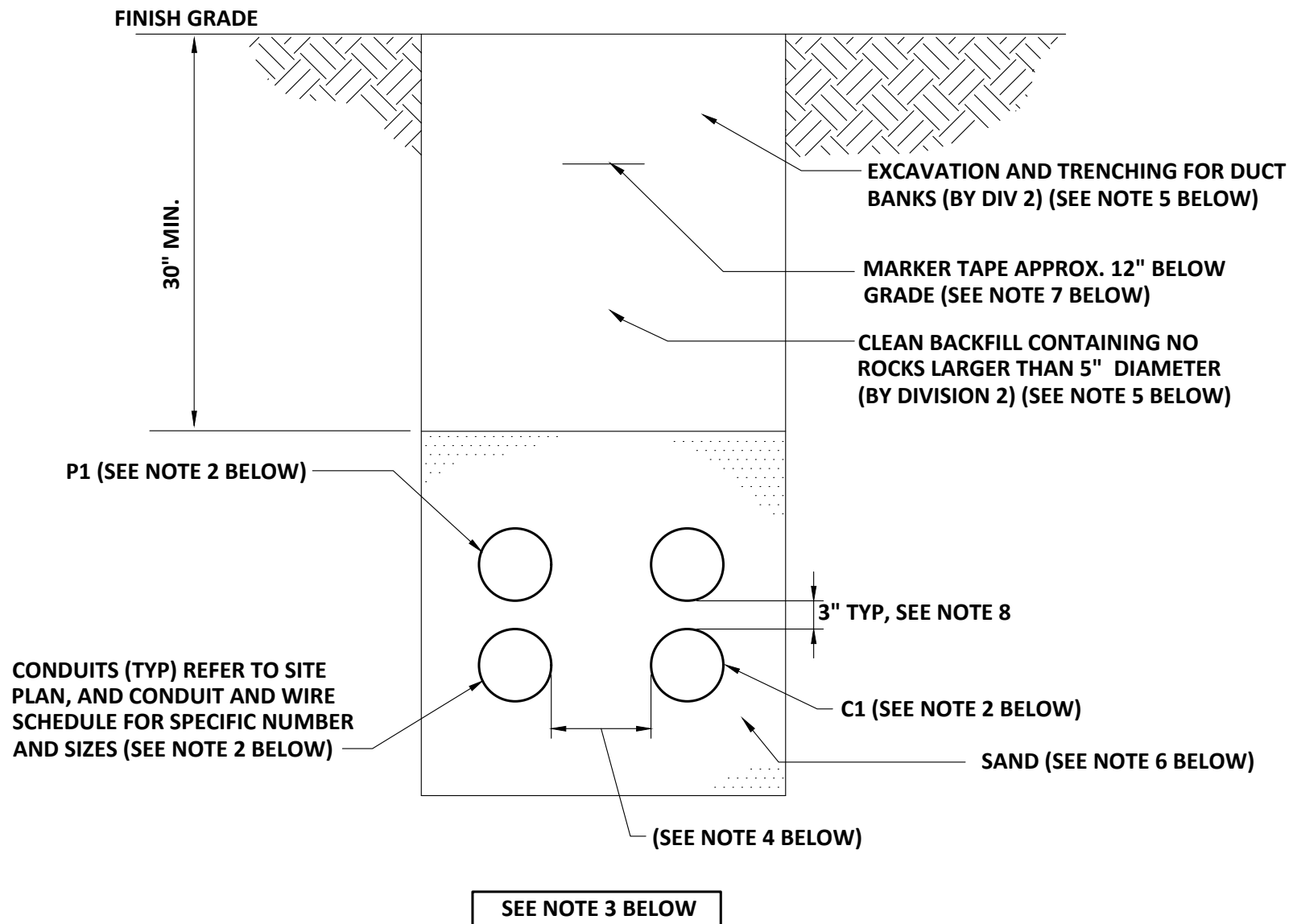


DUCT BANK NOTES:

1. DIMENSIONS SHOWN ARE TYPICAL FOR ALL DUCT BANKS, UNLESS OTHERWISE NOTED.
2. REFERENCES P1 AND C1 DENOTES CONDUIT NUMBERS. REFER TO PROJECT SPECIFIC DUCT BANK SECTIONS ON THE CONTRACT DRAWINGS AND THE CONDUIT AND WIRE SCHEDULES FOR ADDITIONAL DETAILS.
3. THIS TYPICAL DUCT BANK SECTION HAS BEEN SHOWN AS AN EXAMPLE OF THE REQUIREMENTS FOR THE UNDERGROUND INSTALLATION FOR THE DUCT BANK SYSTEMS. THIS DENOTES SPECIFIC SPACING, CONCRETE ENCASEMENT, REINFORCING, ETC. REQUIRED FOR THE DUCT BANK INSTALLATIONS. THE SPECIFIC CONDUIT SIZING AND NUMBERS HAVE BEEN SHOWN BY EACH SPECIFIC DUCT BANK SECTION.
4. IT SHALL BE REQUIRED THAT A MINIMUM OF 1'-0" CLEARANCE BE PROVIDED AT ALL TIMES BETWEEN ALL POWER CONDUITS AND ALL SIGNAL AND/OR CONTROL CONDUITS IN ORDER TO AVOID ANY ELECTRICAL NOISE INTERFERENCE WITH THE CABLES OR WIRES WITHIN THESE SIGNAL AND CONTROL CONDUITS.
5. EXCAVATION, TRENCHING AND BACKFILLING SHALL BE FURNISHED AND INSTALLED
6. CONCRETE ENCASEMENT SHALL BE FURNISHED AND INSTALLED
7. REINFORCING STEEL SHALL BE FURNISHED AND INSTALLED
8. REFER TO THE CONTRACT DRAWINGS FOR SPECIFIC DETAILS FOR CONCRETE ENCASEMENT AND REINFORCING OF ELECTRICAL DUCT BANKS.
9. INSTALL MARKER TAPE THE ENTIRE LENGTH OF EACH DUCT BANK.
10. TYPICAL SPACING BETWEEN CONDUITS SHALL BE 3 INCHES UNLESS OTHERWISE NOTED.
11. THE DEPTH NOTED INDICATES THE TYPICAL REQUIREMENTS UNDER NORMAL CONDITIONS. THIS PROJECT INVOLVES EXISTING CONDITIONS WHICH INVOLVES EXISTING UNDERGROUND ELECTRICAL DUCT BANKS, EXISTING PROCESS PIPING AND OTHER EXISTING UNDERGROUND UTILITIES. THEREFORE THE CONTRACTOR IS RESPONSIBLE FOR DEEPER EXCAVATIONS AND DUCT BANK INSTALLATIONS BASED UPON THESE CONFLICTS AND EXISTING CONDITIONS. THE CONTRACTOR IS RESPONSIBLE TO PROVIDE ALL REQUIRED EXCAVATIONS, BACKFILL, TRENCHING, ETC., IN ORDER TO PROVIDE DEEPER UNDERGROUND ELECTRICAL DUCT BANKS. THIS SHALL BE REQUIRED IN ORDER TO INSTALL THE PROPOSED ELECTRICAL DUCT BANKS BELOW ANY OF THE UNDERGROUND EXISTING CONDITIONS PREVIOUSLY NOTED. THE CONTRACTOR IS RESPONSIBLE FOR ALL REQUIRED LABOR, INSTALLATIONS AND COSTS ASSOCIATED WITH THIS WORK AT ALL LOCATIONS REQUIRED FOR THIS PROJECT.

TYPICAL CONCRETE ENCASED DUCT BANK DETAIL

NTS



(REFER TO NOTES BELOW FOR ADDITIONAL REQUIREMENTS)

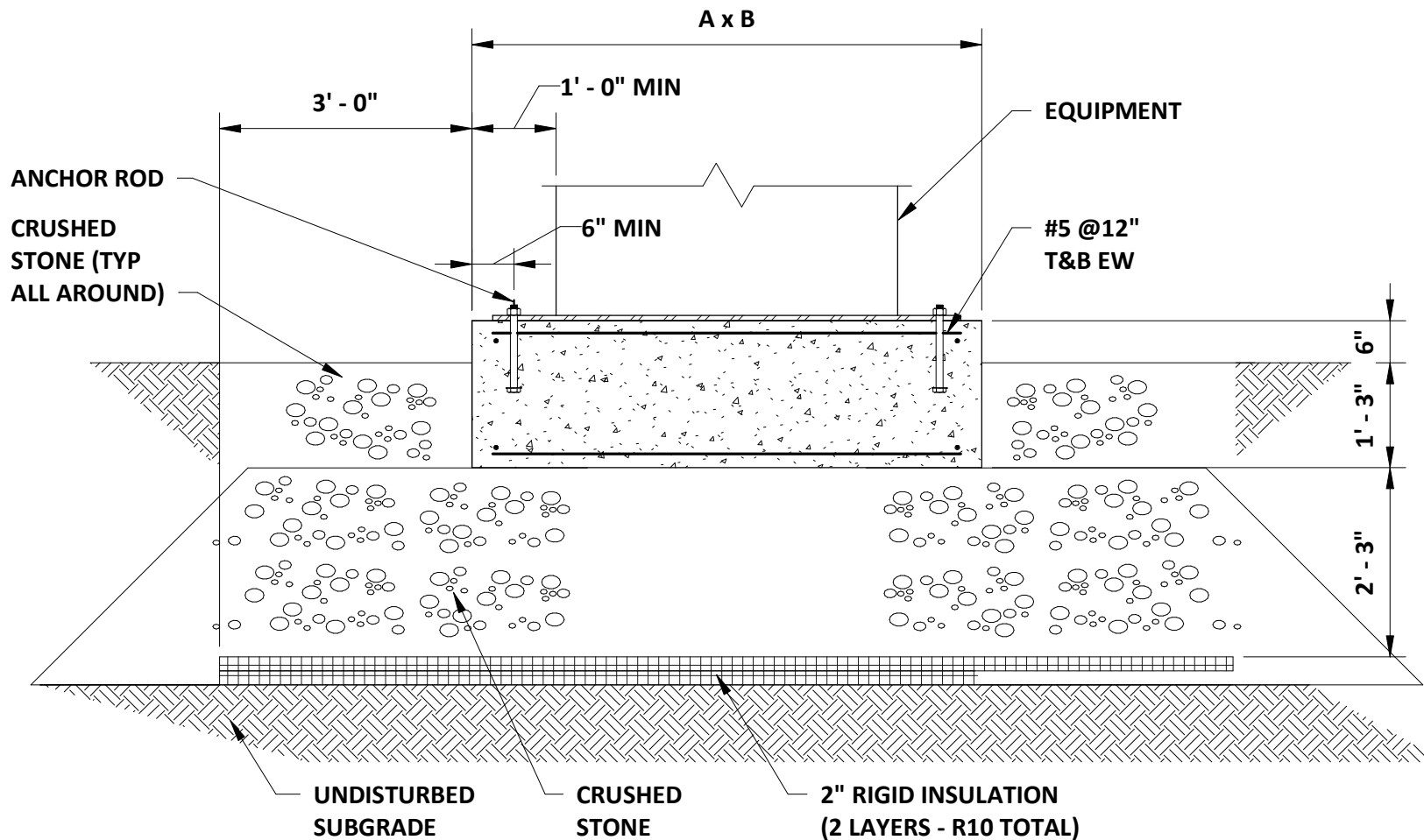
NOTES: (DUCT BANK DETAIL)

1. DIMENSIONS TYPICAL FOR ALL DUCT BANKS, UNLESS OTHERWISE NOTED.
2. FOR CONDUIT DETAILS, SEE CONDUIT AND WIRE SCHEDULES. REFERENCES P1 AND C1 DENOTES CONDUIT NUMBERS. REFER TO SPECIFIC DUCT BANK SECTIONS AND CONDUIT AND WIRE SCHEDULES FOR DETAILS.
3. THIS TYPICAL DUCT BANK SECTION HAS BEEN SHOWN AS AN EXAMPLE OF THE REQUIREMENTS FOR THE UNDERGROUND INSTALLATION FOR THE DUCT BANK SYSTEM. THIS DENOTES SPECIFIC SPACING, CONCRETE ENCASEMENT, REINFORCING, ETC. REQUIRED FOR DUCT BANK INSTALLATIONS. THE SPECIFIC CONDUIT SIZING AND NUMBERS HAVE BEEN SHOWN BY EACH SPECIFIC DUCT BANK SECTION.
4. IT SHALL BE REQUIRED THAT A MINIMUM OF 1'-0" CLEARANCE BE PROVIDED AT ALL TIMES BETWEEN ALL POWER CONDUITS AND ALL SIGNAL AND/OR CONTROL CONDUITS IN ORDER TO AVOID ANY ELECTRICAL NOISE INTERFERENCE WITH THE CABLES OR WIRES WITHIN THESE SIGNAL AND CONTROL CONDUITS.
5. EXCAVATION, TRENCHING AND BACKFILLING SHALL BE FURNISHED AND INSTALLED
6. SAND BEDDING SHALL BE USED IN AREAS.
7. INSTALL MARKER TAPE THE ENTIRE LENGTH OF EACH DUCT BANK.
8. THERE SHALL BE 3" SPACING SEPARATION BETWEEN ALL CONDUITS, EXCEPT AS NOTED. ALSO THERE SHALL BE 3" SPACING ALL AROUND OUTSIDE OF THE CONDUIT DUCTBANK (TYP).

TYPICAL SAND ENCASED DUCT BANK DETAIL

NTS

Detail 06
Concrete generator pad detail



NOTES:

1. DETAIL IS APPLICABLE FOR ALL EXTERIOR EQUIPMENT UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
2. A AND B DIMENSIONS SHALL BE DETERMINED BY THE GENERAL CONTRACTOR BASED ON THE EQUIPMENT SUPPLIED.
3. CONCRETE PAD SHALL ATTAIN THE SPECIFIED COMPRESSIVE STRENGTH PRIOR TO STARTUP OF EQUIPMENT.

EXTERIOR CONCRETE PAD ZONE III

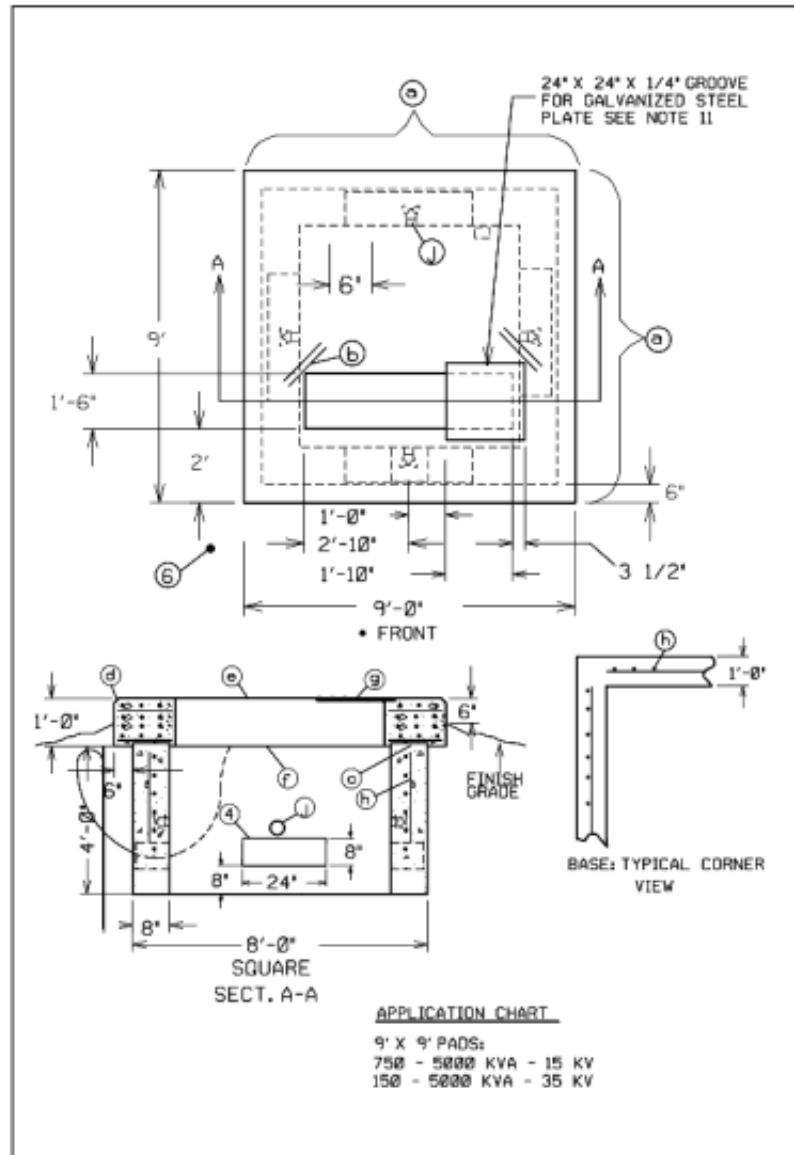
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Detail 07
Concrete transformer foundation detail (CMP)



XII. Illustration No. 25 (continued)

364-10 / LARGE 9' X 9' THREE-PHASE TRANSFORMER FOUNDATION



XII. Illustration No. 25

364-9 / LARGE 9' X 9' THREE-PHASE TRANSFORMER FOUNDATION

NOTES:

- FRONT denotes the side on which the access doors are located. The concrete base shall be set on a suitable gravel base and located so the FRONT is accessible by truck and suitably protected from plow and traffic damage.
- Before installing or requiring any active drainage structure (e.g., drain pipe) into the foundation or pad, the contractor, CMP Line Supervisor, or CMP Distribution Engineer must contact Central Maine Power Company's Environmental Services Department at 623-3521 ext. 3479 to request a site inspection.
- Finish grade shall be graded in such a manner to allow surface water to flow away from the pad.
- Provide 8" X 24" cable holes (bond outs) 8' up the wall from the base. Locate one cable hole per wall, more if necessary. Line up cable holes with trench.
- Conduits entering concrete structures shall be set back from the inside wall 1 to 2 inches and the space within the knockout surrounding the conduits completely filled with mortar to prevent soil from entering structure. Inside the structure the mortar shall be finished and beveled from the conduit ends to the inside wall face to cover and smooth the edges of the knockouts.
- A 3/4" x 8" galvanized ground rod is to be installed six inches in front of the left FRONT corner of the foundation. The top of the ground rod is to be 6 inches below final grade.
- A ground wire shall be installed from the ground rod through the cable hole at the bottom of the pad. 20 Feet of ground wire shall be provided so that it can be installed through the two grounding lugs and connected to the neutral spade.
- Concrete compressive strength shall be 4000 PSI @ 28 days. For cast-in-place early high strength may be used with a minimum of seven day cure time.
- Reinforcing steel to have: FY = 60 KSI.
- The precast supplier shall provide lifting lugs in the slab (foundation) and base; the precast supplier shall assemble the slab to the base prior to shipping to the site to ensure that the slab and base fit properly (with no rocking of the slab evident).
- Use a 24" x 24" x 1/4" galvanized steel plate to cover a portion of the cable hole when the transformer does not completely cover it. Cut the steel plate to fit, if necessary.
 - 9-#5 Rebar evenly spaced each way top to bottom.
 - 2-#4 Corner diagonal rebar 2'-0" long top and bottom.
 - A 3/4" deep by 9" wide groove on the underside of the pad top shall be provided to keep the top in place.
 - Chamfer typical
 - 2" Concrete cover over top rebar.
 - 3" Concrete cover over bottom rebar.
 - 24" x 24" x 1/4" galvanized steel plate, MID#6000621795
 - #5 Rebar on 12" centers.
 - Pulling eye insert, for use with 3/4" national course thread eye-bolt, (Richmond LCB-1 or equivalent). Located opposite each cable hole and 2' (two feet) from the bottom.
 - All rebar ends to be covered by 1' of concrete, minimum.
 - For cast-in-place construction, see Distribution Engineer.