COUNTY OF SPOTSYLVANIA
REQUEST FOR PROPOSAL (RFP) #20-24-TV
PROFESSIONAL ARCHITECTURAL AND ENGINEERING SERVICES –
WWTP CONSOLIDATION WASTEWATER CONVEYANCE
May 22, 2020

Name of Soliciting Public Body:

County of Spotsylvania, Procurement Division
P.O. Box 215, 8800 Courthouse Road
Spotsylvania, VA 22553

Sealed Proposals Will Be Received Until **June 30, 2020 at 2:00 PM**

A **non-mandatory** pre-proposal conference call will be held **June 3, 2020 at 10:00 AM**. Vendors who are interested in being on this call should email tvaughan@spotsylvania.va.us. Call in information will be sent via email no later than 4:30 PM on June 2, 2020.

Questions from Offerors must be received by the Spotsylvania County Procurement Division by **June 12, 2020 at 12:00 noon.** Questions must be emailed to Toni Vaughan, Senior Procurement Officer at tvaughan@spotsylvania.va.us. Other Inquiries for Information Should Be Directed to Toni Vaughan, Senior Procurement Officer at Phone: 540-507-7524. The County is not responsible for verbal clarification of information provided by parties other than staff of the Procurement Division.

PROPOSALS SHALL BE MAILED OR HAND DELIVERED TO:

County of Spotsylvania, Procurement Division
P.O. Box 215, 8800 Courthouse Road, 2nd Floor **Room 414**
Spotsylvania, Virginia 22553

At the time of RFP issuance, due to COVID-19, all Spotsylvania County Office Buildings are closed to the public. See additional delivery instructions on Page 6 of this RFP.

The party submitting the forgoing Proposal acknowledges the provisions, terms and conditions of this RFP, including all attachments and addenda, and agrees to be bound by those provisions, terms and conditions. Further, the party certifies that all information submitted in response to this RFP is correct and true. The person signing this form shall be an authorized signatory officer of the corporation or an individual authorized by the By-Laws of the Corporation that has been given authoritative responsibility to bind the firm in a contract.

Name and Address of Firm:

_____ Date: _____

_____ By: _____
(Signature in Ink by Officer of the Corporation)

_____ Name: _____
(Please Print)

_____Zip Code:_____ Title: _____

Phone: (____) _____ Fax: (____) _____

E-mail:_____ State of Incorporation: _____

DUNS #:_____ State Corporation Commission #: _____

Are you, any member of your immediate family, or any person part of your company that if awarded will provide services for the County of Spotsylvania either employed by the County or a member or part of any County committee, board or commission? **Circle One: YES NO**

If yes, please explain: _____

Receipt of the following Addenda are acknowledged:

Addendum No. _____, dated_____ Addendum No. _____, dated_____ Addendum No. _____, dated_____ (Please note all addenda)
All updates are posted on the Spotsylvania County website at https://www.spotsylvania.va.us/374/Solicitations**. It is the responsibility of the vendor to check back for updates.**

(Return this Form)

TABLE OF CONTENTS FOR RFP #20-24-TV
PROFESSIONAL ARCHITECTURAL AND ENGINEERING DESIGN SERVICES –
WWTP CONSOLIDATION WASTEWATER CONVEYANCE

I.	**PURPOSE**	**3**
II.	**BACKGROUND INFORMATION**	**3**
III.	**SCOPE OF SERVICES**	**4**
IV.	**INSTRUCTIONS TO OFFERORS**	**5**
V.	**PROPOSAL REQUIREMENTS**	**7**
VI.	**PROPOSAL EVALUATION CRITERIA**	**9**
VII.	**TERMS AND CONDITIONS**	**10**

ATTACHMENT A – TRADE SECRETS/PROPRIETARY INFORMATION IDENTIFICATION

ATTACHMENT B – DEEP RUN CONVEYANCE IMPROVEMENTS: Preliminary Engineering Report

ATTACHMENT C – FMC WWTP DECOMMISSIONING AND FMC PUMP STATION: Preliminary Engineering Report

I. PURPOSE

The County of Spotsylvania, Virginia, invites written proposals from qualified engineering firms to provide professional architectural and engineering services to develop and implement the necessary infrastructure for the conveyance of sewage as needed for the consolidation of wastewater from the County owned FMC Wastewater Treatment Plant and the City of Fredericksburg's Wastewater Treatment Plant to the County owned Massaponax Wastewater Treatment Plant.

II. BACKGROUND INFORMATION

The Spotsylvania County Wastewater Plan Update and subsequent Water & Wastewater Master Plan identify potential collection system upgrades and Wastewater Treatment Plant (WWTP) consolidation that require infrastructure improvements needed to convey wastewater from the County's FMC WWTP and City of Fredericksburg's WWTP to the County's expanded Massaponax WWTP. Spotsylvania County identified multiple sanitary sewer pump stations and force main projects for further design development. The FMC Decommissioning and Pump Station and Deep Run Pump Station Preliminary Engineering Reports (PERs) present the basis of design for potential conveyance projects listed below:

A. DEEP RUN PUMP STATION AND FORCE MAIN UPGRADE:
   a. Upgrade and expand existing County owned Deep Run Pump Station (PS) from 2.3 MGD (Peak) to 6 MGD (Peak).
   b. Upgrade portion of existing Deep Run Force Main to convey flow from Deep Run PS to City/County Combined Force Main.

B. FMC PUMP STATION AND FORCE MAIN
   a. New 1.7 MGD (Peak) FMC WWTP PS to collect and convey FMC local wastewater to City/County Combined Force Main.
   b. New FMC PS Force Main to convey flow from FMC PS to City/County Combined Force Main. Utilize existing 12" force that connects existing Deep Run Force Main to FMC WWTP.

C. CITY/COUNTY COMBINED FORCE MAIN
   a. New City/County Combined Force Main that combines and conveys flow from Deep Run PS, FMC PS, and City of Fredericksburg's Influent Pump Station (IPS) and Force Main to County Owned Massaponax WWTP.
   b. Total flow contribution from Deep Run PS, FMC PS, and City IPS conveyed by the Combined Force Main is 27.4 MGD (Peak) and 7.8 MGD (Average).
   c. New flow control valve at convergence point of City IPS Force Main, Deep Run Force Main, and FMC Force Main.
   d. New gravity sewer at discharge point of City/County Combined Force Main up to connection with expanded Massaponax WWTP.

Refer to the attached, Deep Run PS and FMC Decommissioning and PS PERs for information on existing infrastructure, preliminary design alternatives, design flows, and a consolidation overview. The County intends to have all wastewater conveyance infrastructure online by the end of 2024.

III. SCOPE OF SERVICES

Spotsylvania County is seeking written proposals from qualified architectural and engineering firms for all infrastructure related to the conveyance of wastewater flows as part of the City/County Wastewater Treatment Plant consolidation. Infrastructure includes the upgrade and expansion of the County's existing Deep Run PS and Force Main, the new FMC PS and Force Main, and the new City/County Combined Force Main. The County is requesting these services to complete final design and provide complete project bid documents including drawings and specifications. The selected firm will be expected to coordinate with the City of Fredericksburg and the County in regards to project timing and design as it relates to the Massaponax WWTP Expansion and the City IPS Upgrade as part of the overall City of Fredericksburg and County of Spotsylvania WWTP Consolidation.

All services shall be performed in compliance with industry standards and all federal, state, and local laws, ordinances and regulations including the County Standards, EPA (Environmental Protection Agency), Virginia Department of Environmental Quality, Virginia Department of Health, VOSHA (Virginia Occupational Safety and Health Agency) and OSHA (Occupational Safety and Health Agency) rules and regulations.

It is expected that the County will require various services leading to the completion of the project. The services expected may include, but are not limited to the following:

A. PLANNING
   a. Amendments to feasibility studies;
   b. Amendments to hydraulic models for planning and operational analysis of wastewater systems;
   c. Amendments to utility systems' master and local area planning for wastewater collection, conveyance, and treatment systems;
   d. General administrative supporting studies such as facility assessments, workforce planning, resource management, and laboratory planning; and
   e. Studies assessing impacts on water and wastewater services in support of initiatives such as regulatory assistance, funding applications, as well as other policy-oriented initiatives.

B. DESIGN
   a. Survey and Design/permitting services for the capital project;
   b. Design/permitting services for repair and replacement of existing infrastructure, instrumentation / SCADA upgrades, treatment upgrades;
   c. Development of bidding documents to include design drawings and technical specifications and bid phase services;
   d. Project cost estimating services (feasibility level through bid level) and project scheduling services;
   e. Project constructability reviews, value engineering reviews, and peer reviews;
   f. Easement acquisition services to include site visits and correspondence with owners, negotiations, title searches, appraisals, and assistance with eminent domain proceedings if necessary.
   g. Land surveying, appraisal, and easement services;
   h. Local site permitting services for site plans, grading permits, storm water, etc.;

i. Environmental permitting services for floodplain studies, wetland studies, environmental assessments, etc.;
j. Geotechnical exploration and geotechnical engineering; and
k. Asset management program development and support.

C. CONSTRUCTION
   a. General construction administration (e.g. document control, meeting coordination, project close-out, punch-list development, etc.;
   b. Construction inspection services;
   c. Construction schedule and schedule update reviews;
   d. Submittal review, RFI responses and change order support services;
   e. Review of contractor payment applications and claim support;
   f. Start-up, commissioning, testing and training; and
   g. O&M manual and record drawing development.

D. OPERATIONS
   a. Pump Station management/operations troubleshooting and assistance, and
   b. Associated wastewater collections/conveyance system operations troubleshooting and assistance.

Additional civil and environmental engineering and/or related services may also be needed as directed by Spotsylvania County.

Continuous professional involvement will likely be required throughout the project and will include, but not be limited to, scope/budget development, regular progress reports/meetings, preparing reports, processing invoices for service, and timely response regarding project issues and correspondence. Moreover, in addition to the technical services listed above, general project support may require participation at project meetings (with internal and external stakeholders); and as requested, represent County during interactions with other agencies, communities, and the public.

IV. INSTRUCTIONS TO OFFERORS

A. This procurement shall be conducted in accordance with the competitive negotiation procedures of the Spotsylvania County Procurement Policy. The Procurement Policy is available at: https://www.spotsylvania.va.us/377/Spotsylvania-County-Policies.

B. Questions or requests for clarification may be emailed to Toni Vaughan, Senior Procurement Officer at tvaughan@spotsylvania.va.us. All responses to inquires will be in writing in the form of a written addendum and will be posted on the Spotsylvania County website at https://www.spotsylvania.va.us/374/Solicitations. Questions from Offerors must be received at the Spotsylvania County Procurement Division by the date identified on the front of this solicitation in order to ensure that the answers can be sent and received by the prospective Offerors for their consideration prior to the date proposals are due. The County is not responsible for verbal clarification of information provided by parties other than staff of the Procurement Division.

C. Three (3) copies and one (1) original indicated as “Original” of proposals shall be submitted to:

County of Spotsylvania, Procurement Division
P.O. Box 215, 8800 Courthouse Road, 2nd Floor **Room 414**
Spotsylvania, Virginia 22553

D. All Proposals must be in a sealed envelope or box and clearly marked with the following information: "Sealed Proposal, RFP #20-24-TV, WWTP Consolidation Wastewater Conveyance" and company name and address. Proposals not so marked or sealed may be returned to the Offeror and will not be considered. Proposals shall clearly indicate the legal name, address and telephone number of the Offeror (company, firm, partnership, or individual). Proposals shall be signed above the typed or printed name and title of the individual signing on behalf of the Offeror. All expenses incurred for submitting Proposals to Spotsylvania County shall be borne by the Offeror. **All Proposals shall be received by the time and date identified on the front of this solicitation.** Late Proposals shall not be considered. The time of receipt shall be determined by the Procurement time clock stamp in the Procurement Division, Room 414. Any Proposal received after stated time and date will not be considered and will be returned to Offeror unopened if received by special carrier or not accepted if hand delivered by Offeror.

The Offeror has the sole responsibility to have their proposal received by the Spotsylvania County Procurement Division at the above address and by the stated date and time as listed in the Request for Proposal.

At the time of RFP issuance, due to COVID-19, all Spotsylvania County Office Buildings are closed to the public. If you hand deliver your proposal, please note that Offerors need to go to the Snow Library side of the Marshall Building and go to the two white double doors located beside the "Procurement Division" sign and call 540-507-7503 for the Procurement Office. Someone from the Procurement Office will come to the door to receive your proposal. **Offerors are encouraged to submit your proposal early in order to ensure your proposal is received on time**.

Please note that Federal Express and other overnight delivery services do not guarantee morning delivery to Spotsylvania, Virginia. Next day delivery usually arrives in mid-to-late afternoon. Also, please note that USPS deliveries require additional days from the post office to the Procurement Office. If you will be using one of these services for delivery of your proposal, please take this information into consideration, you may also want to let the mail carrier know the Building is locked. Offerors are advised to call the Procurement Office to confirm if your proposal was received.

Inclement Weather: In the event that Spotsylvania County is closed during the scheduled times for a pre-bid (pre-proposal) conference or bid opening, the pre-bid conference or bid opening will occur on the next business day that Spotsylvania County is open at the appropriate times as stated in the IFB/RFP. No exceptions will be made in this situation. Please contact the procurement officer as stated in the IFB/RFP for information pertaining to this procurement.

E. The Offeror shall submit a proposal that demonstrates and provides evidence that the Offeror is

able to provide suitable services and has the capabilities, professional expertise and experience to provide professional architectural and engineering services for Spotsylvania County.

F. Offerors are responsible for familiarizing themselves with the Professional Architectural and Engineering Services requirements, objectives and terms and conditions of the services described herein.

G. As a guideline, Spotsylvania County anticipates the following **tentative** timetable for selection of a Contractor and implementation of a contract(s).

Date	**Activity/Event**
May 22, 2020	Request for Proposal Issued
September 2020	Tentative County Contract(s) Effective Date

H. Any vendor transacting business with Spotsylvania County requires a bidder or Offeror organized or authorized to transact business in the Commonwealth pursuant to Title 13.1 or Title 50 to include in its bid or proposal the identification number issued to it by the State Corporation Commission. Any bidder or offeror that is not required to be authorized to transact business in the Commonwealth as a foreign business entity under Title 13.1 or Title 50 or as otherwise required by law shall include in its bid or proposal a statement describing why the bidder or offeror is not required to be so authorized. **Include a copy of your State Corporation Commission Certificate and a list of Officers with your proposal response.**

V. PROPOSAL REQUIREMENTS

A. The proposal shall provide information necessary for Spotsylvania County to evaluate the qualifications, experience, and expertise of the proposing firm to perform Professional Architectural and Engineering Services for infrastructure related to WWTP Consolidation Wastewater Conveyance. The Offeror shall include a description of the organizational and staff experience as it relates to meeting the County's needs, including experience administering similar contracts for government and wastewater utility entities. The response shall address the firm's size, structure, and number of years in business, as well as office location for each member of the proposed organizational chart.

B. The written proposal shall contain CONCISE summary of the subject items described in the proposal evaluation criteria contained in this RFP, Section VI. Responses should be as thorough and detailed as possible so that the County may properly evaluate the firm's capabilities to provide the required services.

C. The proposal shall clearly indicate and provide a listing of key individuals to be assigned to the County's contract, specify their role in administering the contract, and provide a current biography/resume for each individual.

D. The Offeror shall provide information on any subcontractors or subconsultants that are necessary to provide the services required. Company name, address, telephone number, experience and personnel qualifications shall be provided.

E. Offerors shall indicate any exceptions taken to any part of this Request for Proposals. Offerors shall fill

out and clearly identify any proprietary information on Attachment A and return with proposal response. Identify the specificity of the data or other materials for which protection is sought, indicate the section and page number where it can be found in the Offerors RFP response and state the reasons why protection is necessary in accordance with the Code of Virginia, Chapter 43, § 2.2-4342. For more details, see Section VII Terms and Conditions paragraph Q, Freedom of Information Act.

F. Offeror shall include a copy of their State Corporation Commission Certificate of Good Standing and a list of officers with their proposal response, as identified in Section IV, subdivision H above.

G. The Offeror shall include in their proposal a table of contents, which all pages of the proposal numbered, an introduction/cover letter/executive summary on company letterhead, signed by a person with the corporate authority to enter into any contact which may result from this RFP.

H. Technical Proposal: The proposals submitted by the Offeror shall include at a minimum, the following:

a. The Offeror shall address each requirement identified in the Scope of Services.
b. The Offeror shall provide evidence that demonstrates their ability to provide the services within reasonable completion dates and within budget.
c. The Offeror shall provide its current workload with particular reference to personnel and other resources being proposed.
d. Proposed approach and specific plans for providing the requested services.
e. The Offeror shall provide information on the corporate structure of its firm as well as any proposed subcontractors required to perform the required work.
f. Include as appendices the following information:
    i. A list of completed projects and a resume of personnel expected to be assigned to this contract including the name(s) of the partner in charge;
    ii. The Offeror shall provide a minimum of three (3) references of other similar size projects/contracts, who could attest to the firm's knowledge, quality of work, timeliness, diligence, flexibility, and ability to meet budget constraints. Include names and addresses, contact persons, telephone numbers, and email addresses of all references. The County reserves the right to contact references other than, and/or in addition to those furnished by an Offeror. References may or may not be reviewed or contacted at the discretion of the County. Spotsylvania County cannot be listed as a reference.
    iii. The Offeror shall provide a minimum of one (1) reference for a successfully completed project that involved the use of the Virginia Clean Water Revolving Loan Fund Program (VCWRLF).
g. Cost estimates **shall not** be submitted with the proposal response. **The cost estimate will be requested by the Procurement Division at the completion of the evaluation.** Cost estimates shall be delivered in a separate sealed envelope if requested by the County. This element of the Offeror's proposal must be bound separately and contain the total cost of the proposed services. Costs must include all items such as professional time, travel, data processing, forms, printing, or other expenses included in the proposed cost. Job classifications and the fixed billable rates shall also be included. Offerors shall be aware that throughout the duration of any awarded contract, Spotsylvania County will not allow the awarded vendor to exceed the

Federal Government's (GSA) prescribed rates for mileage, travel, meals and any other travel/reimbursable related accommodations. GSA per diem rates can be located at: http://www.gsa.gov/perdiem.

VI. PROPOSAL EVALUATION CRITERIA

A. Selection of the successful Offeror will be based upon submission of proposals meeting the selection criteria. The minimum selection criteria will include:

EVALUATION CRITERIA		WEIGHT
1.	Specific experience, technical capabilities, professional competence, and qualifications of the proposing firm and project personnel especially those assigned to provide the services in accordance with the Scope of Services.	20
2.	Staff assigned to this project shall possess the knowledge, skills and professional competence to provide the services required. Staff shall possess a minimum of 5 years of experience in architectural/engineering design of wastewater pumping station and conveyance projects.	25
3.	Clearly demonstrated understanding of the work to be performed and completeness and reasonableness of the Offeror's plan for accomplishing the Scope of Services.	30
4.	Past performance, project scheduling performance and general completion of past projects on time and on budget.	15
5.	Interview/Oral Presentation	10
Total		100

B. The Selection Committee will evaluate the most responsive proposals as deemed by staff and may also ask questions of a clarifying nature from offerors as required. Each committee member will complete a proposal evaluation matrix form for each submission received. A composite rating will be developed which indicates the group's collective ranking of the written proposals in a descending order. If deemed necessary by the selection committee, the County shall engage in individual discussions with two or more Offerors deemed the most fully qualified, responsible and suitable on the basis of the Selection Committee's evaluations. These Offerors will be requested to make an oral presentation to the Selection Committee to explain their proposal and answer questions.

C. At the conclusion of discussion, on the basis of evaluation factors as set at the time of issuance of this proposal and all information developed in the selection process to this point, the County shall select in the order of preference two or more Offerors whose professional qualifications and proposed services are deemed most meritorious. Negotiations shall then be conducted; beginning with the Offeror ranked first. If a contract satisfactory and advantageous to the County can be

negotiated at a price considered fair and reasonable, the award shall be made to that Offeror. Otherwise, negotiations with the Offeror ranked first shall be formally terminated and negotiations conducted with the Offeror ranked second, and so on until such a contract can be negotiated at a fair and reasonable price. Should the County determine in writing and in its sole discretion that only one Offeror is fully qualified or that one Offeror is clearly more highly qualified and suitable than the others under consideration, a contract may be negotiated and awarded to that Offeror. Spotsylvania County reserves the right to award a contract to more than one Offeror, if it is in the Owner's best interest.

Selection shall be made of two or more firms deemed to be the most qualified and best suited to perform the requested services identified in the Scope of Services. Spotsylvania County reserves the right to award contracts to more than one Contractor, if it is in the County's best interest in order to provide adequate services. Spotsylvania County has the right to award the contract in the aggregate, by the individual service, or any combination, whichever is in the best interest of the County. The County reserves the right to accept or reject any or all proposals received as a result of this RFP, to negotiate with any qualified firm or to modify or cancel in part or in its entirety the Request for Proposal if it is in the best interest of Spotsylvania County.

VII. TERMS AND CONDITIONS: (Effective March 4, 2019)

A. Acceptance, Invoicing and Payment

Spotsylvania County will make payment to the Consultant, Net 30 days or in accordance with discount terms, if offered, after receipt of an acceptable invoice for work resulting from this RFP.

Nothing herein, or in the process, shall be construed as having obligated the County to pay for any expenses incurred by respondents to this RFP, or to the selected consultant prior to the Board of Supervisors' approval of a consultant services contract.

Pursuant to Virginia Code § 2.2-4354, (1950, as amended), the Consultant covenants and agrees to:

1. Within seven (7) days after receipt of any amounts paid to the Consultant under the Agreement, (i) pay any subconsultant for its proportionate share of the total payment received from the County attributable to the work under the Contract performed by such subconsultant, or (ii) notify the County and the subconsultant, in writing, of its intention to withheld all or part of the subconsultant's payment and the reason therefore;
2. Provide its federal employer identification number or social security number, as applicable, before any payment is made to the Consultant under the Agreement;
3. Pay interest at the legal rate or such other rate as may be agreed to in writing by the subconsultant and the Consultant on all amounts owed by the Consultant that remain unpaid after seven (7) days following receipt by the Consultant of payment from the County for work performed by the subconsultant under the Agreement; and
4. Include in its contracts with any and all subconsultants the requirements of 1, 2, and 3 above.

B. Attorney's Fees

In the event of any action brought by either party against the other to enforce any of the obligations hereunder or arising out of any dispute concerning the terms and conditions hereby created, each party shall pay their own attorney's fees, costs and expenses, except in a case of default by the Consultant, the Consultant shall be responsible for any resulting additional purchase and administrative costs including, but not limited to fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs.

C. Audit

Consultant shall keep and require each of its subconsultant, if any, to keep, at no additional cost to County, full and detailed accounts of costs chargeable to County, during the project, and for five (5) years following completion. County shall be afforded full access to accounts, records, and supporting documents for review, audit, copy (such copies will be the property of County), and verification of costs. Audit access to Consultant's records in lump sum or unit price areas when applicable shall be sufficient to satisfy County that all quantities meet the payments to its subconsultant and suppliers, Consultant shall remit promptly to County the amount of any adjustment resulting from audit.

D. Availability of Funds

It is understood and agreed between the parties herein that the County shall be bound hereunder only to the extent of the funds available or which may hereafter become available for the purpose of this agreement.

E. Binding Effect

The terms, provisions, covenants and conditions contained in any resulting Contract shall apply to, insure to the benefit of, and be binding upon the parties hereto and upon their respective heirs, legal representatives, successors, and permitted assigns except as otherwise expressly provided.

F. Compliance of Law

The Consultant providing materials and services to the County under any contract resulting from this RFP represents and warrants to the County that it is:

1. Conforming to the provisions of the Civil Rights Act of 1964, as amended, as well as the Virginians With Disabilities Act, the Americans With Disabilities Act and Section 2.2-4311 of the Virginia Public Procurement Act, and where applicable, to the Virginia Fair Employment Contracting Act of 1975, as amended, and the Virginia Human Rights Act, as amended.
2. Not employing illegal alien workers or otherwise violating the provisions of the Immigration Reform and Control Act of 1986 and Virginia Code§ 2.2-4311.1;
3. Not requiring, and shall not require, any employee or subcontractor to sign an internal confidentiality agreement or statement prohibiting or otherwise restricting, or purporting to prohibit or restrict, the reporting (in accordance with law) of waste, fraud, or abuse to an investigative or law enforcement representative of a department or agency authorized to receive such information, or otherwise violate any federal and state laws and regulations protecting employees for reprisal against whistleblowing;

4. Complying with federal, state and local laws and regulations applicable to the performance of the goods and services procured, the work performed pursuant to the Agreement shall conform to all professional principles generally accepted as standards of the industry in the Commonwealth, the CONTRACTOR'S work performed shall be free of defects, and any new materials and equipment furnished under this Agreement shall be of good quality and in working condition; and
5. Complying fully with the Virginia Conflict of Interest Act.
6. Authorized to transact business in the Commonwealth of Virginia, pursuant to Section 2.2-4311.2 of the Code of Virginia.

G. Contract Award

Spotsylvania County has the right to award a contract to more than one Offeror, if it is in the County's best interest to provide adequate services in accordance with the criteria found in the Scope of Services. Should Spotsylvania County determine in writing and in its sole discretion that only one offeror is fully qualified, or that one offeror is clearly more highly qualified and suitable than the others under consideration, a contract may be negotiated and awarded to that offeror. Spotsylvania County reserves the right to award the contract to the most qualified, responsible, and responsive offeror(s), resulting in a negotiated agreement, which is most advantageous to and in the best interest of Spotsylvania County. Spotsylvania County shall be the sole judge of the Proposal and the resulting negotiated agreement that is in the public interest, and Spotsylvania County's decision shall be final.

H. Contract Changes

No verbal agreement or conversation with any officer, agent or employee of Spotsylvania County either before or after execution of the contract resulting from this Request for Proposal (RFP), RFP Addendum or follow-on negotiations, shall effect or modify any of the terms or obligations contained in the contract. No alterations to the terms and conditions of the contract shall be valid or binding upon Spotsylvania County unless made in writing and where Board approval is not required, by the County Administrator or his designee.

I. Contract Documents

The contract entered into by Spotsylvania County and the Consultant shall consist of this Request for Proposal, any addendum issued, the proposal submitted by the Consultant, Spotsylvania County's Standard Form of Agreement, and any approved change orders issued, all of which shall be referred to collectively as the Contract Documents. Additional documents which the parties agree to include as contract documents may be set forth in the final contract.

J. Definitions:

1. Consultant:
   The Consultant who enters into a contract with Spotsylvania County to provide the services herein for Spotsylvania County.

2. County:

Wherever the word "County" appears, it shall be understood to mean Spotsylvania County Government.

3. Offeror:
A person who makes an offer in response to a Request for Proposals.

4. Informality:
A minor defect or variation in a bid or proposal from the exact requirements of the Invitation for Bid, or the Request for Proposal, which does not affect the price, quality, quantity, or delivery schedule for the goods, services or construction being procured.

K. Design Errors and/or Omissions and A/E Professional Liability Insurance

The A/E shall carry professional liability insurance covering negligent act, errors, and omissions in an amount not less than 5% of the estimated cost of construction of all County projects designed by the A/E which are currently under construction, but in no event shall the amount of professional liability insurance be less than $100,000. As an alternative to the calculated amount indicated above the A/E may work with the County to procure a “project Insurance” package for that project which is satisfactory to the County or the A/E may provide a Certificate of insurance indication coverage in the amount of $2,000,000 per claim and $6,000,000 in the aggregate.

The A/E shall maintain this insurance in force after completion of the services under the Contract for a period of five years after completion of construction.

The County’s review, approval or acceptance of, nor payment for any of the services required shall be construed to operate as a waiver by the County of any rights or any cause of action arising out to the contraction. The A/E shall be and remain liable to the County for all costs of any kind which are incurred by the County as a result of negligent acts, errors, or omissions on the part of the A/E including its subconsultants and consultants, in the performance of any of the services furnished.

The A/E shall be responsible for all costs resulting from its errors, omissions and other breaches of the applicable standards of care established under Virginia law including, but not limited to, it own cost for labor and other in-house costs, any resulting Consultant Change Order costs including costs for demolition, cutting patching, repairs, removal or modification of Work that is already in place, any Firm or County delay damages, and any judgments, fines or penalties against the County resulting from A/E errors, omissions, and other breaches of the applicable standards of care. However, the A/E shall not be responsible for the cost of the correct equipment or system which should have been originally specified, except the A/E shall b responsible for any increased costs, whether the result of inflation, reordering, restocking or otherwise, of incorporating the corrected Work into the Consultants’ Contract Changer Order. For the Purposes of determining the A/E’s share of such costs for Work which has not yet been performed, the cost of work performed by Consultant’s change order shall generally be presumed to be 15% great than if the work had been included in the Consultant’s Contract. The A/E shall have the burden of disproving this presumption.

The County shall actively pursue reimbursement of costs resulting from the A/E’s errors, omissions, or breaches of the applicable standard of care. Upon determination that there may be A/E financial responsibility

involved, the A/E shall be contacted by the County. The A/E shall be advised of the design deficiency, informed that it is the County's opinion that the A/E may be financially responsible, and requested to provide a technical solution to the problem including cost estimate. Upon notification of potential liability, the A/E should coordinate with the County to determine required technical support and timing to minimize delay costs. Pending final decision by the County, the A/E will be invited to attend all price negotiations with the Consultant for the corrective work. The A/E shall participate as a non-voting technical advisor to the County's negotiator. IF the A/E refuses to cooperate in the negotiations or disputes its responsibility, the County shall have the right to proceed with the remedial construction and/or change order negotiations without the A/E.

L. Drug Free Workplace

During the performance of this contract, the Consultant agrees to (i) provide a drug-free workplace for the Consultant's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Consultant's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the Consultant that the Consultant maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subconsultant or vendor.

For the purposes of this section, "drug-free workplace" means any site at which the performance of work is done in connection with this contract awarded to the Consultant, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

M. Ethics in Public Contracting

The Offeror hereby certifies that it has familiarized itself with Article 6 of Title 2.2 of the Virginia Public Procurement Act, Section 2.2-4367 through 2.2-4377, Virginia Code Annotated, and that all amounts received by it, pursuant to a Contract resulting from this RFP, are proper and in accordance herewith. By submitting their proposals, Offerors certify that their proposals are made without collusion or fraud that they have not offered or received any kickbacks or inducements from any other offeror, supplier, manufacturer or subconsultant in connection with their proposal, and that they have not conferred on any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.

N. Examination of Records

The Consultant agrees that Spotsylvania County or any duly authorized representative shall have access to and the right to examine any and copy any directly pertinent books, documents, papers and records of the Consultant involving transactions related to any Contract resulting from this RFP. The period of access provided in this paragraph for records, books, documents, and papers and software which may be related to any arbitration, litigation, or the settlement of claims arising out of the performance of any subsequent contract or any subsequent Contracts with vendors shall continue until disposition of any appeals, arbitration, litigation,

or claims. Consultants agrees to keep all records in accordance with the state and local retention laws including but not limited to Virginia Code § 55-525.27.

O. Faith-Based Organizations

Pursuant to Section 2.2-4343.1 of the Code of Virginia of 1950, in all invitations to bid, requests for proposals, contracts, and purchase orders, the COUNTY does not discriminate against faith-based organizations.
"Faith-based Organization" means a religious organization that is or applies to be a Consultant to provide goods or services for programs funded by the block grant provided pursuant to the Personal Responsibility and Work Opportunity Reconciliation Act of 1996, P.L. 104-193.
If CONSULTANT is a faith-based organization, then Consultant shall give to each individual who applies for or receives goods, services, or disbursements provided pursuant to this Agreement the following notice:

NOTICE

Pursuant to Section 2.2-4343.1 of the Code of Virginia of 1950, as an applicant for or recipient of goods, services, or disbursements provided pursuant to a contract between the COUNTY and a faith-based organization, you are hereby notified as follows:

Neither the COUNTY'S selection of a charitable or faith-based provider of services nor the expenditure of funds under this contract is an endorsement of the provider's charitable or religious character, practices, or expression. No provider of services may discriminate against you on the basis of religion, a religious belief, or your refusal to actively participate in a religious practice. If you object to a particular provider because of its religious character, you may request assignment to a different provider. If you believe that your rights have been violated, please discuss the complaint with your provider or notify the COUNTY Administrator.

P. Federal-Aid Provisions

When the U. S. government pays all or any portion of the cost of a project, the Consultant shall observe all federal laws, rules, and regulations made pursuant to such laws. The work shall be subject to inspection by the appropriate federal agency. Such inspection shall in no sense make the federal government a party of the contract and will in no way interfere with the rights of either party. Consultant shall require all subconsultants to observe all federal laws, rules, and regulations made pursuant to such laws. Reporting requirements that is part of the regulation shall be followed in accordance with the federal law, rules and/or regulation made pursuant to such laws. A Duns number will be provided by the Consultant and registration with the Central Consultant Registration (CCR) shall be followed according to the federal aid provisions.

Q. Freedom of Information

All information submitted to the County in response to this RFP will constitute public information and pursuant to the Virginia Freedom of Information Act will be available to the public for inspection upon request. Pursuant to Virginia Code § 2.2-4342 and County Procurement Policy § 3-27, a Bidder/Offeror may request an exception to disclosure for trade secrets or proprietary information as such is defined under Virginia Code § 59.1-336, part of the Uniform Trade Secrets Act. In order to claim this exemption, a Bidder/Offeror must: (1) Submit a request in writing referencing their desire to invoke the protections of Virginia Code § 2.2-4342; (2) Specifically identify which data or materials they wish to have protected; and (3) Articulate the

rationale for why protection is necessary for the particular data or materials, to the satisfaction of the County. Failure to meet these requirements will result in the data or materials being open for inspection in response to a valid inquiry under the Virginia Freedom of Information Act and serve to waive any right of the Bidder/Offeror to assert a claim against the County for disclosure of trade secrets or proprietary information.

R. Grant Funds Provision

When a project is funded in part or all by grant funds, the Consultant shall observe all rules and regulations according to the grant fund award documentation. Consultant has the responsibility to comply with all grant fund reporting requirements and any or all award documentation terms and conditions.

S. Governing Law

In any contract resulting from this RFP, the parties agree that this agreement is governed by and shall be interpreted in accordance with the Spotsylvania County Procurement Policy and laws of the Commonwealth of Virginia, and that proper venue, in the event of litigation concerning this matter, shall be in the Circuit Court of Spotsylvania County, Virginia. The parties agree that any litigation involving this Agreement shall be brought only in such court.

T. Headings

Headings in the RFP and any resulting contract are informational only and the substance of each numbered or lettered provision shall prevail in the event of any ambiguity or inconsistency between a heading and its content.

U. Insurance

During the performance of any Contract resulting from this RFP, the Consultant shall have and keep current insurance whichever is greater in scope or amount as follows:

1. Worker's Compensation Insurance in compliance with all states in which Consultant does business, including coverage B Employer's liabilities in not less than the following amounts:

    i. Bodily Injury by accident $100,000 for each accident;
    ii. Bodily Injury by disease, $500,000 policy limit;
    iii. Bodily Injury by disease, $100,000 for each employee.

2. General Liability insurance in amount not less than $1,000,000 for any occurrence involving bodily injury, and not less than $1,000,000 for any occurrence involving property damage. This coverage shall include contractual liability, broad form property damage, independent Consultants, and personal injury.

3. Automobile liability insurance in an amount not less than $1,000,000 combined single limit bodily injury and property damage. This coverage shall include liability for the use of hired and non-owned apparatus.

4. Professional Liability Insurance in an amount not less than $2,000,000 per claim and $6,000,000 in the aggregate. The amount of coverage may increase according to the project value.

The General Liability and Automobile Liability insurance policies specified herein shall name Spotsylvania County as additional insured with regard to work performed under any contract resulting from this RFP. The Consultant shall provide Spotsylvania County with copies of certificates of insurance coverage and proof of payment of all premiums. These certificates shall have provisions for notifying Spotsylvania County if there is any change in liability insurance.

V. Interpretation

Words of any gender used in any Contract resulting from this RFP shall be held and construed to include any other gender, and words in the singular number shall be held to include the plural, and vice versa, unless the context otherwise requires.

W. Non-Collusion

The party making the foregoing proposal hereby certifies that such proposal is genuine and not collusive or sham; that said Offeror has not colluded, conspired, connived or agreed, directly in indirectly, with any Offeror or person, to put in a sham proposal or to refrain from offering, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person to fix the proposal price or affiant or of any proposal, or to fix any overhead, profit or cost element of said proposal price, or of that of any other Offeror, or to secure any advantage against the County or any person interested in the proposed contract; and that all statements in said proposal are true.

X. Non-Discrimination

Any contract resulting from this RFP and every contract, sub-contract, or purchase order there under shall include the following provisions according to Virginia Code §2.2-4311:

During the performance of a contract, the Consultant agrees as follows:

1. The Consultant will not discriminate against any employee or applicant for employment because of race, religion, color, sex, age, or national origin, except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the Consultant. The Consultant agrees to post in conspicuous places, available to employees and applicant for employment, notices setting forth non-discrimination clause.
2. The Consultant, in all solicitations or advertisements for employees placed by or on behalf of the Consultant, will state that such Consultant is an equal opportunity employer.
3. Notices, advertisements, and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirement.

The Consultant will include the provisions in the foregoing paragraphs a, b, and c in every contract, subcontract, or purchase order of over $10,000, so that the provisions will be binding upon each subconsultant or vendor associated with Spotsylvania County.

Y. Partial Invalidity

Neither any payment for, nor acceptance of, the whole or any part of the services by Spotsylvania County, nor any extension of time, shall operate as a waiver of any provision of any Contract resulting from this RFP, nor of any power herein reserved to Spotsylvania County, or any right to damages herein provided, nor shall any waiver of any breach of any Contract be held to be a waiver of any other or subsequent breach. Failure of Spotsylvania County to require compliance with any term or condition of any Contract shall not be deemed a waiver of such term or condition nor a waiver of the subsequent enforcement thereof.

Z. Proposal Withdrawal

Any Proposal may be withdrawn up until the time set above for the opening of the Proposal. Any Proposals not so withdrawn shall constitute an irrevocable offer for a period of 150 days.

AA. RFP Proposal and Clarification

Spotsylvania County reserves the right to request clarification of information submitted and to request additional information of one or more offerors. Each offeror shall examine the Request for Proposal documents and shall judge all matters relating to the adequacy and accuracy of such documents. Any inquiries, suggestions or requests concerning interpretation, clarification or additional information pertaining to the Request for Proposal shall be made in writing to the Spotsylvania County Procurement contact listed on the first page of this RFP. Spotsylvania County shall not be responsible for oral interpretations given by any employee, representative, or others. The issuance of a written RFP Addendum issued by the Spotsylvania County Procurement Division is the only official method whereby interpretation, clarification, or additional information can be issued.

BB. Release and Ownership of Information

Spotsylvania County shall make a good faith effort to identify and make available to the Consultant all non-confidential technical and administrative data in Spotsylvania County's possession which Spotsylvania County may lawfully release including, but not limited to contract specifications, drawings, correspondence, and other information specified and required by the Consultant and relating to its work under this Contract. Spotsylvania County reserves its rights of ownership to all material given to the Consultant by Spotsylvania County and to all background information, documents, and computer software and documentation developed by the Consultant in performing any Contract resulting from this RFP.

No reports, information or data given to or prepared by the Consultant under the resulting Contract shall be made available to any individual or organization by the Consultant without the prior written approval of Spotsylvania County, which approval Spotsylvania County shall be under no obligation to grant.

As may be allowed by law, any information, ideas, or concepts that the County receives during the procurement process from any offeror's written proposal, any discussion or interview with the offeror or as a result of any portion of the procurement process for the services described in this Request for Proposal shall become the property of Spotsylvania County. Spotsylvania County may use this information for any purpose

without compensation to the offeror from whom the information was received.

CC. Rights and Responsibilities of Consultant

The Consultant shall indemnify, defend and hold harmless the County and its representatives from any and all claims, suits and actions for injury or damage sustained by any person or property from any act or omission by Consultant and/or its Consultants or employees, or anyone else for who Consultant is or may be responsible. This section shall survive the termination this agreement.

The Consultant in any contract resulting from this RFP shall pay all royalties and license fees necessary for performance of the contract. The Consultant shall defend all suits or claims for infringement of any patent rights or any other proprietary rights arising from or related to performance of the resulting contract and shall save Spotsylvania County harmless from any and all loss, including reasonable attorneys' fees, on account thereof.

DD. Subconsultants and Assignments

The Consultant shall not sublet or assign or transfer any interest in this Contract or any portion thereof without the prior written consent of Spotsylvania County of which Spotsylvania County shall be under no obligation to grant. In seeking consent for any subcontract or assignment, the Consultant shall furnish all information required by Spotsylvania County to permit Spotsylvania County to ascertain the qualifications of the proposed subconsultant to perform the work, and the Consultant shall submit a copy of the subcontract to Spotsylvania County for approval. The subcontract shall incorporate by reference all provisions and conditions of the Contract resulting from this RFP.

Spotsylvania County's approval of a subconsultant shall not relieve the Consultant of any of its responsibilities, duties or liabilities hereunder. The Consultant shall continue to be responsible to Spotsylvania County for performance of the subconsultant and the subconsultant, for all purposes, shall be deemed to be an agent or employee of the Consultant. Nothing in the Contract resulting from this RFP or any subcontract shall create any contractual relationship between any subconsultant and Spotsylvania County.

EE.Tax Exemption

The County of Spotsylvania as a public body politic and corporate of the Commonwealth of Virginia, is exempt from any Federal excise tax and Virginia sales and use tax for purchases made by the County.

FF. Termination

Spotsylvania County shall have the right to terminate at Spotsylvania County's convenience, with or without cause, any Contract resulting from this RFP by specifying the date of termination in a written notice. In this event, the Consultant shall be entitled to just and equitable compensation for any satisfactory work completed. All work produced, and data collected shall become the property of Spotsylvania County.

ATTACHMENT A

TRADE SECRETS/PROPRIETARY INFORMATION IDENTIFICATION

IF NO PROTECTION IS NEEDED STATE "N/A" ON THE TABLE BELOW AND SIGN.

Trade secrets or proprietary information submitted by any Bidder/Offeror in connection with a procurement transaction shall not be subject to public disclosure under the Virginia Freedom of Information Act, however, the Bidder/Offeror must invoke the protection of §2.2-4342(F) of the Code of Virginia, in writing, prior to or upon submission of the data or other materials, and must clearly and specifically identify the data or other materials to be protected, and state the reasons why protection is necessary. **The proprietary or trade secret material submitted must be identified by the Bidder/Offeror on the table below. If the Bidder/Offeror fails to identify any protected information on the table below, the Bidder/Offeror by return of this form, hereby releases the County and all of its employees from any and all claims, damages, demands or liabilities associated with the County's release of such information, and agrees to indemnify it for all costs, expenses and attorney's fees incurred by the County as a result of any claims made by Bidder/Offeror regarding the release of such information. By submitting its bid or proposal, Bidder/Offeror understands and agrees that any language seeking protection from public disclosure, any specific documents or information, unless identified on the table below, are null and void and of no legal or binding effect on the County.** The classification of line item prices, and/or total bid prices as proprietary or trade secrets is not acceptable. If, after being given reasonable time, the Bidder/Offeror refuses to withdraw such a classification designation, the bid/proposal will be rejected.

SECTION/TITLE	PAGE NUMBER(S)	REASON(S) FOR WITHHOLDING FROM DISCLOSURE

COMPANY NAME: _____

SIGNATURE: _____

ATTACHMENT B

SPOTSYLVANIA COUNTY, VIRGINIA

DEEP RUN CONVEYANCE IMPROVEMENTS

PRELIMINARY ENGINEERING REPORT

REQUEST FOR PROPOSAL (RFP #20-24-TV)

March 2020

DEEP RUN CONVEYANCE IMPROVEMENTS

Preliminary Engineering Report

Spotsylvania County,
Virginia

March 2020

OBG
Part of Ramboll

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SPOTSYLVANIA COUNTY DEEP RUN CONVEYANCE IMPROVEMENTS

TO:	Julia Monat, Scott Powell	**CC:**	Ben Loveday – County
FROM:	Matt Wimmer, Don Simmons		Bill Meinert – OBG, Part of Ramboll
RE:	Spotsylvania County Deep Run Conveyance Improvements		
FILE:	73802		
DATE:	March 18, 2020		

TABLE OF CONTENTS

Spotsylvania County Deep Run Conveyance Improvements ..... **i**
Section 1 - Introduction **5**
1.1 Background 5
1.2 Purpose 5
Section 2 - Design Flows **6**
2.1 Background 6
2.2 Current Flows 6
2.2.1 Average Daily Flow (ADF) 6
2.2.2 Peak Instantaneous Flow (PIF) 7
2.3 Design Flows 7
2.4 Additional County and City Flows 7
2.5 Summary 8
Section 3 – System Curve Development and Pump Selection **8**
3.1 General 8
3.2 System Curve – Deep Run Pump Station 8
3.3 Force Main Sizing 11
3.4 Summary 12
3.5 Pump Selection 13
3.4.1 Suction Lift Pumps 13
3.4.1.1 System Curve – Design Conditions 13
3.4.1.2 Gorman-Rupp Suction Lift Pumps 14
3.4.1.3 Smith & Loveless Suction Lift Pumps 15
3.4.1.4 Pump Selection Summary 17
Section 4 - Site Concept Design and Pump Station Structure **17**
4.1 Site Conditions 17
4.1.1 Existing 17
4.1.2 Proposed Location 17
4.2 Flood Elevation Assessment 17

4.2.1 Base Flood Elevation Development 18
4.2.1.1 Contour Interpolations Method 18
4.2.2 RPA Buffer 18
4.3 Site Layout 18
4.3.1 General 18
4.3.2 Approach Sewer/Headworks 19
4.3.2.1 Emergency Sewer Bypass Option 19
4.3.3 Wet Well 19
4.3.4 Pump Arrangement 19
4.3.4.1 Existing Pump Upgrades 20
4.3.4.2 Bypass Pumping Operations 20
4.3.5 Permitting 20
Section 5 - Pump Station – Structural Design 20
5.1 Codes and Standards 20
5.2 Description of Structural Systems 21
5.3 Design Criteria 21
5.3.1 Material Properties 23
Section 6 - Pump Station – Architectural Design 23
6.1. Code Analysis Summary 23
6.2. Description of Architectural Systems 24
Section 7 – Pump Station – Electrical Design 24
7.1 Electrical Basis of Design 24
7.1.1 Reliability and Flexibility 24
7.1.2 Safety 24
7.1.3 Codes and Standards 25
7.2 Power Distribution Summary 25
7.2.1 Electrical Distribution 25
7.2.2 Standby Power System 25
7.2.3 Variable Frequency Drives 26
7.2.4 Transient Voltage Surge Suppression Equipment 26
7.2.5 Disconnect Switches 26
7.2.6 Electric Motors 26
7.2.7 Lighting 27
7.2.8 Telecommunications 27
7.2.9 Fire Alarm System 27
Section 8 – Pump Station – Instrumentation and Controls Design 27
8.1 Introduction 27
8.2 Codes and Standards 27
8.3 Basis of Design 27

8.3.1 Process Control 27
8.3.2 Panels 28
8.3.3 Redundancy and Reliability 28
8.3.4 Remote Communications 28
8.3.5 Constructability 29
Section 9 - Pump Station – Mechanical Design 29
9.1 Basis of Design 29
9.1.1 HVAC 29
9.1.2 Plumbing 29
9.1.3 Fire Protection 30
9.2 Virginia SCAT Guidelines 30
9.3 Constructability 30
Section 10 - Force Main Design and Alignment 30
10.1 Alternative Alignment Evaluation 30
10.1.1 Existing Alignment 30
10.1.2 Alternative Alignments 30
10.1.3 Alternative Alignment Evaluation 31
10.1.3.1 Proposed Alignment 31
10.1.3.2 Traffic Impacts and Road Crossings 32
10.1.3.3 Force Main appurtenances 32
10.1.3.4 Permitting 33
Section 11 - Preliminary Construction Cost Estimate 33
11.1 Summary 33
Section 12 - Conclusions and Recommendations 33
12.1 Summary 33

LIST OF TABLES

Table 2.1: Deep Run Flow Study Results **6**
Table 2.2: Current (2019) Influent Flow Projections **7**
Table 2.3: Design Influent Flow **7**
Table 3.1: IPS/FMC/DR FM Manifold to MWWTP Velocities **12**
Table 3.2: IPS/FMC/DR FM Manifold to MWWTP TDH **12**
Table 5.1: Design Basis – Live Loads **21**
Table 5.2: Design Basis – Snow Loads **22**
Table 5.3: Design Basis – Wind Loads **22**
Table 5.4: Design Basis – Seismic Loads **22**
Table 5.5: Design Basis – Flood Loads **23**
Table 5.6: Design Basis – Concrete & Masonry **23**

Table 6.1: Pump Station – Building Code Analysis.....**23**

Table 11.1: Summary – Preliminary Construction Cost Estimate (Year 2020 Projection).....**33**

LIST OF FIGURES

Figure 3.1: Wet Well Profile.....**9**

Figure 3.2: Deep Run System Curve (Deep Run Only) – Current/Design Conditions.....**10**

Figure 3.3: Deep Run System Curve (Combined County/City Peak) – Current/Design Conditions.....**11**

Figure 3.4: Deep Run System Curve (County and City) – Design Conditions.....**14**

Figure 3.5: Deep Run System Curve (County and City) – Design Gorman-Rupp, Model T10A3S-B.....**15**

Figure 3.6: Deep Run System Curve (County and City) – Design Smit & Loveless, Model 8D4V.....**16**

LIST OF APPENDICES

Appendix A: Pump Manufacturer Literature

Appendix B: City IPS/FMC/DR FM Manifold

Appendix C: FEMA Firm Map

Appendix D: Preliminary Pump Station and Force Main Plans

Appendix E: Alignment 1 – Aerial Figures

Appendix F: VDOT LUP-OC – Open-Cut Pavement Restoration Requirements

Appendix G: Preliminary Construction Cost Estimate

Appendix H: Report of Geotechnical Study

SECTION 1 - INTRODUCTION

1.1 BACKGROUND

Previously, O'Brien & Gere, part of Ramboll (OBG) delivered a series of planning-level technical memoranda (Technical Memoranda No. 1 through No.4) to Spotsylvania County (County) and the City of Fredericksburg (City). Collectively, those memos evaluated and modeled the decommissionings of the City WWTP and/or the County's FMC WWTP; associated conveyance projects to deliver the City and FMC flows to the Massaponax WWTP (MWWTP); and several expansions and upgrade scenarios to the MWWTP (9.4 to 17.9 MGD ratings). These scenarios represented various combinations of potential County and City flows (average, peak) that might be transferred to the MWWTP. The existing Deep Run system can be conveyed to either FMC WWTP (FWWTP) or MWWTP, or both (uneven split based on hydraulics of the two force mains), depending upon the average and peak flows being processed overall at one or the other County WWTP. All of these scenarios included the rehabilitation and/or replacement of the Deep Run Pump Station (DRPS), as necessary, in order to convey flows from the Deep Run basin to the MWWTP, with and without flows from County FMC and City IPS; consideration was also given as to whether the existing 16-inch Deep Run Force Main (DRFM) should be re-used or if Deep Run flows should be conveyed through a new, "combined" force main that included flows from the City IPS and FMC PS.

Please refer to the Conveyance & Treatment Alternatives Evaluation – Technical Memoranda #2 & #3 (dated 10/13/15), Wastewater Plan Update Draft Memorandum (dated 1/26/17), and the Deep Run Flow Study (dated 1/9/19) which approximated the sanitary sewer flows for the Deep Run sewer basin and evaluated capital improvements (pump station and force main) necessary to effectively convey average and peak flows from the Deep Run sewer basin to the MWWTP. Specifically, data evaluated as part of the initial evaluations suggested that the existing DRPS was in compliance with the Virginia Department of Environmental Quality's (DEQ) Sewerage Collection and Treatment (SCAT) Regulations and capable of adequately conveying peak flows to the FMC WWTP and/or MWWTP for treatment. However, the results of the 2018-19 Deep Run Flow Study showed that influent flow rates to the pump station's wet well during wet weather events exceeds the station's peak pumping capacity, and influent flows were backing up into the Deep Run collection system.

Therefore, in September 2019, OBG was retained by the County to provide professional engineering services to advance planning-level analyses to preliminary engineering stage for the construction of a new County-City DRPS, Force Main, and associated appurtenances. Initially on hold, this preliminary engineering was completed now that the County and City have decided to consolidate its wastewater management. The need to design and construct the DRPS and Force Main has been accelerated due to: 1) wet weather flow rates within the Deep Run collection system 2) design and construction phasing of other, parallel wastewater conveyance and treatment improvements, as part of the County's and City's plan to consolidate wastewater treatment at MWWTP.

Coinciding with decommissioning of the City's WWTP and replacement of its existing IPS, a new force main is necessary to convey City flows to MWWTP. Initially, reuse of the existing 16-inch force main was considered, but given the age of the existing main (>30 years old), this PER assumes that the existing force main will be abandoned in place and connect to the City force main approximately 300 linear feet east of the DRPS; preliminary engineering for the replacement FMC Pump Station and Force Main is underway (PER completed under separate cover), and its force main will connect to the City Force Main (flow metered and controlled, assumedly, upstream of the manifolding) at approximately the same location. Refer to the overall Consolidation Program Schedule for sequencing of Deep Run, FMC, City, and Massaponax system upgrades. From the County manifold location, the combined flow will be conveyed to the County's MWWTP for treatment. [Note: The City Force Main was considered as part of the OBG County-City Wastewater Planning Update study in 2017, reviewed and requirements updated by OBG and WR&A in 2018 to incorporate a new City IPS and manifolding of City, Deep Run, and FMC PS FMs (IPS/FMC/DR FM manifold).]

1.2 PURPOSE

The purpose of the Deep Run Conveyance Improvements Project is to advance preliminary engineering design of an expanded and upgraded pump station and new force main to convey current and future flows from the Deep Run sewer basin to MWWTP for treatment. Pumping hydraulics consider FMC and City flows and pumping

conditions. Preliminary design is mainly focused on civil, mechanical, structural, and electrical components, with the intent to: 1) increase the conveyance capacity of the Deep Run Pump Station, and 2) provide a comprehensive conveyance solution that ultimately redirects flow from the County's Deep Run collection system, accounting for flows from both the City's IPS and FMC PS within a combined force main, to MWWTP.

Specifically, this Preliminary Engineering Report is comprised of the following components:

- Pump Station
  - » Design flows
  - » System curve development
  - » Conceptual design of the pump station's approach sewer, headworks, wet well, control building and
  - » Associated mechanical, electrical, instrumentation, and controls designs
- Force Main design and alignment considerations
- Preliminary construction cost
- Preliminary construction schedule.

SECTION 2 - DESIGN FLOWS

2.1 BACKGROUND

DRPS flow meter records between 2012 and 2015 were analyzed as part of the 2015 WW Technical Memorandum #2 (TM #2). Records suggested that the DRPS had an ADF of approximately 0.6 MGD; a peaking factor of 3 was assumed, which resulted in a PIF of 1.8 MGD. Based on those assumed flows, it was believed at the time that the pumps were capable of conveying peak flows if the pumps were rehabilitated to include larger motors (up to 75 Hp) and larger impellers; upsizing pumps were projected to convey approximately 3.0 MGD with one pump in service. [Note: The existing DRPS is a duplex station; for SCAT compliance, the pump station's peak rating is based on one pump in service, with the second pump serving as a "standby".]

In the Fall of 2018, OBG performed a flow monitoring study of the Deep Run sewer basin, as recommended in the 2015 TM #2. The purpose of the study was to: 1) quantify the average daily flow (ADF) and peak instantaneous flow (PIF) within the basin 2) to confirm whether those flows exceeded the conveyance capacity of the existing DRPS.

2018 Flow Study results are summarized in **Table 2.1** below.

TABLE 2.1: DEEP RUN FLOW STUDY RESULTS

AVERAGE DAILY FLOW (ADF)	0.77 MGD
PEAK INSTANTANEOUS FLOW (PIF)	5.10 MGD

Source: O'Brien & Gere

Based on the results of the 2018 Flow Study, the 2015 assumption that the collection system had a 3.0 peaking factor was deemed incorrect. The existing station experiences significantly higher-than-expected peak flows and its pumps are undersized to effectively convey peak flows to FMC WWTP and/or MWWTP for treatment. Therefore, current and future flows must be developed for the purposes of establishing the design basis for a new/upgraded Deep Run Pump Station. [Of note, the County is currently modifying existing pumps and motors to increase capacity in the interim.]

2.2 CURRENT FLOWS

2.2.1 AVERAGE DAILY FLOW (ADF)

Initial average daily and peak instantaneous flows to the proposed Deep Pump Station were established based on the flow monitoring efforts from 2018-19 (0.77 MGD and 5.10 MGD, respectively). To be consistent with the Spotsylvania County Water and Wastewater Master Plan (dated 1/27/19), an annual growth rate of two percent

was applied to the apparent 2018 average daily flow of 0.77 MGD to establish the 2020 average daily flow (0.80 MGD).

2.2.2 PEAK INSTANTANEOUS FLOW (PIF)

For peak instantaneous flow, the Flow Study captured a max PIF of 5.1 MGD, which equates to a "peaking factor" of 6.6 of the ADF (i.e., 5.1/0.77). Applying a peaking factor of 6.6 to the projected 2020 ADF results in a 2020 PIF of 5.20 MGD. These 2020 flows will be used and referenced herein for the pump station's existing conditions and are listed in **Table 2.2** below. These flows will also serve as the baseline for establishing the basis of design for the pump station's peak capacity, described further in **Section 2.3**.

TABLE 2.2: CURRENT (2020) INFLUENT FLOW PROJECTIONS	
Average Daily Flow (ADF):	0.8 MGD
Peak Instantaneous Flow (PIF):	5.2 MGD
Source: OBG, part of Ramboll	

2.3 DESIGN FLOWS

The proposed DRPS and Force Main sized in the 2017 WW Plan Update assumed contributions from the City IPS and County FMC stations, and a peaking factor of 3.1 was assumed to establish the design PIF.

Based on the results of the 2018-19 Deep Run Flow Study, the assumed peaking factor is low, and the design flows for the new DRPS and FM must be re-established. Applying a 2% annual growth rate (consistent with 2018-19 Wastewater Master Plan recommendations) over a 20-year planning horizon (consistent with previous conveyance planning estimates), the projected design ADF is 1.2 MGD, which essentially assumes approximately 0.4 MGD of infill development within the Deep Run Basin over the next 20 years.

For estimating the design PIF, OBG recommended that the County address I/I within the Deep Run basin in order to reduce the size/capacity (and cost) of the new Deep Run PS and FM and reduce the amount of non-wastewater that is conveyed to MWWTP for treatment. With County confirmation, a peak design capacity of 6.0 MGD was selected for the proposed DRPS, corresponding to a PIF/ADF peaking factor of 5. 6.0 MGD provides adequate conveyance capacity for Deep Run in the near-term but relies on some level of future County I/I rehabilitation efforts within the Deep Run collection system, with rehab efforts predominantly driven by the amount and timing of infill development and additional base flows that are added to the collection system. Design flows are summarized in **Table 2.3: Design Influent Flow** (below).

TABLE 2.3: DESIGN INFLUENT FLOW PROJECTIONS (YEAR 2039)	
Design Average Daily Flow (ADF):	1.2 MGD
Design Peak Instantaneous Flow (PIF):	6.0 MGD
Source: OBG, part of Ramboll	

2.4 ADDITIONAL COUNTY AND CITY FLOWS

For the purposes of discussing the force main and system curve development in **Section 3**, the Deep Run Force Main (DRFM) has been separated into two segments, reference **Figure 2.1 – City IPS/FMC/DR FM Manifold** in **Appendix B**:

- From DRPS to the IPS/FMC/DRFM manifold
- From the IPS/FMC/DRFM manifold to MWWTP.

Sizing and selection of the section of new force main extending from the City's IPS (IPS FM) site to the IPS/FMC/DRFM manifold is outside the scope of this PER; however, it is understood that the IPS FM sizing/selection will be based on an average flow of 6.0 MGD and a peak flow of 19.7 MGD from the City IPS.

The County has requested that the FMC PER be updated to include a higher pumping capacity for the new PS and FM. The section of new force main extending from the County's proposed FMC PS (FMC FM) site to the

IPS/FMC/DR FM manifold will be sized to convey an average flow of 0.6 MGD and a peak flow of 1.7 MGD from the new FMC PS.

At the IPS/FMC/DR FM manifold, the Deep Run FM and FMC FM are anticipated to connect to the City IPS FM, with the flows combining, and a combined "County-City Force Main" will extend from the manifold to MWWTP for treatment.

2.5 SUMMARY

The proposed DRPS is currently estimated to receive an average daily flow of 0.80 MGD and a PIF of 5.2 MGD. Projecting towards Year 2040, an ADF of 1.2 MGD is estimated for Deep Run. A peak conveyance capacity of 6.0 MGD was mutually selected by County and OBG for the DRPS, resulting in a reduced peaking factor of 5 (compared to 6.6, as identified in the 2018-19 flow study), and likely requiring the County to complete future I/I reductions within the collection system to maintain sufficient capacity at the pump station.

SECTION 3 – SYSTEM CURVE DEVELOPMENT AND PUMP SELECTION

3.1 GENERAL

System curves are developed as a means for estimating the TDH of a pumping and conveyance system at various flow rates, and ultimately for selection and sizing of pumps and force main. The curves illustrate the relationship between the flow and head loss through the pump station and force main, and are largely influenced by:

- Static head conditions
- Force main pipe diameter
- Force main pipe material.

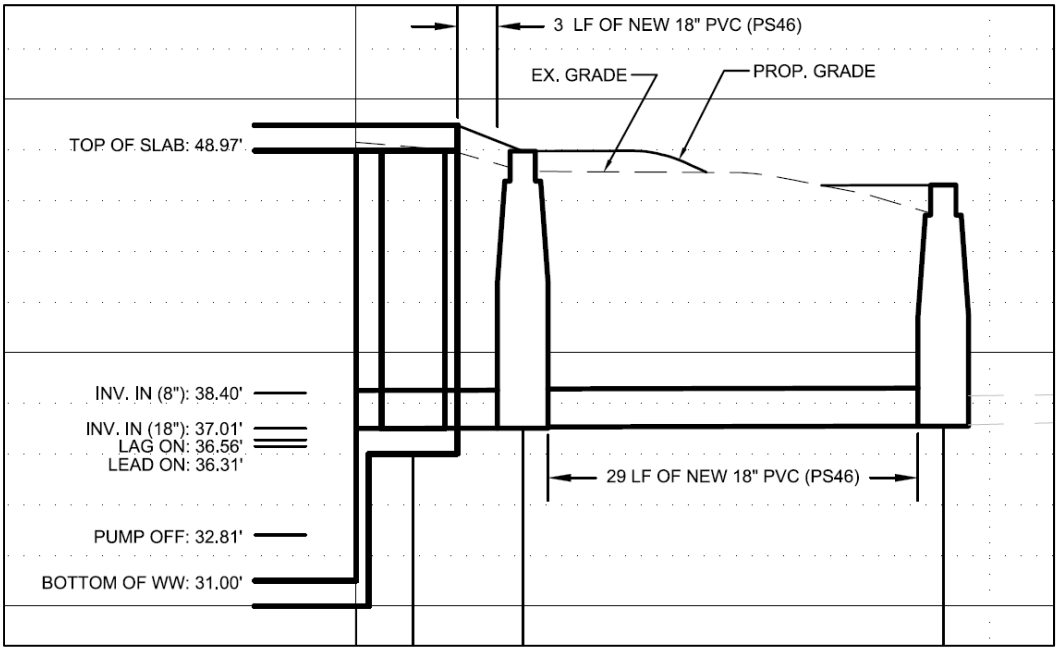
Static head is the water surface elevation difference between the pump's suction and force main's discharge points; the static head has little variance across the range of pump operating conditions. Regarding pipe diameter, as the diameter decreases, the head loss experienced throughout the force main's system increases. Conversely, as the diameter increases, head loss will decrease. The Hazen-Williams Roughness C-value represents the pipe's interior integrity as it relates to friction losses through the force main. C-values differ amongst the various pipe materials, with plastic pipes generally having a higher C-value (and thusly less friction loss) than metallic pipes. For instance, High-density polyethylene (HDPE) pipe is generally considered to have a C-value in the range of 130-150, depending on its interior condition; while the C-value for ductile iron pipe (DIP) generally ranges between 100-140, depending on its interior condition.

3.2 SYSTEM CURVE – DEEP RUN PUMP STATION

Spotsylvania County's Water and Sewer Design and Construction Standards Manual dictates that DIP shall be used for sanitary sewer force mains, and a C-value of 120 shall be assigned to the force main for the purposes of developing the corresponding system curve. Along with the estimated C-values, the force main and pump station layout was evaluated to obtain a more accurate total dynamic head (TDH) calculation. Based on the preliminary pump station and force main layout presented in **Section 4** and **Section 10**, losses from bends, pipe entrances and exits, and other minor losses were approximated to generate the system curves. Losses associated with the City IPS and County FMC force main branch connections were estimated and incorporated into a revised system curve.

As shown in **Figure 3.1** (below), the expected invert influent elevations into the wet well are 38.40 ft and 37.01 ft for the 8-inch and 18-inch pipes, respectively. The elevation of the wet well floor is be 31.00 ft. and the "pump off" elevation will be 32.81 ft. The force main alignment reaches a maximum elevation of approximately 80 ft., resulting in a static head of approximately 46 ft.

Figure 3.1: Wet Well Profile



Section 4 of this report discusses the pump station layout, including system and site constraints. **Sheet C-11**, provided in **Appendix D**, presents the hydraulic profile of the proposed alignment discussed in **Section 7.1.2.1** of this report.

System curves for the proposed pump station were developed to determine the TDH loss occurring from the proposed wet well location to the MWWTP discharge point. For this report and calculations contained herein, DIP was selected for the Deep Run Force Main. However, there may be a potential material cost savings for the utilization of HDPE pipe and could be considered as a bid alternate to DIP as part of later design efforts.

For the purposes of developing the DRPS system curves, the Deep Run Force Main has been separated into two distinct segments for further analysis:

1. Deep Run PS to the City IPS/FMC/DR FM manifold – From the pumps' discharge header, Deep Run-only flows will be conveyed for approximately 300 lf to a force main manifold, where it will combine with County FMC and City IPS flows and enter the "combined force main" for further conveyance to MWWTP. [Note: This initial section of force main was evaluated to determine comparative velocities and friction losses for 16-inch, 18-inch, and 20-inch DIP, with 16-inch selected for subsequent system curve development; see **Section 3.3** for additional information.]

2. County-City manifold to MWWTP – From the manifold, combined County and City flows will be conveyed for approximately 3 miles to the MWWTP for treatment.

Because the DRPS is conveying flows into a combined force main, the pump station will experience a wide range of operating head conditions, depending on the operations and conveyed flows from the City IPS and FMC PS. Therefore, two sets of system curves have been developed (see **Figures 3.2 and 3.3)**, with each set of system curves evaluating the DRPS operation conditions for three different pipeline diameters (for sizing/selection of the combination force main) – 30", 36", and 42".

Figure 3.2 (below) projects the current (2020) and design flow conditions onto the system curves for an assumed 30-inch, 36-inch, and 42-inch diameter County-City combined force main, assuming only DRPS flows are being conveyed through the combined force main (i.e., City IPS and FMC PS are not in operation).

Based on the system curves developed in **Figure 3.2,** the anticipated "lower operating condition" TDHs within a 30-inch, 36-inch, and 42-inch diameter DIP are estimated to be 62 ft., 59 ft., and 57 ft., respectively, at 6.0 MGD (4,167 gpm).

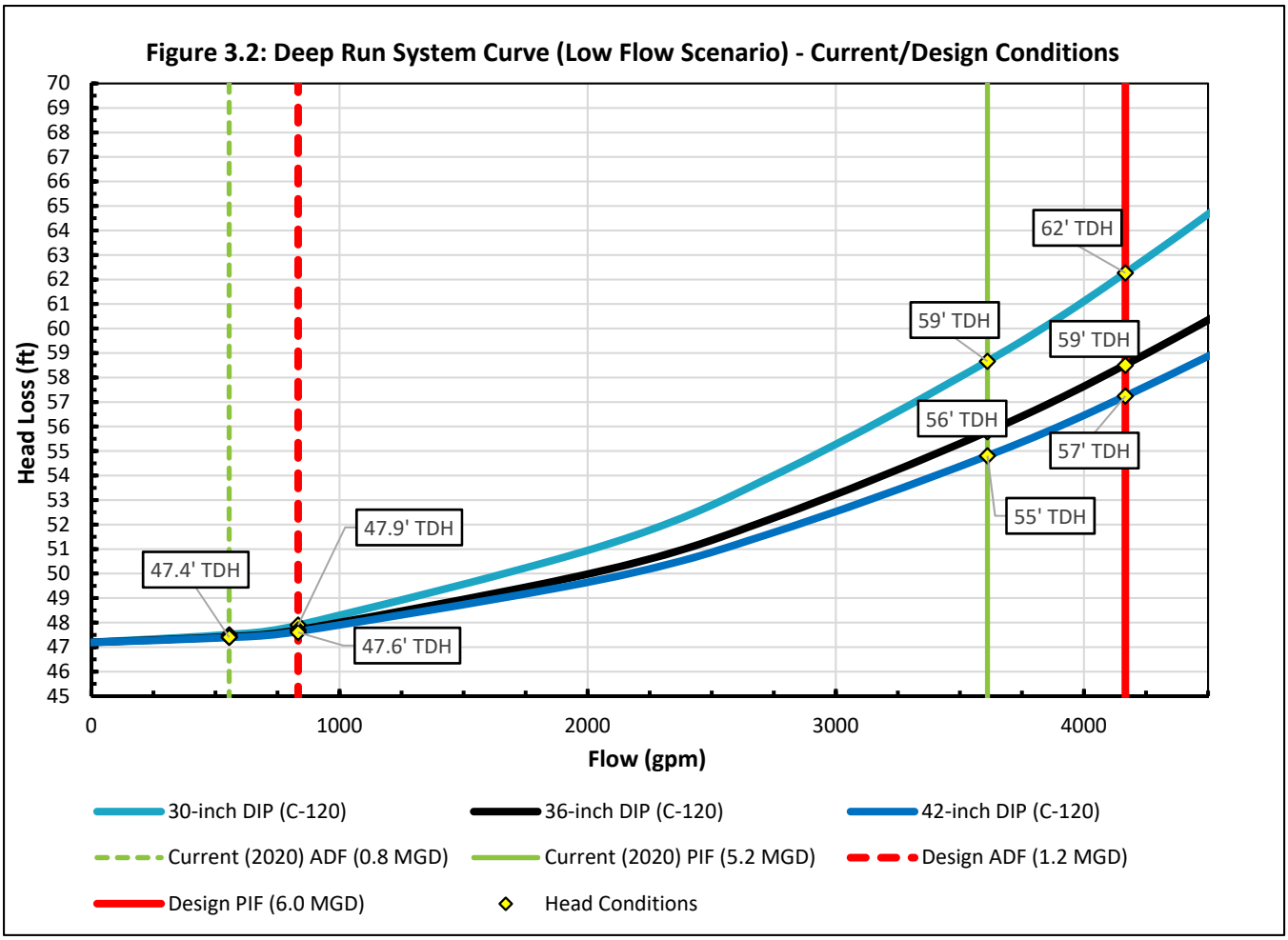


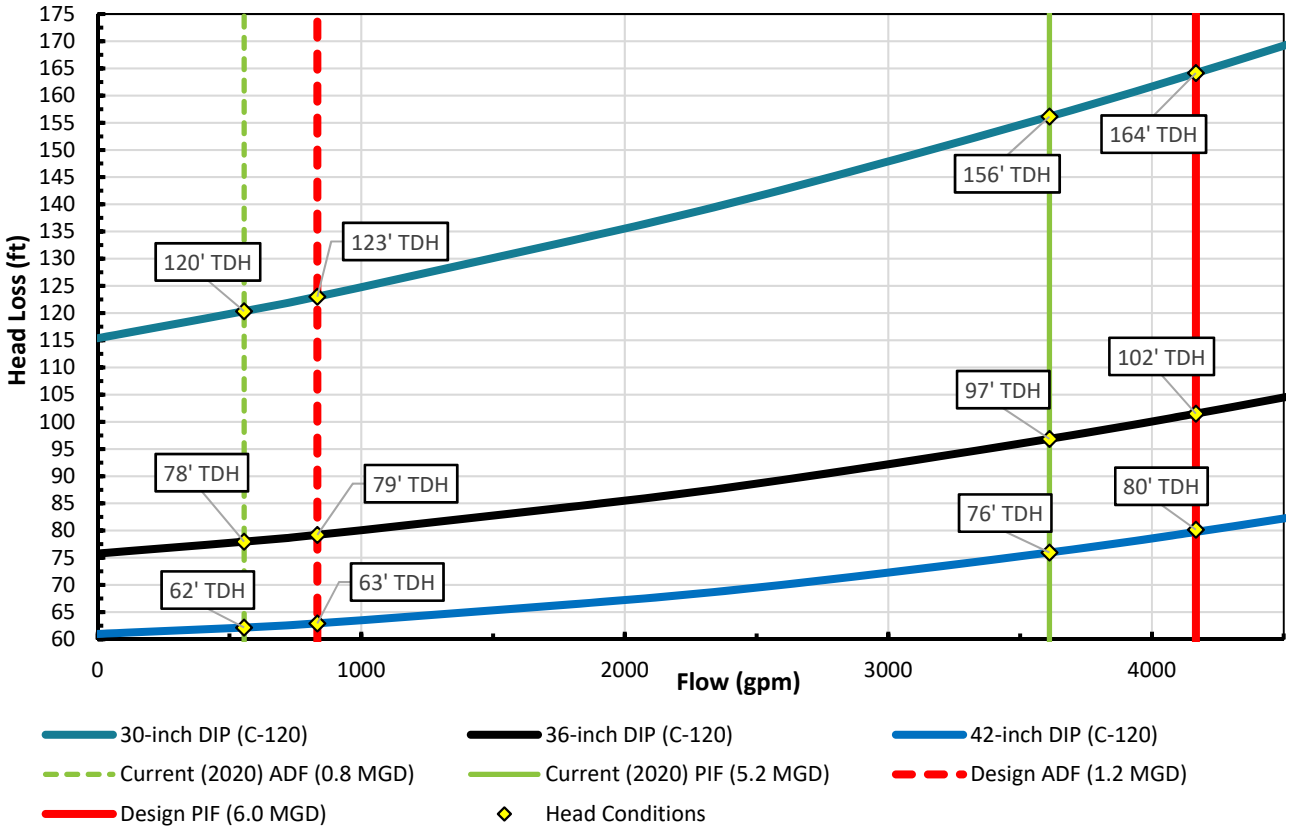
Figure 3.3 (below) projects Deep Run's current (2020) and design flow conditions onto the system curves for a 30-inch, 36-inch, and 42-inch diameter pipe, assuming 100% flows from the City IPS and FMC PS are also being conveyed through the combination force main.

Based on the system curves developed in **Figure 3.3** anticipated "upper operating condition" TDHs within a 30-inch, 36-inch, and 42-inch diameter DIP are estimated to be 166 ft., 102 ft., and 80 ft., respectively, at 6.0 MGD (4,167 gpm).

[Note: Under this scenario, DRPS's initial head conditions at the varying pipeline diameters are different. This is because, when the other two pump stations are in operation, Deep Run's initial head condition includes the static head (which is the same for all three pipe diameters), plus the back pressures from the City PS and FMC PS operations within the force main. The back pressures are dynamic, with their magnitude being dependent on the

force main's diameter at any given flow rate (i.e., as the force main's diameter increases, the back pressure decreases), resulting in lowered head conditions as the force main size is increased, as evidenced below.]

Figure 3.3: Deep Run System Curve (Peak Flow Scenario) - Current/Design Conditions



3.3 FORCE MAIN SIZING

As discussed in **Section 3.2**, pipeline diameters for the initial 300 lf section of Deep Run Force Main, extending from the pump station to the combination main's manifold, were evaluated to compare their relative friction losses and ultimately recommend sizing for final design. Based on completed friction loss calculations, flow through a 300 lf section of 16-inch force main resulted in less than 3' of increased headloss compared to a 20-inch main (5.0 ft vs. 2.3 ft). Because of the relative indifference in headlosses, and minimal/no impact on pump sizing/selection, final force main design in this area should assume 16-inch diameter pipe.

For the County-City combination force main, 30-inch, 36-inch, and 42-inch diameters were analyzed to determine their velocities at average (combined average flow) and peak (combined high flow) flow conditions, to verify SCAT Regulations compliance. The combined average flow condition (7.8 MGD) assumes the DRPS, City IPS, and FMC PS are all contributing average daily flows, discussed in **Section 2.4**, and the combined high flow condition (27.4 MGD) assumes the DRPS, City IPS, and FMC FM are all contributing peak flows into the combined force main. Combination force main velocities for diameter/flow condition are represented below in **Table 3.1** for County/City flow scenarios.

TABLE 3.1: IPS/FMC/DR FM Manifold to MWWTP Velocities		
Pipe Diameter (in)	**Flow (MGD)**	**Velocity (fps)**
30-inch DIP	7.8 (Combined Average Flow)	2.3
30-inch DIP	27.4 (Combination Peak Flow)	8.1
36-inch DIP	7.8 (Combined Average Flow)	1.6
36-inch DIP	27.4 (Combination Peak Flow)	5.6
42-inch DIP	7.8 (Combined Average Flow)	1.2
42-inch DIP	27.4 (Combination Peak Flow)	4.1
Source: OBG, part of Ramboll		

Table 3.2 lists provides the range of head conditions that are anticipated for each force main diameter. [Note: 1.2 MGD is the "Design ADF" for DRPS and corresponds to the 7.8 MGD "Combined Average Flow" condition described in **Table 3.1**. 6.0 MGD is the "Design PIF" for DRPS and corresponds to the 27.4 "Combined Peak Flow" condition described in **Table 3.1**.]

TABLE 3.2: IPS/FMC/DR FM manifold to MWWTP TDH		
Pipe Diameter (in)	**Flow (MGD)**	**TDH (ft)**
30-inch DIP	1.2 (Design ADF)	58
30-inch DIP	6.0 (Design PIF)	164
36-inch DIP	1.2 (Design ADF)	52
36-inch DIP	6.0 (Design PIF)	102
42-inch DIP	1.2 (Design ADF)	50
42-inch DIP	6.0 (Design PIF)	80
Source: OBG, part of Ramboll		

Per the SCAT Regulations, the force main's velocity should be between the minimum and maximum allowable velocities of 2.0 fps and 8.0 fps, respectively. When operating the force main at velocities less than 2.0 fps, solids can collect in the bottom of the pipe; when velocities exceed 8.0 fps, the force main's interior can potentially be damaged due to solids' scouring.

In **Table 3.1**, average velocities through the 36-inch and 42-inch section will be approximately 1.6 fps and 1.2 fps (combined average daily flow from County/City); and peak velocities will be approximately 5.6 fps and 4.1 fps (combined peak flow from County/City), respectively. During average and low flow scenarios, velocities within the 36-inch and 42-inch main will be below the SCAT Regulations' minimum velocity (2.0 fps). The exact opposite is the case with the 30-inch force main, where its low and average flow velocities are expected to be within the SCAT Regulations' recommended limits, but during peak flow events, there could be instances where pipe velocities will be above the SCAT Regulations maximum recommended velocity of 8.0 fps (8.1 fps).

From a pump operations standpoint, operating at lower velocities is preferred for the DRPS due to the length of the force main and to maintain a reasonable TDH during peak County/City flow conditions (27.4 MGD). Under peak flow conditions, a 36-inch or 42-inch force main results in significantly lower TDHs (102 ft. and 80 ft., respectively), provided in **Table 3.3**, than the 30-inch main (166 ft.). Given the low average velocities within the 36-inch and 42-inch force mains, solids settlement is a concern and would need to be mitigated by manually operating the pump stations to re-suspend and flush the force main on a regular interval.

3.4 SUMMARY

To summarize, a 16-inch diameter DIP force main is recommended for the first 300 lf of the DRFM. For the County-City combined force main, a 36-inch diameter, ductile iron force main is recommended for the following reasons:

1. During peak or near-peak flow events, the estimated TDH in the 30-inch main is fairly high and would require installation of additional pumps (to pump in series and parallel) in order to meet the peak flow/head conditions. The 30-inch main's resulting TDH is also be expected to be problematic for the City's IPS design.

2. The 36-inch main's expected TDH during peak flow conditions (approximately 102 ft.) is reasonable, from a pump design basis, and can be accommodated via parallel pumping operations; the need for series pumping is not anticipated.

3. There are no apparent pump station design savings associated with selection of a 42-inch force main, and the force main's construction costs would be increased, compared to the 36-inch force main.

Note: Regardless of the selected force main diameter, velocities during normal operations are expected to be near or less than 2 fps, and it's recommended that the County flush the force main on a semi-regular basis (e.g. weekly or bi-weekly) in order to prevent solids from settling in the main and to re-suspend solids that may have previously settled. For long-term maintenance of the force main, it is recommended that pig launching and receiving pits be installed to allow for periodic cleaning of the force main.

3.5 PUMP SELECTION

Due to the current flows (0.77 MGD ADF and 5.1 MGD PIF), discussed in **Section 2.2**, compared to the conveyance capacity of the existing DRPS (2.3 MGD), the County is in the process of retrofitting the station's existing Gorman-Rupp pumps (2) as an intermediate phase of the pump station upgrade to better convey peak flows while the new pump station is under design/construction.

The station's existing pumps are fixed-speed, Gorman-Rupp Model T Series suction-lift pumps. Each pump is equipped with a 30-horsepower (Hp) motor and is capable of conveying 1,400 gpm at 54 feet of head. Deep Run Pump Station, as it is currently configured, is capable of conveying a maximum flow of 2.0 MGD with one pump in operation and 2.3 MGD with both pumps running. The pumps were originally configured such that each 30 Hp motor could be replaced with a 75 Hp motor to convey 2,150 gpm (3.1 MGD) at 80 feet of head (per pump).

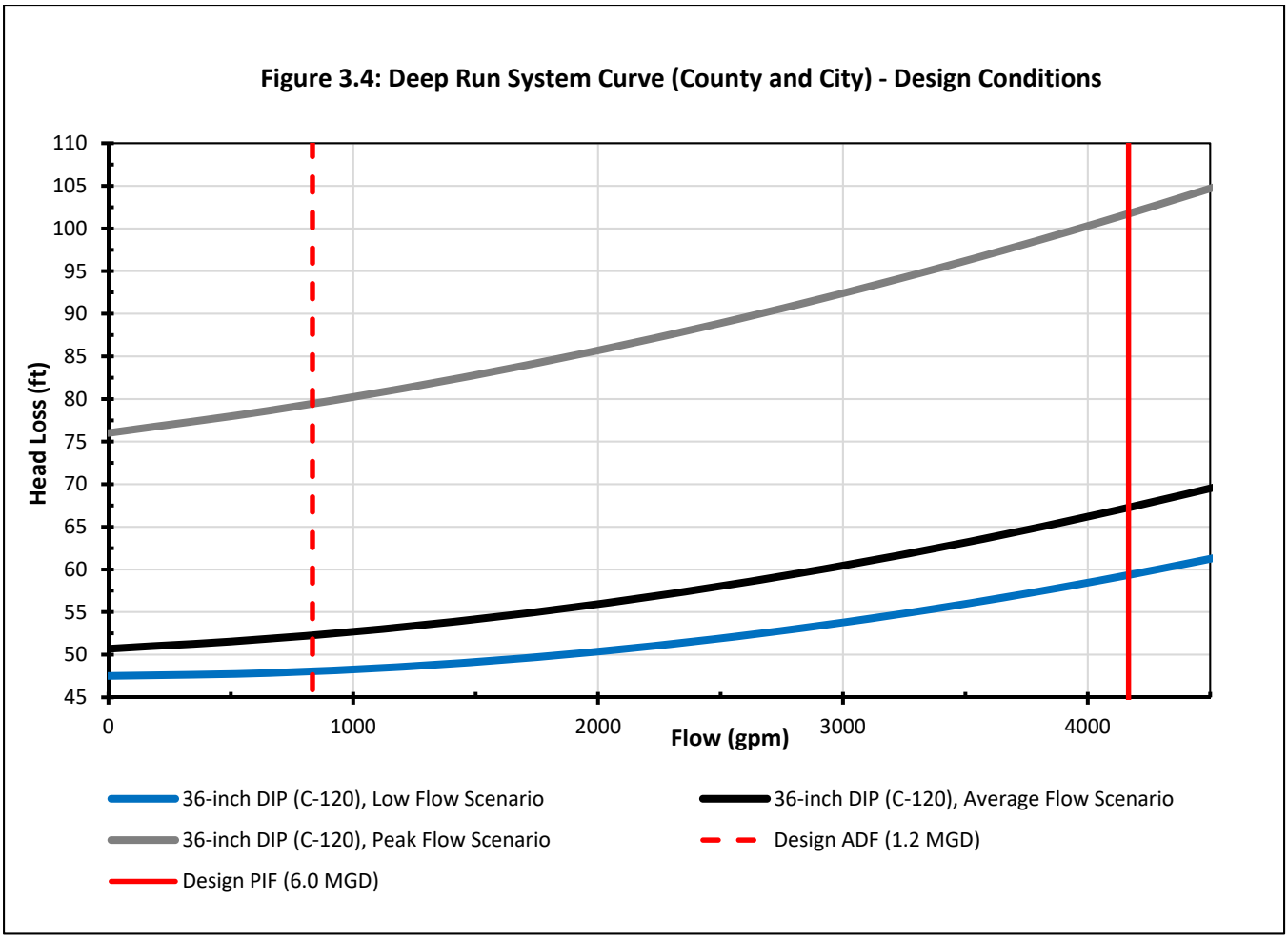
Because of the ongoing upgrades to the existing Gorman-Rupp pumps, this PER prioritizes reuse of the existing pumps and their compatibility with the new pumping system. Smith & Loveless pumping systems are preferred by County maintenance personnel due to reduced O&M manpower requirements, compared to Gorman-Rupp, and an evaluation of Smith & Loveless pumps is included herein. Due to the pump station's proximity to Deep Run Creek and existing grade elevations at the site, footprint expansion is limited. Therefore, an evaluation of flooded suction pumps, which was completed as part of other, previous pumping evaluations, is not included herein due to the compatibility issues with the existing pumps and site constraints previously noted. Therefore, for the purposes of this report, only Gorman-Rupp self-priming and Smith & Loveless vacuum-priming centrifugal pumps were considered.

3.4.1 SUCTION LIFT PUMPS

3.4.1.1 System Curve – Design Conditions

As discussed in **Section 3.3**, a 16-inch diameter DIP force main is recommended for the first 300 lf of the DRFM. For the County-City combined force main, a 36-inch diameter, ductile iron force main is recommended. Because flows from DRPS will discharge into a force main that's receiving flow from two other pump stations (City IPS, FMC PS), a wide range of operating conditions are expected. To account for the varied head conditions, system curves were developed for the following scenarios (see **Figure 3.4**, below):

- "Low Flow Scenario" – DRPS, with City IPS and FMC PS not (temporarily) pumping
- "Average Flow Scenario" – DRPS, with City IPS and FMC PS pumping at average
- "Peak Flow Scenario" – DRPS, with City IPS and FMC PS pumping at peak (worst-case TDH condition).



Based on the system curves in the Figure above, the maximum TDH within the proposed Deep Run force main is approximately 102 ft. at 4,167 GPM (6.0 MGD peak) and assumes that all three pump stations are simultaneously conveying peak flows to MWWTP. The other two system curves establish the change in pump discharge conditions that would be accommodated through VFD speed adjustment and/or discharge pressure regulation. The three system curves were used to adequately size and select the pumps, discussed in **Section 3.4.1.2** and **3.4.1.3**.

3.4.1.2 Gorman-Rupp Suction Lift Pumps

The County is familiar with Gorman-Rupp pumps, with G-R pumps installed at both the Industrial Park Pump Station (e.g., FMC) and at the Deep Run PS itself. Based on the 36" system curve, the following pumping system arrangement is recommended, in consultation with Gorman-Rupp's local manufacturer's representative:

- Three (3) 10-inch Model T10A3S-B Series pumps with each pump equipped with a 100 Hp motor and variable frequency drive (VFD). [Note: the two existing DRPS pumps are also G-R Model T10A3S-B pumps. Therefore, by upsizing the motors to 100 hp and installing VFDs, only one "new" G-R pump may be required for the pump station upgrade.]

The pumps would be installed in a lead/lag/standby orientation, with controls configured to allow for parallel pumping at the higher flow/head conditions, as no single pump is capable of conveying the design peak flow at the peak (combined County/City) head conditions. Under normal operations, it is expected that one pump is capable of conveying the average daily flow. However, during peak conditions, two pumps will be in operation, with the third pump serving as a standby for SCAT Regulations' compliance.

Further discussed in **Section 4.3.3**, an ultrasonic level transmitter, force main discharge pressure gauge, and floats (backup) will turn pumps on, in parallel, as necessary to meet the flows and/or head conditions. A common header discharge pipe allows the pumps to operate in parallel at any time. During final design, controls will also be

evaluated and designed to prevent pump "run out" conditions, in the event that other pump stations shut off and there is a significant change in the system pressures, such that potential pump cavitation at Deep Run is mitigated.

Reference **Figure 3.5** (below), which illustrates the pumps' performance relative to the varying operating conditions within the 36-inch force main. Pump manufacturer's literature is provided in **Appendix A**.

[Note: Net positive suction head calculations indicate that up to 20 feet of suction lift is available for the Gorman-Rupp pumps, which is adequate for the intended pump station and wet well designs, identified and discussed in subsequent sections.]

Figure 3.5: Deep Run System Curve (County and City) - Design Conditions (Gorman-Rupp, Model T10A3S-B)

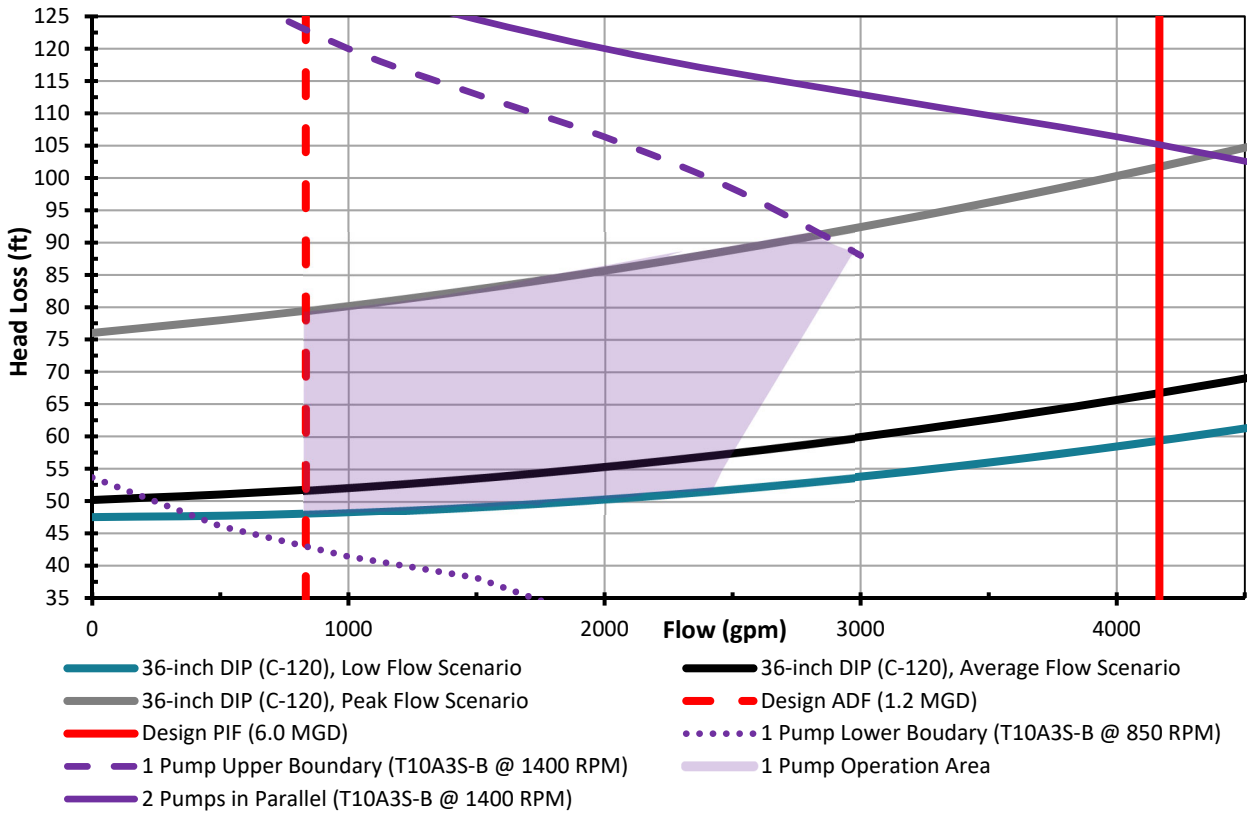


Figure 3.5 shows the lower and upper boundaries of one 10-inch Gorman-Rupp, Model T10A3S-B pump at 850 rpm and 1400 rpm plotted against the pump station's low, average, and peak flow operating conditions (representing the operating conditions identified in **Section 3.2**). Based on **Figure 3.5**, one 10-inch pump can convey a maximum flow of 3.4 MGD at 1400 RPM, well above the design ADF (1.2 MGD); and two pumps (pumping in parallel) are required in order to convey 6.0 MGD at the peak design head (approximately 102 ft).

3.4.1.3 Smith & Loveless Suction Lift Pumps

The County prefers Smith & Loveless (S&L) pumps, when/where applicable, and S&L are pumps installed at a majority of the County's wastewater pump stations. Based on the 36" system curve, the following S&L pumping system arrangement is recommended for Deep Run, in consultation with S&L's local manufacturer's representative:

> Three (3) 8-inch Model 8D4V pumps with each pump equipped with a 100 Hp motor and variable frequency drive (VFD).

The pumps would be installed in a lead/lag/standby orientation, with controls configured to allow for parallel pumping at the higher flow/head conditions, as no single pump is capable of conveying the design peak flow at the peak (combined County/City) head conditions. Under normal operations, it is expected that one pump is capable of conveying the average daily flow. However, during peak conditions, two pumps will be in operation, with the third pump serving as a standby for SCAT Regulations' compliance.

Further discussed in **Section 4.3.3**, an ultrasonic level transmitter, force main discharge pressure gauge, and floats (backup) will turn pumps on, in parallel, as necessary to meet the flows and/or head conditions. A common header discharge pipe allows the pumps to operate in parallel at any time. During final design, controls will also be evaluated and designed to prevent pump "run out" conditions, in the event that other pump stations shut off and there is a significant change in the system pressures, such that potential pump cavitation at Deep Run is mitigated.

Reference **Figure 3.6** (below), which illustrates the pumps' performance relative to the varying operating conditions within the 36-inch force main. Pump manufacturer's literature is provided in **Appendix A**.

[Note: Net positive suction head calculations indicate that up to 20 feet of suction lift is available for the S&L pumps, which is adequate for the intended pump station and wet well designs, identified and discussed in subsequent sections.]

Figure 3.6: Deep Run System Curve (County and City) - Design Conditions (Smith & Loveless, Model 8D4V)

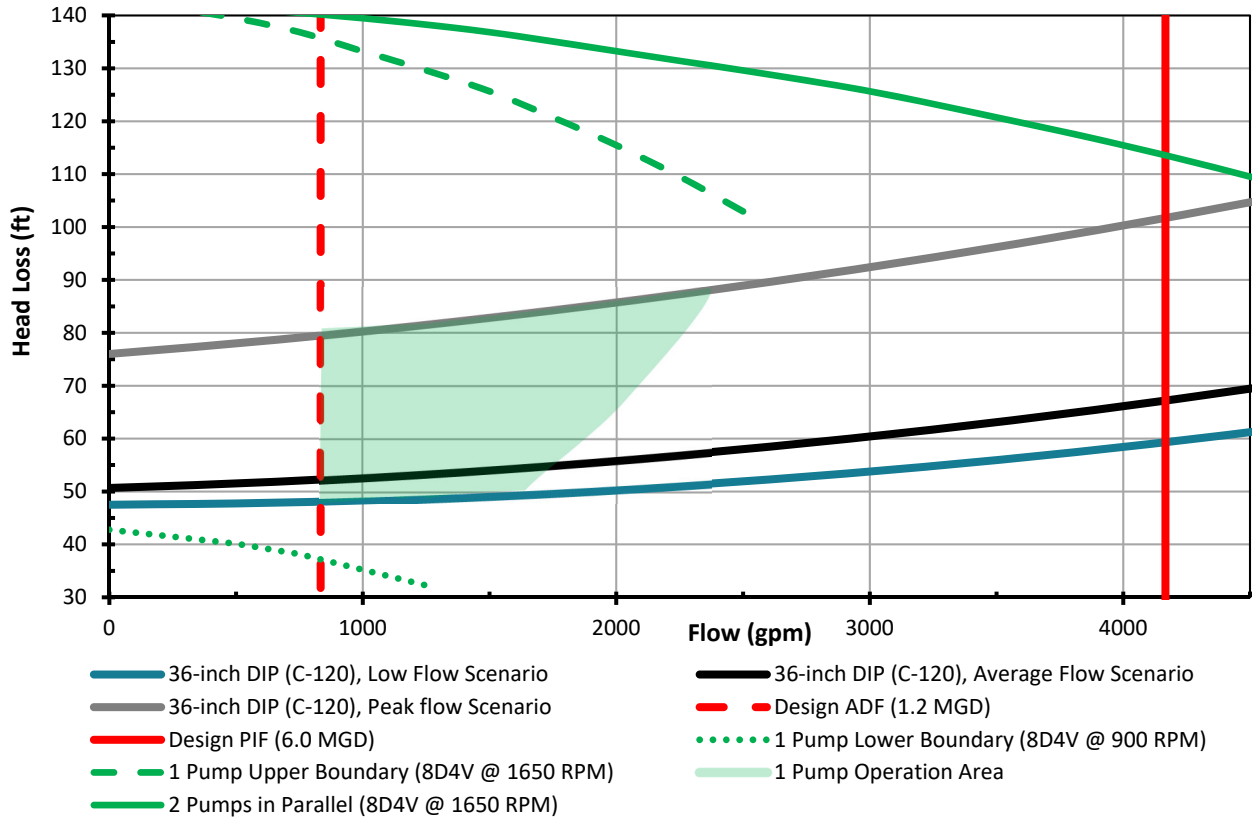


Figure 3.6 shows the lower and upper boundaries of one 8-inch S&L, Model 8D4V pump at 900 rpm and 1650 rpm plotted against the pump station's low, average, and peak flow operating conditions (representing the operating conditions identified in **Section 3.2**). Based on **Figure 3.6**, one 8-inch pump can convey a maximum flow of 3.4 MGD at 1650 RPM, well above the design ADF (1.2 MGD); and two pumps (pumping in parallel) are required in order to convey 6.0 MGD at the peak design head (approximately 102 ft).

3.4.1.4 Pump Selection Summary

Both the Gorman-Rupp and Smith & Loveless pumping systems, evaluated in the above sections, appear to be viable options for the proposed Deep Run Pump Station. Provided below is a summary for both pump manufacturers:

- Gorman-Rupp Model 10A3S-B
  - Upgrade the existing fixed-speed Gorman-Rupp Model T Series suction-lift pumps with 100 Hp motors and VFDs and install one new model 10A3S-B with 100 Hp motor and VFD.
    - Potential cost savings compared to complete pump replacement alternatives.
- Smith & Loveless Model 8D4V
  - Completely replace the existing G-R pumps with three (3) new, Model 8D4V pumps with 100 Hp motors and VFDs.
    - Smith & Loveless is preferred by County maintenance personnel due to reduced O&M manpower efforts, compared to Gorman-Rupp

Pump selection will be finalized during further design.

SECTION 4 - SITE CONCEPT DESIGN AND PUMP STATION STRUCTURE

4.1 SITE CONDITIONS

4.1.1 EXISTING

The Deep Run Pump Station is located southeast of the intersection of Route 2 and Joseph Mills Drive. The Pump Station is an above-grade, duplex station (housed in a prefabricated building) constructed in the early 2000's. A Kohler 125-kilowatt (kW) generator is located on-site and serves as the backup power source for the station. The Pump Station receives flow from the Deep Run Drainage Basin (via the Deep Run Interceptor) and conveys flow to the Massaponax WWTP.

In terms of existing utilities in the area, electric (aerial), natural gas, potable water, and telecommunications are all in close proximity to the proposed pump station site. Electrical, potable water, and telecommunications services currently existing at the pump station. New and upgraded utilities are discussed in the following sections. Construction/modification of these utilities will be coordinated with the corresponding utility owners during later design.

Note: A fiber optic line is not currently present at the pump station site. Reference **Section 8.3.4** for further discussion regarding remote communications at the pump station site.

4.1.2 PROPOSED LOCATION

Preliminary design proposes that new pump station structures be built adjacent to the existing wet well, to allow for intermediate utilization of the existing pumps. Easement acquisition, along with some additional clearing and grading, will be necessary to construct the proposed improvements and provide adequate vehicular and O&M access.

Portions of the site are located with the Special Floodplain District (100-year flood plain, Type-A) and a Resource Protection Area (RPA).

4.2 FLOOD ELEVATION ASSESSMENT

Since construction will occur within a Special Floodplain District, the 100-year flood elevation must be considered and evaluated during design, to establish associated design requirements and/or constraints.

In 1998, the County obtained mapping, as part of the National Flood Program, from the Federal Emergency Management Agency (FEMA). The mapping identified the existence and severity of flood in the geographic area of the County. FEMA's FIRM indicated the proposed pump station is located within the "Zone A" 100-year flood elevation. Areas designated as "Zone A" are areas where a Base Flood Elevation (BFE) has not been provided by FEMA. Therefore, for "Zone A" areas, a BFE must be obtained using all data available from a Federal, State or another approved source. These data are to be used as criteria for requiring new construction, substantial improvements and other development within all approximate "Zone A" areas to meet the applicable requirements of the NFIP regulations, including the requirement that structures have their lowest floors elevated at or above the BFE, or floodproofed to or above the BFE for non-residential structures.

A copy of the FEMA FIRM used to determine the 100-year flood zone is included in **Appendix C**.

4.2.1 BASE FLOOD ELEVATION DEVELOPMENT

In the event that BFE data is not available and the proposed construction is below the threshold specified in Subparagraph 60.3(b)(3) of the NFIP regulations, BFEs for development within Zone A can be estimated by using the method described in the following section.

4.2.1.1 Contour Interpolations Method

Contour interpolation involves superimposing approximate Zone A boundaries onto topographic map in order to establish a BFE. BFEs obtained by this method can only be assumed to be as accurate as one-half of the contour interval of the topographic map that is used. The floodplain boundary must generally conform with the contour lines along the flooding source in question. The difference between the elevations determined on the right overbank and left overbank must be within one-half of the map contour interval. Otherwise, this method is not acceptable.

Using survey and County GIS topographic and flow path data, the Deep Run creek flow path has shifted such that it is not within the FIRM Zone A boundary. The approximate Zone A boundary crosses contour elevations, perpendicular to the proposed superstructure, at two locations (39.3 ft. and 64.0 ft.). The difference between the two elevations is 24.7 ft., which is greater than one-half of the contour interval or 2.5 ft. Therefore, this method is not acceptable for use on this portion of the stream.

As discussed in **Section 3.4.1**, the Gorman-Rupp pumping alternative assumes the existing pumps will be upgraded and remain in operation, along with the existing pump pad. The proposed upgrades to the pump station will maintain the top slab elevation of the existing wet well and pump building (48.97 ft.). An appropriate BFE should be determined from new FIRM maps based on the new flow path of the Deep Run Creek and associated topography. FEMA is currently updating all FIRM maps within the County and are expected to submit final review maps in late February 2020. Once the updated FIRM maps have been finalized, an appropriate BFE can be determined during later design.

4.2.2 RPA BUFFER

Resource Protection Areas (RPAs) are corridors of environmentally sensitive lands that lie alongside or near the shorelines of streams, rivers and other waterways. In their natural condition, RPAs protect water quality, filter pollutants, reduce the amount of storm water runoff, prevent erosion, and perform many other important biological and ecological functions. The proposed pump station is within an RPA. During subsequent design stages and prior to construction, a RPA Waiver application will need to be submitted to the City's Environmental Planning Department for review and approval.

4.3 SITE LAYOUT

4.3.1 GENERAL

Pump station upgrades design includes the design of a new pump station control building and wet well structure, adjacent to the existing wet well and housing the existing pumps. An identical wet well is proposed adjacent to the existing wet well, connected via 3 ft. x 3 ft. sluice gate. The majority of the influent will flow through a new 18-inch approach sewer (existing 18-inch sewer routing was modified to accommodate the proposed pump station

site development, see **Section 4.3.2** below), from the southwest, to the Pump Station's proposed headworks, and then into the proposed wet well. The remaining influent will flow through the existing 8-inch approach sewer, from the northeast, to the existing wet well. The proposed wet well will be a 16.5 ft. x 9 ft. concrete structure, similar to the existing wet well. The northern side of the wet well will have a 3 ft. x 3 ft. metal access hatch with aluminum ladder located outside the pump station building to allow internal access.

Sheets C-10 and C-11, provided in **Appendix D**, present the proposed pump station configuration discussed in this section.

4.3.2 APPROACH SEWER/HEADWORKS

The existing DRPS receives flow from two sources – an existing 18-inch sewer (from the south) and an existing 8-inch sewer (from the north). A majority of the DRPS flows come from the 18-inch sewer, and it requires re-routing to accommodate the proposed wet well and headworks. It is proposed that the influent will flow from the two proposed manholes, via 18-inch PVC pipes, and enter a new headworks structure.

The headworks will be a 9 ft. x 5 ft. below-grade concrete structure. The headworks will contain an in-channel grinder; a Channel Monster Flex, Model CMF2418-M2.0E is proposed. The grinder is rated for a maximum flow of 6.6 MGD, with separate motors for the screen (1 hp) and grinder (5 hp). Flow from the 18-inch influent sewer will flow from the headworks, through the grinder, and enter the proposed wet well.

Installation of a grinder downstream of the 8-inch influent sewer was considered. However, the 8-inch influent sewer does not have a history of maintenance issues (e.g., ragging), and therefore no modifications to the 8-inch line are proposed at this time.

4.3.2.1 Emergency Sewer Bypass Option

Per County standards, a pump-around stand pipe and cap will be installed outside the pump station building to allow emergency sewer bypassing. Reference **Appendix D** for locations of the manholes and suggested gate locations.

4.3.3 WET WELL

The operations and functionality of the new pumping system and wet well is proposed to match that of the existing pumps and wet well. Once in the wet well, the wastewater depth will rise until it reaches the "lead pump on" elevation, at which point the lead pump will turn on and the wastewater will be drawn through the corresponding pump's suction piping. The suction piping will have a flange and flare located two feet below the "pump off" elevation within the wet well. If the influent's depth in the wet well continues to increase with one pump on, the water surface elevation (WSEL) will reach the "lag pump on" elevation and the lag pump will switch on. The influent will then be drawn through two suction pipes and conveyed by both the lead and lag pumps until the WSEL is reduced to the "pump off" elevation. At that elevation, both pumps will turn off and will not turn on again until the influent's WSEL reaches the "lead pump on" elevation. A combination of an ultrasonic level transmitter (primary) and float switches (backup) will be utilized to monitor the level in the wet wells.

For wet well odor control, a radial flow odor control system will be provided and installed on a concrete slab-on-grade adjacent to the wet well (north). Odor control system will be designed to provide 12 air changes per hour, as indicated in **Section 9.1.1**. Odor control system will be an ECS Model VX 600 or equal; other manufacturers can be evaluated, later in design.

4.3.4 PUMP ARRANGEMENT

The proposed layout will provide accessibility for pump maintenance, space for electrical panels, flow meter, and room for the pumps to be installed and removed. As discussed in **Section 3.4.1**, both pump alternatives require a total of three pumps for SCAT Regulations' compliance.

Under the Gorman-Rupp scenario, if the County prefers to maintain and upgrade the existing pumps, one new pump will need to be installed in addition to the existing two pumps. The existing pump orientation and configuration, including suction intake location, will not change. The new pump will be orientated such that the

new suction intake is on the northeast side of the proposed wet well. The pumps will be oriented such that adequate spacing is provided between the concrete pads to allow for periodic maintenance of the pumps.

For the Smith & Loveless scenario, the existing G-R pumps will be replaced with three new S&L pumps. Depending on construction sequencing, it is expected that two of the S&L pumps will be installed overtop of the proposed wet well. Upon demolition of the G-R pumps, the third S&L pump will be installed overtop of the existing wet well, with the existing suction and discharge floor penetrations infilled with concrete and new penetrations cored into the wet well top slab/building floor for the S&L pump.

For both pump alternatives, the discharge of each pump will connect to a common header within the proposed control building. From the header pipe, the discharge will transition to the 16-inch force main, manifold into the 36-inch combined force main, and then proceed to the MWWTP for treatment. A flow meter will be installed on the discharge header within the pump station. It is anticipated that additional flow metering may be completed at the manifold location of the three force mains; its necessity/design will be evaluated later, as part of final design efforts.

Sheets C-10 and C-11, provided in **Appendix D**, present the proposed pump station configuration discussed in this section.

4.3.4.1 Existing Pump Upgrades

If the Gorman Rupp alternative is selected, the existing pumps will need to be modified to upsize the motors from 75 to 100 hp, and VFD controls need to be installed. The pumps' existing suction piping does not require modification, but the discharge piping will require reconfiguration to connect to the new, third pump and connect to the proposed 16" force main.

Under the Smith & Loveless alternative, all of the existing pump equipment, piping and controls would be demolished.

4.3.4.2 Bypass Pumping Operations

It is anticipated that bypass pumping operations will be required for approximately 6-8 weeks while the structural and electrical systems are being upgraded and the pumps' suction and discharge piping is being modified (or demolished). The existing suction and discharge emergency bypass lines will be maintained and utilized, and flow will be conveyed through the existing 16-inch force main to MWWTP for treatment.

4.3.5 PERMITTING

The following permits and/or authorizations are anticipated for the construction of the Deep Run Pump Station:

- County Site Plan Review and Building Permit; County Clearing and Grading Permit
- VDOT Land Use Permit (LUP)
- Virginia Stormwater Management Permit (VSMP) and corresponding Stormwater Pollution Prevention Plan (SWPPP)
- Environmental permits (to be determined during later design)

SECTION 5 - PUMP STATION – STRUCTURAL DESIGN

The following section lists the applicable codes and referenced standards, describes the structural systems, provides structural design criteria, and identifies anticipated material properties for the design of the proposed Deep Run Pump Station.

5.1 CODES AND STANDARDS

The structural design for the project will be in accordance with the following codes, referenced standards and publications:

- Part I of the Virginia Uniform Statewide Building Code (2012) referred to as the Virginia Construction Code (VCC)
  - The 2012 International Building Code (IBC 2012) as incorporated by reference into the VCC.
- American Society of Civil Engineers (ASCE) 7-10, Minimum Design Loads for Buildings and Other Structures
- ACI 318-11, Building Code Requirements for Structural Concrete
- ACI 350-06, Code Requirements for Environmental Engineering Concrete Structures.

5.2 DESCRIPTION OF STRUCTURAL SYSTEMS

The pumping station consists of an existing below-grade wet well and a new-below grade wet well, with a 3'x3' opening and sluice gate installed on the wet wells' common wall, to allow for flow equalization. A new, small below- grade headworks structure houses a grinder unit and a small above-grade superstructure. The above-grade portion of the structure will house the pumps and the electrical equipment.

The superstructure is proposed to be formed with a pre-engineered precast building such as the "Easi-Span" system developed by "Easi-Set Buildings", which provides insulated concrete bearing wall panels with a tapered concrete roof. The building will be partially supported on cast-in-place concrete foundation walls that rest on a concrete strip footing and then partially supported on both the existing and new wet well structures. A cast-in-place concrete slab-on-grade will be provided for the floor surface within the building, with the exception of the area where the two well wells are located, as the top slab of those structures will be used as part of the floor in the building.

The new wet well and headworks structures will be formed with cast-in-place concrete slabs and walls and this system will be tied to the existing wet well concrete structure.

Access to the headworks and wet wells will be made with at-grade vault doors and aluminum ladders. Each ladder will be equipped with an extendable ladder safety post to assist with safe ladder use.

For pump maintenance, a monorail system is proposed to be supported by the roof of the superstructure.

Reference Structural Sheets in **Appendix D** for related design.

5.3 DESIGN CRITERIA

Design live loads are as follows:

Table 5.1: Design Basis – Live Loads

LIVE LOAD CRITERIA	REFERENCE
Floor Live Load = 250 psf	Not explicitly stated in Table 1607.1 (IBC 2012), but rated for supporting large pumps and electrical equipment (similar to heavy manufacturing or heavy storage)
Wheel loads on at-grade slabs = 32,000-lb axle load (16,000-lbs per wheel)	Section 1607.7 (IBC 2012) & AASHTO
Minimum Uniform Roof Live Load = 20 psf	Table 1607.1 (IBC 2012)
Handrails & Guards Live Loads: 50 lbs/ft linear load and a 200-lb concentrated load	Section 1607.8 (IBC 2012) & Section 4.5.1 (ASCE 7)

Design snow load is defined as follows:

Table 5.2: Design Basis – Snow Loads

SNOW LOAD CRITERIA	REFERENCE
Ground Snow Load, p_g = 25 psf	Figure 7-1 (ASCE 7)
Snow Load Importance Factor, I_S = 1.1	Table 1.5-2 (ASCE 7)
Thermal Factor, C_t = 1.0 (assumes heated building)	Table 7-3 (ASCE 7)
Exposure Factor, C_e = 1.0 (Exposure B)	Table 7-2 (ASCE 7)
Flat Roof Snow Load, $p_f = 0.7\ C_e\ C_t\ I_s\ p_g$ = 19.3 psf	Eq. 7.3-1 (ASCE 7)

Design wind loading is defined as follows:

Table 5.3: Design Basis – Wind Loads

WIND LOAD CRITERIA	REFERENCE
Ultimate 3-second wind gust speed = 120 mph	Figure 26.5-1C (ASCE 7)
Exposure category: B	Table 1.5-2 (ASCE 7)

Design seismic loading is defined as follows:

Table 5.4: Design Basis – Seismic Loads

SEISMIC LOAD CRITERIA	REFERENCE
Site class: D	Assumed value, pending geotechnical study.
Mapped spectral acceleration at short period, S_S = 0.146	Figure 22-1 (ASCE 7)
Mapped spectral acceleration at 1-sec Period, S_1 = 0.056	Figure 22-2 (ASCE 7)
Site Coefficient, F_a = 1.6	Table 11.4-1 (ASCE 7)
Site Coefficient, F_v = 2.4	Table 11.4-2 (ASCE 7)
Maximum Considered EQ Spectral Response Accel, S_{MS} = 0.234	Eq. 11.4-1 (ASCE 7)
Maximum Considered EQ Spectral Response Accel, S_{M1} = 0.134	Eq. 11.4-2 (ASCE 7)
Design Spectral Response, S_{DS} = 0.156	Eq. 11.4-3 (ASCE 7)
Design Spectral Response, S_{D1} = 0.089	Eq. 11.4-4 (ASCE 7)
Seismic importance factor: I_E = 1.25	Table 1.5-2 (ASCE 7)
Seismic Design Category: B	Section 11.6 (ASCE 7)

Design flood load criteria is defined as follows:

Table 5.5: Design Basis – Flood Loads

FLOOD CRITERIA	REFERENCE
Basis of Design – Top Slab elevation = 48'-11.5"	Based upon finished floor elevation of the existing pump station.

Equipment Loads:

Equipment loads supported by the structure will be based on information supplied by the equipment manufacturer. Design will address vibration loads where appropriate, including start-up, operating and shutdown frequencies, and follow the guidelines provided in ACI 351.3 – Foundation for Dynamic Equipment.

5.3.1 MATERIAL PROPERTIES

Table 5.6: Design Basis – Concrete & Masonry

ELEMENT	VALUE
Cast-in-place Concrete:	
Minimum 28-day compressive strength	f'_c = 4,500 psi
Maximum water-cement ratio	0.42
Aggregate	ASTM C33, 1" max.
Slump	4" to 6" (prior to addition of admixtures)
Air entrainment	4.5% to 7.5%
Steel reinforcement	ASTM A615, Gr. 60

SECTION 6 - PUMP STATION – ARCHITECTURAL DESIGN

6.1. CODE ANALYSIS SUMMARY

Applicable regulations:

- 2015 Virginia Construction Code
- 2015 Virginia Energy Conservation Code

The following table summarizes the key elements of the building code analysis conducted for the construction activities associated with the DRPS:

TABLE 6.1: PUMP STATION – BUILDING CODE ANALYSIS	
Occupancy Classification	Group F-2
Construction Classification	Type IIB – Non-combustible
Fire Protection	Sprinkler – Not required
Fire Detection	Fire Detection or Heat Detection – Not required
Emergency Lighting	Emergency Lighting – Required (Section 1008.1)
Means of Egress Exits	One exit required (Section 1006.3.2)
Accessibility	Exempt (Section 1103.2.9)

6.2. DESCRIPTION OF ARCHITECTURAL SYSTEMS

- Exterior Walls: The exterior walls will be comprised of precast concrete sandwich panels, (MIN R-9.5) to 14 feet above finished floor.
- Roof: The roof system will consist of a fully adhered single ply roof membrane over tapered polyiso rigid insulation (MIN R-30) on a pre-manufactured reinforced precast concrete roof.
- Interior Finishes are as follows:
  - Floor: Sealed concrete
  - Walls: Sealed concrete
  - Ceiling: Exposed structure – painted.
- Exterior Doors and Frames: The exterior doors and frames will be hollow metal.
- Building R-Value Requirements are as follows:
  - Roof: R-30ci
  - Above Grade Walls/Mass: R-9.5ci
  - Slabs on Grade/Unheated Slab: R-10 for 24 inches below grade
  - Exterior Doors: U = 0.61

SECTION 7 – PUMP STATION – ELECTRICAL DESIGN

7.1 ELECTRICAL BASIS OF DESIGN

7.1.1 RELIABILITY AND FLEXIBILITY

System reliability and flexibility are essential elements of the distribution system, which are required to maintain operation of the wastewater pump station and related equipment. The power distribution system will be configured to maximize this aspect, as well as providing adaptation for future system changes.

7.1.2 SAFETY

The materials and installation of the Electrical equipment will be performed in accordance with the latest editions of the following Codes and Standards:

- Virginia Uniform Statewide Building Code
- National Fire Protection Association – NFPA
- National Electric Code – NEC (NFPA 70)
- Underwriters Laboratories, Inc. – UL
- National Electrical Manufacturers Association – NEMA
- Institute of Electrical and Electronic Engineers – IEEE
- American Society of Testing Materials – ASTM
- Insulated Power Cable Engineers Association – IPECA
- American National Standard Institute – ANSI.

All electrical equipment will be UL listed and labeled by Underwriters Laboratories, Inc. (UL). Provisions will be made to allow access to power distribution equipment to be restricted to authorized personnel only.

7.1.3 CODES AND STANDARDS

The Electrical portion of the design for the proposed pump station will conform to the latest editions of the following Codes and Standards:

Codes:

- Virginia Uniform Statewide Building Code
- National Electrical Code (NFPA 70)
- National Electrical Safety Code (NFPA 70E)

Standards:

- NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities

Where the requirements of more than one Code or Standard are applicable, the most stringent will take precedence.

7.2 POWER DISTRIBUTION SUMMARY

7.2.1 ELECTRICAL DISTRIBUTION

The Electrical Utility for this location is Dominion Power. There is an overhead primary electric line along US-17 Tidewater Trail that will be used to provide Electrical Service to the building.

The building will be fed via two 4-inch direct-buried PVC Schedule 80 conduits, with pull strings, from the utility primary riser pole on US-17 Tidewater Trail to the location of the utility pad-mounted transformer located adjacent to the control building. It is anticipated that the transformer will be a 1000kVA unit, with a 480/277 volt, three-phase secondary voltage.

Within the building provide a 1000 amp, 480/277 volt rated service entrance rated main fused switch with 800 amp fuses, and an auxiliary metering section (for location of the utility CTs). The utility meter socket will be located on the exterior of the building. The main switch section will feed the normal side of the building's automatic transfer switch.

The load side of the automatic transfer switch will feed a 1600 amp, 480/277 volt rated distribution switchboard to feed the pump station equipment, including the three 100 HP pumps.

A 45 kVA dry type transformer to step voltage down to 208/120 volts will be provided for convenience and lighting loads.

Based on preliminary Electrical load estimates, the proposed pump station's peak operating Electrical load would be approximately 589 kVA at 480/277 volts, 3-phase. This includes a 25% spare capacity to accommodate future Electrical loads. This dictates that the building be provided with a 1000 amp Electrical service at 480/277 volts.

7.2.2 STANDBY POWER SYSTEM

The Deep Run Pump Station is designated as a Reliability Class I facility, which is required to be provided with two separate and independent sources of power. Each power source will be capable of maintaining continuous pumping operation at peak design flow during power failures, flooding, or equipment malfunctions. The second source of power will have sufficient capacity to operate all components vital to the pump station's operations during peak wastewater flow conditions, together with critical lighting and ventilation equipment.

The second source of power for the proposed pump station will be provided by an on-site standby generator system. Depending on the ultimate sizing and selection of the pumps, as well as consideration for future capacity, calculations have verified that up to an 800 kW, 480/277-volt generator will be required. The merits of diesel and natural gas-powered generators were previously discussed with the County, and it was decided that a diesel-powered generator was preferred, due to familiarity, cost, and availability.

The unit will be located exterior to the building, at grade, within a Level 1 Enclosure; it is assumed that sound attenuation is not required. The unit will be provided with a minimum 1,500-gallon sub-base, dual-wall (rupture basin with leak detection) fuel tank. This will provide a minimum of 24 hours of operation at full load. The generator will be provided with a critical grade silencer to mitigate the noise while operational. The unit will be provided with an output circuit breaker for connection to a portable load bank to be used for load testing.

The main service entrance switch (normal power) and the generator (standby power) will each feed a 1000 amp rated, three-pole automatic transfer switch. This unit will be provided with a time clock to exercise the generator to meet NFPA 110 requirements for periodic testing. The automatic transfer switch will be located within the proposed pump station. For purposes of this PER's project scoping, layout, and cost estimate, it is assumed that the new generator is provided and installed by the general contractor (not separately by County or its generator systems' vendor).

7.2.3 VARIABLE FREQUENCY DRIVES

Variable frequency drives will be provided to control the speed of the sewage pumps. The VFDs are expected to be PWM type drives (18-pulse drives) or provided with active front end harmonics mitigation. Each VFD would include a main circuit breaker, fusing, surge protective equipment and bypass starters where required. The VFDs would be designed to meet IEEE 519 Standards for both current and voltage harmonic distortion limits.

7.2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION EQUIPMENT

Transient Voltage Surge Suppression Equipment (TVSS) will be provided in accordance with UL 1449 Standards to minimize the impacts of voltage surges on the electrical distribution system.

- Class C TVSS equipment will be provided for the electrical service entrance equipment.
- Class B TVSS equipment will be provided to protect individual distribution and control system components.
- Class A TVSS equipment will be provided for protection of branch circuit wiring where appropriate.

TVSS equipment will be integrated into the equipment component enclosures, where practical, to minimize the grounding lead lengths. Instrumentation circuits would also be provided with surge protection equipment for circuits that enter/exit the pump station building.

7.2.5 DISCONNECT SWITCHES

Disconnect switches will be provided, where required by the NEC, to disconnect equipment and motors. Disconnect switches will be heavy-duty, enclosed safety switches. Disconnect switches will be non-fused, unless fusing is required for HACR equipment or other specific applications. Disconnect switches will not be provided where the motor short circuit and ground fault protective device is permitted to be used in lieu of a separate disconnect switch located at the motor (i.e. combination motor starter applications where the circuit breaker is lockable in the open position), unless preferred for specific applications.

7.2.6 ELECTRIC MOTORS

Electric motors will be premium high efficiency squirrel cage induction type, with one common specification for all NEMA frame motors in the plant. Submersible, hermetic compressor, valve actuator motor, and other special application motors will be specified in individual mechanical Division 21 - 25 Sections.

NEMA frame motors other than explosion-proof motors will have nominal and minimum guaranteed efficiencies in accordance with NEMA MG1-2016 Table 12-12 Full-Load Efficiencies for NEMA Premium™ Efficiency Electric Motors Rated 600 Volts or Less (Random Wound).

Motor enclosures will be TEFC in non-hazardous wet and damp indoor locations. Open drip-proof enclosures will be used in non-hazardous dry indoor locations. IEEE 841 motors (mill and chemical duty TEFC) with anti-condensation heaters or sealed insulation systems will be used in non-hazardous outdoor locations. Explosion-proof motors will be used in Hazardous (Classified) Locations.

Motors in variable frequency drive applications will be inverter duty rated, in accordance with NEMA MG1-2016 31.4.4.3 recommendations, to provide long insulation life when operating on PWM variable frequency controller output voltage waveforms.

Motors 1/3 HP and smaller will be 120 V single phase 60 Hz. Motors 1/2 HP and larger will be 460 V, 3 phase, 60 Hz.

7.2.7 LIGHTING

New interior and exterior LED lighting, conforming to the State of Virginia Energy Conservation Code, will be provided within the pump station where needed for access to and illumination of the pump station equipment. Lighting provided in the drywell will be unclassified per the National Electrical Code. Lighting within the pump station itself will be gasketed and vandal resistant. A minimum of 30 footcandles of illumination will be provided within the pump station, in accordance with the Illuminating Engineering Society and the ASCE – Design of Municipal Wastewater Treatment Plants guidelines. The exterior lighting will be provided with photo controls for dusk to dawn operation and will be provided with step dimming (50% dimmed when no activity is detected) so that the lighting will only be at full brightness when activity is detected.

7.2.8 TELECOMMUNICATIONS

Communications will be through the County's existing cellular network. Equipment will be specified to match County's network. Final details will be established during design. During PER development meetings, County staff advised that security / surveillance monitoring (or CCTV) is not required for the DRPS upgrade project.

7.2.9 FIRE ALARM SYSTEM

By code, an automatic fire alarm system is not required for the control building, but this report assumes that one would be provided. The system would consist of single station smoke detectors tied to the SCADA system for reporting of fire conditions. These units would provide protection and notification in the event of a fire at the building.

SECTION 8 – PUMP STATION – INSTRUMENTATION AND CONTROLS DESIGN

8.1 INTRODUCTION

The new Deep Run Pump Station (DRPS) will be capable of unoccupied operation while providing remote monitoring through the County's existing SCADA system. The wet well will be provided with a level transmitter as well as backup floats for redundant control. Self-priming sewage pumps will be controlled to maintain level set-point. A magnetic flow meter will monitor instantaneous station flow rate. Local control of the pumping station will be provided by a Process Automation Controller. Visibility of the process control system will be provided locally through a panel mounted Operator Interface Terminal (OIT). This graphical depiction of the process conditions providing local control will be coordinated with the SCADA graphical presentation to provide a consistent user experience.

8.2 CODES AND STANDARDS

The overall design of the instrumentation and control (I&C) systems will conform to the guidelines of *Virginia DEQ SCAT Regulations* and *Spotsylvania County Department of Utilities – Water and Sewer Design and Construction Standards Manual*. The specifics of how many of these requirements will be met will be determined during final design. Additionally, the instrumentation systems provided by this project will be in compliance with industry standards and OBG's experience with similar Spotsylvania projects.

8.3 BASIS OF DESIGN

8.3.1 PROCESS CONTROL

Local control of the pumping station will be provided by a Pump Control Panel, to provide reliable and robust pump operations. Additionally, a Process Control System (PCS) panel will be provide the interface between the

Pump Control Panel and the County's SCADA. The PCS Panel will consist of a Programmable Logic Controller (PLC) to control pump operations, monitor building systems, provide alarming and communicate to the County's remote monitoring facility. A 12-inch color touch-screen OIT will be provided and to provide centralized automated operation and monitoring of new equipment. This new PLC will be capable of running autonomously, as standalone systems, in the absence of a network connection.

- PCS will be located in proximity to the pump control panel, variable frequency drives (VFDs) and other equipment to minimize conduit runs. The door-mounted OIT will provide real-time color graphic monitoring and control of the local devices and processes. The PLC will be equipped with Ethernet connectivity and will communicate with other equipment (VFD, SCADA, Odor Control, etc.) where possible via Ethernet TCP/IP protocols.
- Field inputs and outputs from instruments and controlling devices, critical to the operation of the equipment, will be hard-wired to PLC Control Panel's I/O using conventional electrical signals over copper conductors. Intelligent I/O networks (i.e. Ethernet) will be used to communicate non-critical information. Discrete (on/off) inputs will be 24Vdc powered. Discrete (on/off) outputs will be dry relay contacts for motor starter circuits, control system permissive and interlocks. All analog inputs and outputs to be 4-20 mA dc current loops.

8.3.2 PANELS

Control Panels (PCS and Pump Control) will be mounted in non-classified environments, away from classified areas and/or zones. Should equipment need to interface with instruments or equipment in such areas, intrinsic safety barriers (ISB) and conduit with filled seal-offs will be used for signal wiring - isolating the hazardous area from the safe area electrically.

PLC, I/O and components will be designed to today's conventional standards. It is assumed that the wastewater processes are determined to be of low risk and thus Safety Instrumented Systems (SIS) and Safety Integrity Level (SIL) will not be part of this design.

Some new equipment may be provided with OEM control panels. The PLC Control Panel will interface to these vendor control panels to varying degrees allowing an operator some capability to monitor and/or control the equipment through the PLC Control Panel OIT.

8.3.3 REDUNDANCY AND RELIABILITY

The DRPS design will consider redundancy and reliability as much as practical. As minimum, the following will be included in the design.

- The control panel will house an Uninterruptible Power Supply (UPS) that will protect to the control system against line frequency variations, power line noise voltage transients, and will provide voltage regulation and back-up power for a minimum duration of 15 minutes.
- Wiring of I/O will be specified such that the failure of any single PLC I/O module minimally affects an overall process. In general, control outputs for multiple pumps of similar purpose will be distributed across separate PLC output modules.
- To maintain operational reliability, improved productivity and consistency with County standards, the controls infrastructure will be designed around Allen-Bradley's CompactLogix family of products. OIT's will be specified as Allen-Bradley PanelView Plus 6 utilizing Factory Talk View ME for visibility.

8.3.4 REMOTE COMMUNICATIONS

A communications path will be established by the County to be incorporated into the design and provide a link for remote monitoring of the facility. Communications may be via a land-line, fiber-optic based Ethernet LAN, cellular, wireless radio, or cable modem. For Deep Run, is assumed that cellular communications will be utilized, with further details explored during later design.

NOTE: Design does not include design details and coordination with utilities outside the pump station boundary, including wireless radio feasibility survey and studies or fiber optic planning.

8.3.5 CONSTRUCTABILITY

The distributed control approach of this design provides a modular, robust and expandable control system. Vendor panels will be provided to best match pumps, motors, controls and accessories for maximum compatibility and system performance.

SECTION 9 - PUMP STATION – MECHANICAL DESIGN

9.1 BASIS OF DESIGN

- The HVAC, plumbing, and fire protection systems provided by this project will be in compliance with the following codes and standards:
- Virginia Uniform Statewide Building Code
- Virginia Sewage Collection and Treatment (SCAT) Regulations
- NFPA 820 – Fire Protection in Wastewater Treatment and Collection Facilities
- American National Standards Institute (ANSI)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- 2015 International Building Code
- 2015 International Energy Conservation Code
- 2015 International Existing Building Code
- 2015 International Fire Code
- 2015 International Fuel Gas Code
- 2015 International Mechanical Code
- 2015 International Plumbing Code

9.1.1 HVAC

The HVAC systems provided by this project are recommended to include the following features:

- Electric unit heaters for heat in the process areas.
- Exhaust fans and louvers for ventilation in the process areas.
- Supply air fans and exhaust fans in hazardous process areas as required by NFPA 820.
- Heat for ventilation supply air or make-up air will be evaluated for airflow rates that create possible freezing problems within the buildings. Heating source energy can be electric or natural gas. For the purposes of this report, electric has been assumed, but use of natural gas can be explored during later design, if desired by the County.
- Wet Well – Ventilation of 12 air changes per hour is to be provided. This ventilation rate results in a requirement for the electrical classification for this space as 'Class I Division 2 Group D'. There is no minimum ventilation rate required for the electrical classification of this space.

9.1.2 PLUMBING

The plumbing systems provided by this project are recommended to include the following features:

- Building drainage with floor drains to sanitary wet well.
- Hose bibs and reels for wash-down where required.
- Sump pumps in dry well if required for groundwater removal.

For purposes of design development, it is assumed that the potable water flow and pressure is adequate.

9.1.3 FIRE PROTECTION

Fire protection systems will be provided, as indicated in **Section 7.2.9**.

9.2 VIRGINIA SCAT GUIDELINES

Design requirements for HVAC, plumbing and fire protection systems as part of the Deep Run Pump Station project will be in accordance with the SCAT Regulations, latest edition.

9.3 CONSTRUCTABILITY

The HVAC, plumbing, and fire protection systems will be designed as unitary systems without central plants.

SECTION 10 - FORCE MAIN DESIGN AND ALIGNMENT

10.1 ALTERNATIVE ALIGNMENT EVALUATION

10.1.1 EXISTING ALIGNMENT

The existing Deep Run Force Main consists of approximately 6,000 linear feet of 16-inch diameter pipeline that extends from the Pump Station to a 24-inch gravity sewer main, which ultimately flows to the Massaponax WWTP. Record date for the 16-inch main is incomplete; is the main is understood to ductile iron and is assumed to be in good condition.

A 12-inch diameter main tees off of the 16-inch main approximately 300 linear feet south of the pump station. The 12-inch main was installed in 1985 and records suggest that the main is Class 52 ductile iron. The 12-inch main crosses Route 2 and follows along a private gravel road (adjacent to Bend Farm Road) and Joseph Mills Road, ultimately extending to the FMC WWTP. Isolation valves are located on both the 16-inch and 12-inch mains (on the branch and run of the 16-inch x 12-inch tee), giving the County the flexibility to divert 100% of the flow to either Massaponax or FMC. Under normal operating conditions, both valves are left open, allowing flow to be split between both treatment plants; the split is approximately 57/43 between Massaponax and FMC.

The 16-inch Deep Run Force Main discharges into a 24-inch, reinforced-concrete gravity sewer line upstream of the Massaponax WWTP. The sewer main is approximately 9,000 linear feet long and includes approximately 35 sewer manholes. The maximum capacity of the sewer segments varies from 5.68 MGD to 16.59 MGD.

10.1.2 ALTERNATIVE ALIGNMENTS

Through consultation with County personnel and as part of the new force main's design, the alignment – that generally follows the Route 2 public right-of-way – was segregated into two separate alignments to evaluate different alternative routes specific to impact to the VDOT roadway. The two alignments extend from the proposed DRPS to the MWWTP. From the pump station southeast along Route 2, primarily within the shoulder and/or turning lanes, to Glenda's Way, both alignments are identical. The following are the sub-alignments evaluated for each section:

- **Alignment No. 1** - The force main will extend from the proposed DRPS southeast along Route 2. The force main will be located within the shoulder and/or turning lanes of the southbound side of Route 2 until reaching Brooke Road. Prior to this intersection, the force main will turn cross perpendicular to Route 2 and continue southeast along the northbound side to HCC Drive. At the intersection of Route 2 and HCC Drive, the force main will turn northeast along HCC Drive, briefly within the southbound turning lane. The force main will continue along the HCC Drive southbound side shoulder until reaching Hamiltons Crossing Drive, where upon the alignment crosses to the northbound shoulder. The force main will then follow HCC Drive to the MWWTP influent structure.
- **Alignment No. 2** – Alignment No. 2 is identical to Alignment No. 1 from the DRPS to the intersection of Glenda's Way and Route 2. The alignment crosses Glenda's way and extends northeast into The Shops at River Club

lots/parking area. The force main will extend southeast, parallel to Route 2, to the south corner of the shopping center. From there, the force main navigates an existing storm retention pond then follows an existing gravity sewer main alignment to HCC Drive. the force main will turn northeast along HCC Drive, within the shoulder. The force main will continue along the HCC Drive southbound side shoulder until reaching Hamiltons Crossing Drive, where upon the alignment crosses to the northbound shoulder. The force main will then follow HCC Drive to the MWWTP influent structure.

Reference **Sheets C-1 through C-7**, provided in **Appendix D**, for the horizontal alignments discussed herein.

10.1.3 ALTERNATIVE ALIGNMENT EVALUATION

The alignments presented in **Section 10.1.2** were each evaluated to determine the preferred alignment. Following a Workshop with the County, the following alignment was selected to develop a preliminary force main alignment:

- **Alignment 1** – Extending from the DRPS along the Route 2 corridor to the intersection of HCC Drive and Route 2. The alignment then turns north along HCC Drive to the MWWTP.

The preliminary force main alignment has been provided to VDOT for review and a meeting was held to discuss VDOT requirements within the right-of-way -- see **Section 10.1.3.2** for further information. There is a potential the proposed alignment will be altered further, pending the future VDOT review meetings.

10.1.3.1 PROPOSED ALIGNMENT

A Workshop was conducted with the County and comments were provided on the alternative alignments. Based on constructability concerns determined during the initial site visit and Workshop, Alignment No. 1 was selected, with minor modifications, and a preliminary alignment was established; the proposed FM alignment is approximately 2.9 miles, extending from the proposed DRPS to MWWTP.

Upon establishing the preferred FM alignment, preliminary plans were submitted to VDOT, and a preliminary meeting was held to review the design and identify potential VDOT design conditions/restrictions. Based on the meeting, additional evaluations are needed and there is the potential that the proposed alignment will require additional modifications, pending future VDOT review(s).

The force main alignment selected may require temporary and/or permanent easements for up to 16 parcels. The exact quantity and location of temporary and permanent easements will ultimately be finalized during later design, but the following parcels have been identified for consideration:

- Skeet2holdings LLC, PIN 24-12-10
- Wilson Realty LLC, PIN 25-15-B
- Wilson Realty LLC, PIN 25-15-4A
- WAWA Inc., PIN 25-15-2
- Wilson Realty LLC, PIN 25-15-1
- Shannon Airport LLC, PIN 24-12-5
- Commonwealth Center LLC, PIN 25-A-17
- Southern States Cooperative Inc. Fbg. Petroleum Service Tax Dept., PIN 25-A-27B
- Civil War Preservation Trust (Slaughter Pen Farm Historic Site), PIN 25-A-27
  - An existing 80' VDOT ROW currently exists along the Slaughter Pen Farm Historic Site parcel. If a permanent easement is needed for the force main, documents required in Section 106, Protection of Historic Properties, of the National Historic Preservation Act will need to be submitted to federal agencies for review and approval. The review and approval process will likely extend the design schedule.
- Kermit P Thomas or Audrey C Thomas, PIN 25-6-17

- Wilson Duerden LLC, PIN 25-6-A
- 11032 Tidewater Trail LLC c/o idX Impressions LLC, PIN 25-1-1
- Hamilton's Crossing POA Inc., PIN 25E-1-C
- Carlin Venaglia or Teara Venaglia, PIN 25E-1-75
- Daniel Pedraza Vaca or Nancy Figueroa Mandujano, PIN 25E-1-76
- Hamilton's Crossing POA Inc., PIN 25E-1-D.

Sheets C-1 through C-4, provided in **Appendix D**, present the horizontal alignment discussed in this section.

10.1.3.2 TRAFFIC IMPACTS AND ROAD CROSSINGS

Understanding that the County prefers that the new force main be installed outside of the Route 2 pavement limits, roadway and associated traffic impacts will be minimized to the greatest extent possible. OBG requested a preliminary meeting to discuss the alignment with VDOT and adjust the proposed alignment accordingly. Based on comments provided by VDOT at the meeting, and on similar, previous projects impacting pavement within the ROW, anticipated VDOT requirements may include the following:

- All pavement repairs must be in accordance with VDOT's Land Use Permit requirements. Reference **Exhibit F-1: LUP-OC**, provided in **Appendix F**. Note that parallel installation within the pavement may require partial -width pavement overlay of the effected roads.
- Completion of geotechnical investigations and SUE QL-A (test pitting) and QL-B utility designation.
- Nighttime pavement replacement operations.
- Development of a TMP (Transportation Management Plan).

Sheets C-1 through C-7, provided in **Appendix D**, present the horizontal alignment and associated road crossings discussed in this section.

10.1.3.3 FORCE MAIN APPURTENANCES

- Force main exterior coating – Barring geotechnical investigations that indicate otherwise, the DIP force main will have an exterior zinc coating with V-Bio poly wrap. No exterior coating is necessary for HDPE.
- Force main interior lining – The DIP main should be lined with a corrosion-inhibiting ceramic epoxy lining system (e.g. Protecto-401) to protect the pipe's interior from hydrogen sulfide corrosion. HDPE pipe does not require an interior lining system for corrosion protection.
- Cathodic Protection System – It is recommended that stray current testing be completed along the alignment corridor to verify whether installation of a cathodic protection system is necessary.
- Air release valves – Installation of combination air valves are recommended at each of the intermediate highpoints along the force main's alignment. The air valves would likely be installed within a 4-foot diameter precast concrete manhole.
    - Given that the force main is expected to be located within the well-traveled Route 2 corridor, the County has expressed an interest in installing an odor control system at each of the air release valve locations. There are several options to choose from, including more economical vent pipe-type filters (e.g. OdorHog) and manhole lid filter inserts (e.g. SweetStreet Manhole Odor Control Module); as well as a more complex and expensive individual air valve odor control unit (e.g. Wager 3100-V Vacuum Air Release Odor Control Valve). Odor control options can be further investigated during later design.
- Isolation valves – Up to three isolation valves are recommended for the force main, allowing the force main to be partially isolated in the event of a main break or during pigging operations. Generally, plug valves are recommended for wastewater force mains, but the County may consider gate valves as a cost saving alternative.

- Pigging Stations – Due to the low velocities expected within the 36-inch force main, installation of pig launching and receiving stations are recommended for routine maintenance of the force main and to maintain long-term capacity within the force main.

10.1.3.4 PERMITTING

The following permits and/or authorizations are anticipated for the construction of the Deep Run Force Main:

- County Clearing and Grading Permit
- VDOT Land Use Permit (LUP)
- Virginia Stormwater Management Permit (VSMP) and corresponding Stormwater Pollution Prevention Plan (SWPPP)
- Environmental Permits (to be determined during later design)

SECTION 11 - PRELIMINARY CONSTRUCTION COST ESTIMATE

11.1 SUMMARY

Preliminary construction costs have been estimated for the Deep Run Pump Station and Force Main based on available material costs and available bid tab data for similar projects completed in Central Virginia. However, pending guidance from VDOT is expected to significantly influence the force main's cost.

The following is a summary of the estimated construction costs for the Deep Run Pump Station and Force Main; costs have been projected to Year 2020 dollars, accounting for the estimated construction schedule (reference **Appendix G** for complete cost breakdowns):

TABLE 11.1: SUMMARY – PRELIMINARY CONSTRUCTION COST ESTIMATE (YEAR 2020)	
Mobilization	$ 450,000
Subtotal – Influent Sewer and Pump Station	$ 3,175,000
Subtotal – Force Main to MWWTP	$ 11,900,500
Subtotal – Project	$ 15,525,500
Contingency (30%)	$ 4,600,500
Construction Cost Estimate – Total	**$ 20,126,000**
Source: OBG, Part of Ramboll	

SECTION 12 - CONCLUSIONS AND RECOMMENDATIONS

12.1 SUMMARY

The following is a listing of conclusions and recommendations for the Deep Run Conveyance Improvements Project:

- Initially on hold, preliminary engineering of the Deep Run Pump Station and Force Main was necessitated (and accelerated) due to:
  - Progression in County/City wastewater consolidation negotiations
  - 2018-19 Deep Run Flow Monitoring results, which identified the existing DRPS as being undersized to effectively convey current wet weather flows from the Deep Run collection system.
- Average daily and peak instantaneous flows to the proposed Deep Pump Station are based on the flow monitoring efforts from 2018-19 (0.77 MGD and 5.10 MGD, respectively). To be consistent with the Spotsylvania County Water and Wastewater Master Plan (dated 1/27/19) an annual growth rate of two

percent was applied to the estimated 2018 average daily flow of 0.77 MGD to establish the 2020 average daily flow (0.80 MGD). Applying the same growth rate to the PIF results in a 2020 PIF of 5.2 MGD.

- In tandem with the influent flow conclusions above, the results of the 2018 Flow Study confirmed that the DRPS peaking factor (3.0), assumed as part of the 2016-17 Wastewater Planning Update, was incorrect. The existing station experiences significantly higher-than-expected peak flows, and its pumps are undersized to effectively convey peak flows to FMC WWTP and/or MWWTP for treatment. In the near-term, the County is in the process of retrofitting the existing Gorman-Rupp pumps (2) to increase the stations conveyance capacity; and ultimate replacement/retrofit of the existing Deep Run Pump Station and Force Main is recommended to sufficiently convey peak Deep Run flows and to better integrate with concurrent City and County conveyance designs.
- For Pump Station Basis of Design conditions, an ADF of 1.2 MGD was selected, which corresponds to 2% annual growth for the next 20 years and allows for approximately 400,000 gallons of infill development within the Deep Run collection system. 6.0 MGD was selected as the pump station's peak design basis, understanding that it corresponds to a lower peaking factor (5.0) than what was identified during the flow monitoring study (6.6). Depending on the amount and timing of infill development within Deep Run, the County will need to address I/I challenges within the collection system in order to preserve/extend the pump station's peak capacity.
- The new pump station will require modifications to the existing 18-inch approach sewer to accommodate the proposed wet well and headworks. It is proposed that the influent will flow from two proposed manholes, via 18-inch PVC pipes, and enter a new headworks structure.
- The headworks will be a 9 ft. x 5 ft., below-grade, concrete structure equipped with an in-channel grinder; a Channel Monster Flex, Model CMF2418-M2.0E is proposed to alleviate concerns with pump ragging and clogging.
  - For the DRPS size range, the County has considered whether a grinder or mechanical screen is desired for the 8-inch influent pipe. The 8-inch influent does not have a history of maintenance issues (e.g., ragging) and therefore no modifications to the 8-inch line are proposed at this time.
- Because of the ongoing upgrades to the existing Gorman-Rupp pumps, this PER prioritizes reuse of the existing pumps and their compatibility with the new pumping system. However, Smith & Loveless pumps are preferred by County maintenance personnel due to reduced O&M efforts, compared to Gorman-Rupp, and are a viable alternative to the proposed Gorman-Rupp system. The Gorman-Rupp system likely offers some capital cost savings, via reuse of the existing G-R pumps, but S&L is considered to offer an O&M advantage. Therefore, it is recommended that Final Design consider both pumping options, pending further design direction from the County.
- A standby power system or backup diesel pump set is required for the pump station, due to its designation as a Reliability Class I facility. An on-site generator (up to 800 kw) is recommended instead of a stand-alone diesel pump set, due to site constraints and the wide range of potential flow/head conditions that the backup pump set would have to accommodate. Additional generator recommendations include:
  - At-grade installation of the generator, within a weatherproof enclosure.
  - Installation of a minimum 1,500-gallon sub-base, dual-wall diesel fuel tank, to provide a minimum of 24 hours of operation at full load.
  - Sound attenuation or screening wall is not anticipated to be required.
- A 16-inch diameter force main is recommended for the (small) section of Deep Run-only flows; a 36-inch diameter force main is recommended for the combined County and City flows in order to achieve desired velocities and head conditions during low and average flow conditions.
- Ductile iron pipe, with Protecto P-401 lining and zinc coating, is recommended for the force main's pipe material, in accordance with the County's Water and Sewer Design and Construction Standards Manual. Subsequent geotechnical investigations will determine the necessity of polyethylene encasement.
- The force main will be approximately 3 miles long, extending from the proposed DRPS to the MWWTP. The force main will extend from the existing pump station site southeast of the intersection of Route 2 and Joseph

Mills Drive and continue southeast along Route 2. Along the way, the force main will cross approximately eight roads, and railroad crossing. Additional force main considerations include:

- Expedited completion of additional field investigations (e.g., geotechnical and SUE) along select portions of the force main alignment.
- Avoiding installation of the force main within the Route 2 corridor to the greatest extent practical. When within the Route 2 corridor, consideration should be given to locating the force main within the adjacent shoulder to minimize pavement impact.
- Completing all VDOT-maintained road crossings via jack-and-bore installation methods.
- Installation of combination air valves at every intermediate high point.
- Installation of isolation valves at regularly spaced intervals along the pipe alignment to allow for main isolation in the event of a line break.
- Installation of pig launching and receiving stations on the 36-inch force main.

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Appendix A – Pump Manufacturer's Literature

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Pump Manufacturer's Literature – Gorman Rupp Pumps (Suction Lift)

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Basic Pump

Self Priming Centrifugal Pump

Model T10A3S-B

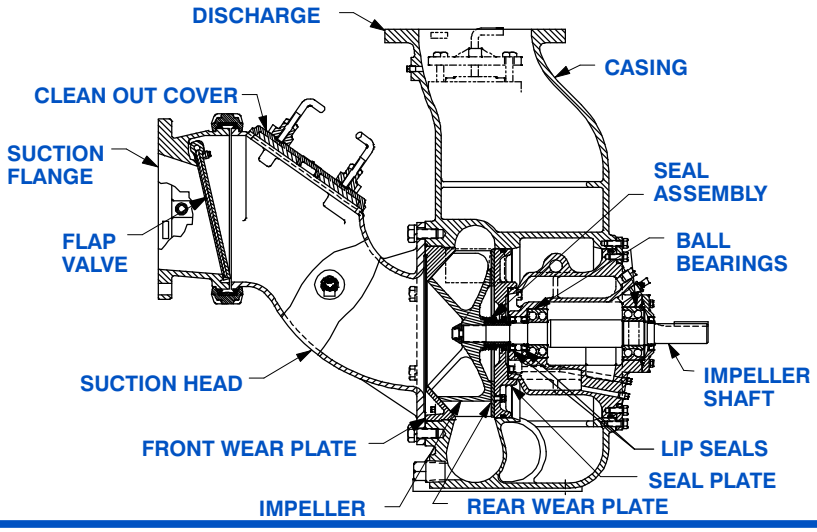
Size 10” x 10”

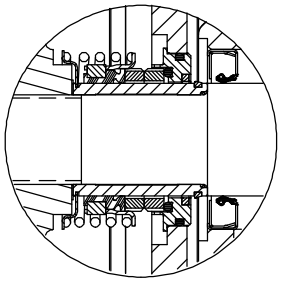
PUMP SPECIFICATIONS

Size: 10” x 10” (254 mm x 254 mm) Flanged.
Casing: Gray Iron 30.
Maximum Operating Pressure 99 psi (683 kPa).*
Semi-Open Type, Two Vane Impeller: Ductile Iron 65-45-12.
Handles 3” (76,2 mm) Diameter Spherical Solids.
Impeller Shaft: Stainless Steel 17-4 PH.
Shaft Sleeve: Alloy Steel 4130.
Replaceable Front Wear Plate: Ductile Iron 80-55-06.
Replaceable Rear Wear Plate: Carbon Steel 1026.
Removable Clean-out Cover Plate: Gray Iron 30; 9 lbs. (4 kg).
Flap Valve: Neoprene W/Steel Reinforcing.
Seal Plate: Gray Iron 30.
Bearing Housing: Gray Iron 30.
Radial and Thrust Bearings: Open Double Row Ball.
Bearing and Seal Cavity Lubrication: SAE 30 Non-Detergent Oil.
Suction Flange: Gray Iron 30.
Suction Head: Gray Iron 30.
Gaskets: Buna-N, PTFE, Cork, and Rubber.
O-Rings: Buna-N.
Hardware: Standard Plated Steel.
Brass Pressure Relief Valve.
Bearing and Seal Cavity Oil Level Sight Gauges.
Optional Equipment: Metal Bellows Seal. Automatic Air Release Valve. High Pump Temperature Shutdown Kit. 120V/240V Casing Heater. Continuous Vane Ductile Iron Impeller.
Gray Iron 30 Spool Flanges:
10” ASA Discharge.
250 mm DIN 2527 (PN 16) Suction and Discharge
(Specify Model T10A3S-B /FM).

Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.

Shown with Optional Discharge Spool Flange (Suction/Discharge Spool Flanges Available in ASA or DIN Standard Sizes).





SEAL DETAIL

Cartridge Type, Mechanical, Oil-Lubricated, Double Floating, Self-Aligning. Tungsten Titanium Carbide Rotating and Stationary Faces. Stainless Steel 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel 18-8 Cage and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).*

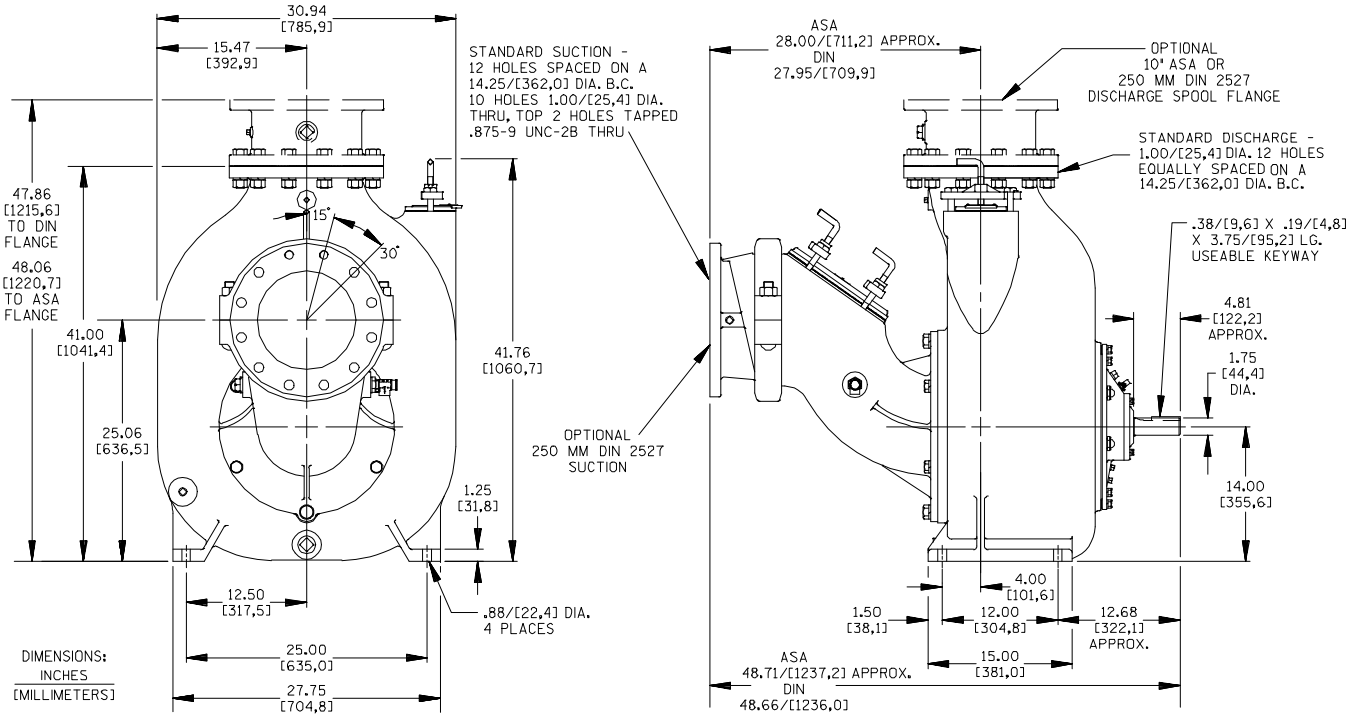
Specification Data

SECTION 55, PAGE 2400

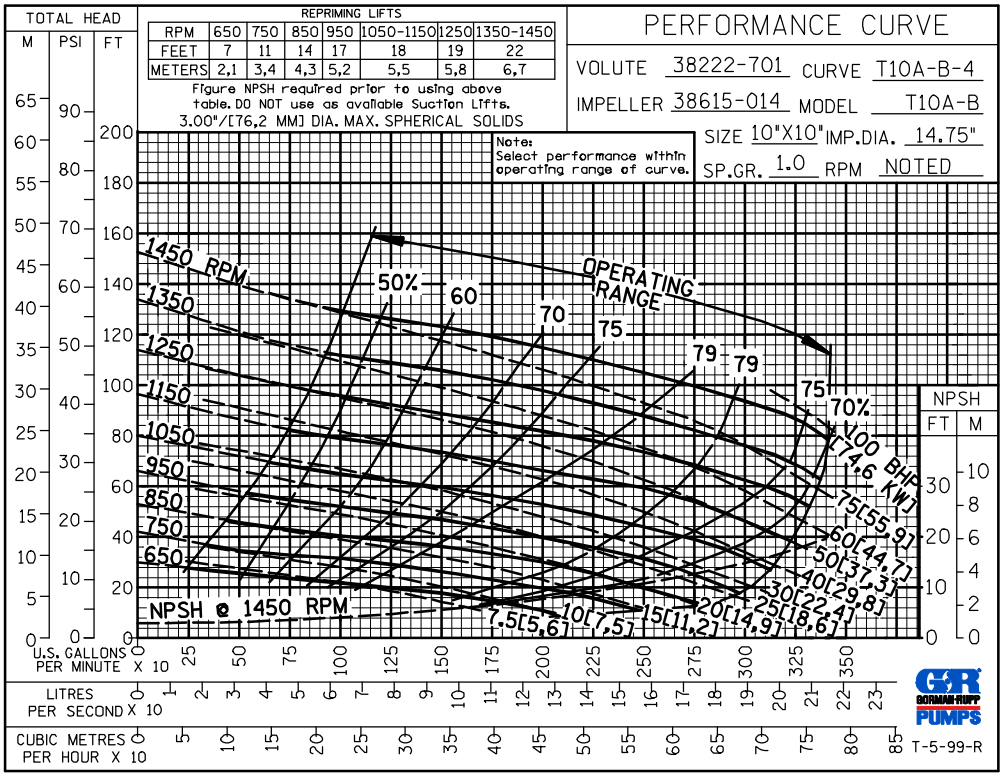
APPROXIMATE DIMENSIONS and WEIGHTS

NET WEIGHT:	**1440 LBS. (653 KG.)***
SHIPPING WEIGHT:	**1590 LBS. (721 KG.)***
EXPORT CRATE:	**70.3 CU. FT. (2 CU. M.)**

***ADD 71 LBS. (32,2 KG.) W/DISCH SPOOL FLANGE**



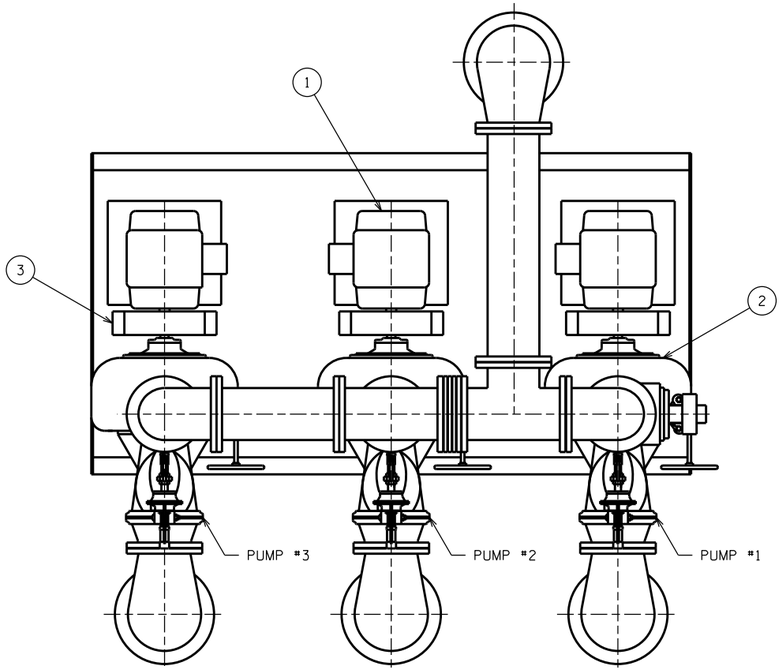
OPTIONAL ASA OR DIN STANDARD SPOOL FLANGES AVAILABLE



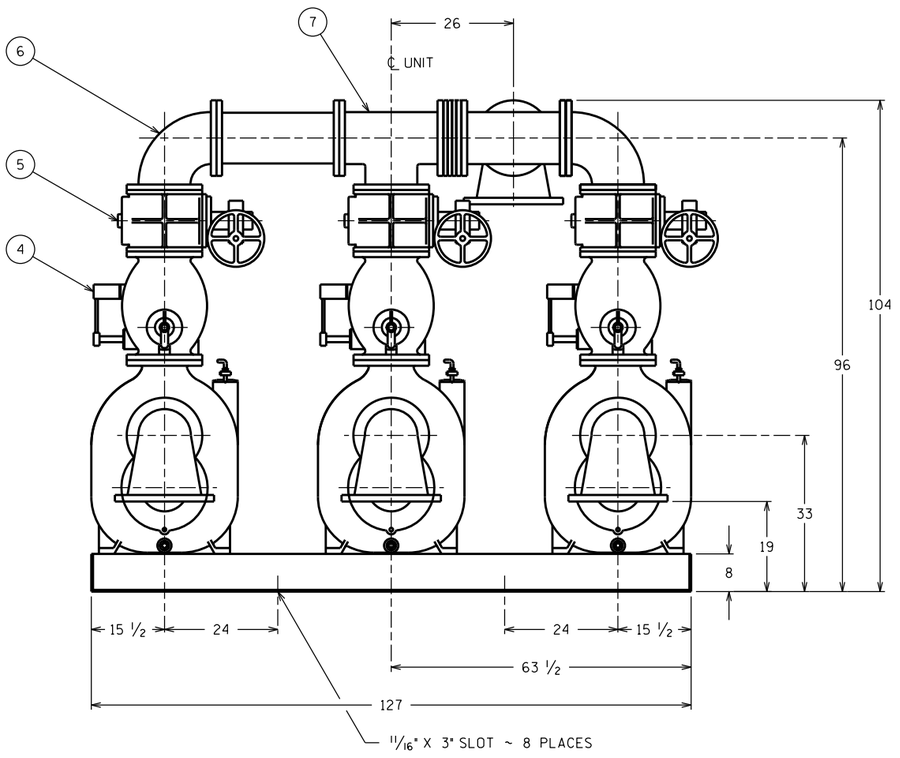
GORMAN-RUPP PUMPS

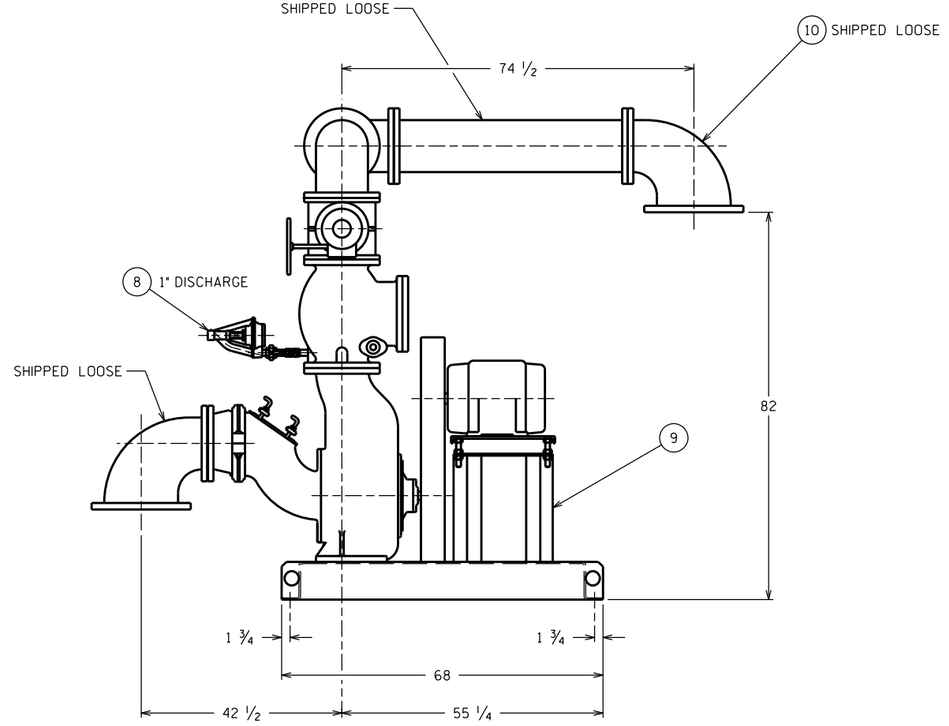
www.grpumps.com

REVISIONS				
SYM.	DATE	RECORD	DR.	CK.



ITEM	DESCRIPTION	MATERIAL & SIZE
1	MOTOR	CAST IRON
2	PUMP	CAST IRON T10A-B
3	BELT GUARD ASSY	STEEL
4	DISCHARGE CHECK VALVE	CAST IRON 10"
5	DISCHARGE PLUG VALVE	CAST IRON 10" W/HW
6	DISCHARGE ELBOW 90°	CAST IRON 10"
7	DISCHARGE TEE	CAST IRON 10"
8	AIR RELEASE VALVE	CAST IRON 1" (SHIPPED LOOSE)
9	PUMP & MOTOR BASE ASSY	STEEL
10	DISCHARGE ELBOW 90°	CAST IRON 14" X 10"





T10A-B, 14" X 10" X 14"
AS SHOWN

SAN BENITO WTP BACKWASH PUMP
SAN BENITO, TX
SERIAL NO. 16-3286-LE

163286LE.S01.DGN

GORMAN-RUPP	THE GORMAN-RUPP CO. MANSFIELD, OHIO ST. THOMAS, ONTARIO			
NAME: BASE MOUNTED TRIPLEX PUMP UNIT				
DRN. BM	CHK. PFB	APP. PFB	DATE 12-20-79	
D	46126-160		SERIAL NO. 16-3286-LE	

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Pump Manufacturer's Literature – Smith & Loveless Pumps (Suction Lift)

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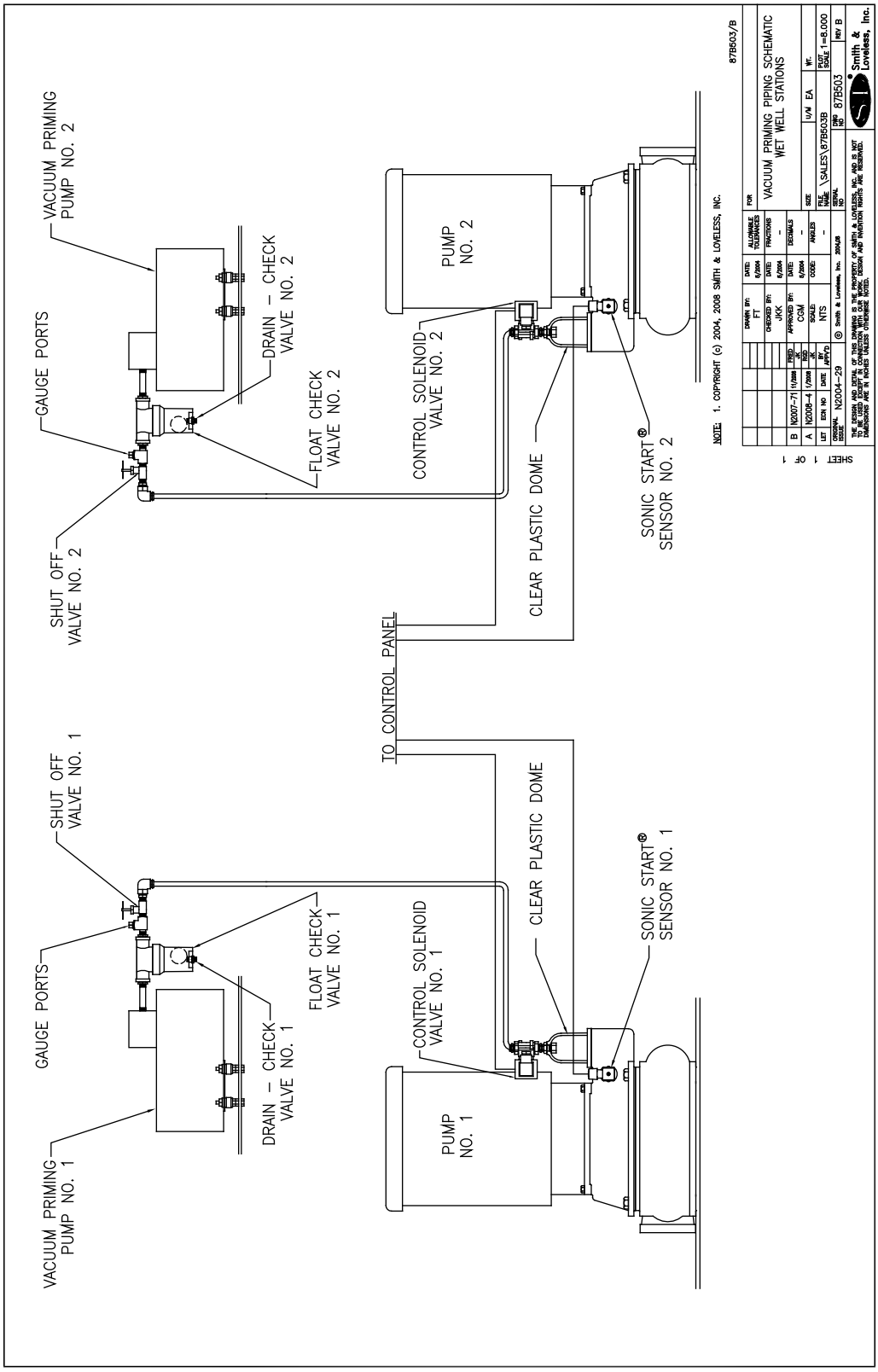
ENGINEERING DATA

Smith &
Loveless, Inc.®

14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

Vacuum Priming Diagram
Vacuum Primed Pump Station
Drawing 87B503
March, 2009

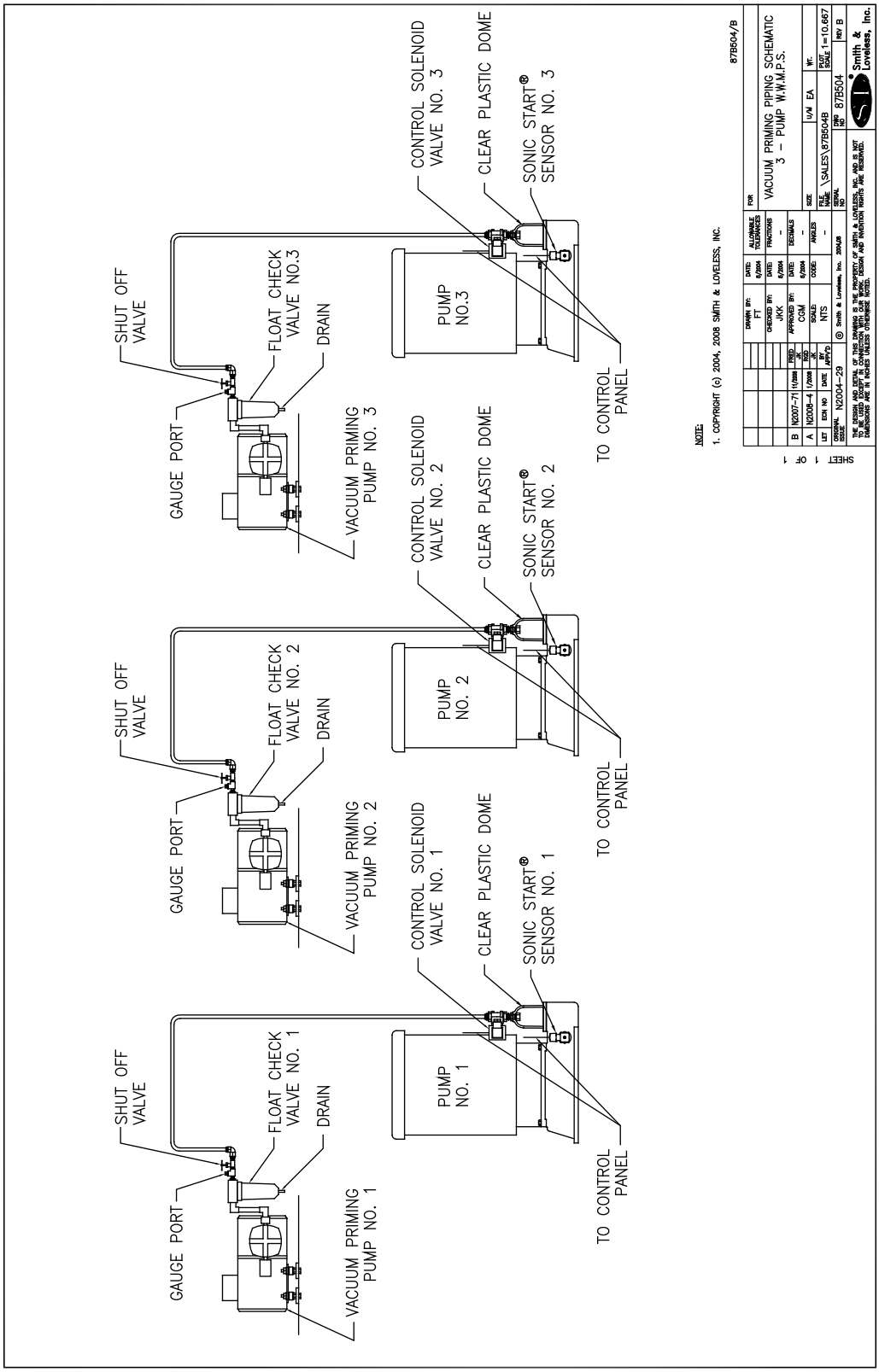


ENGINEERING DATA

Smith &
Loveless, Inc.®

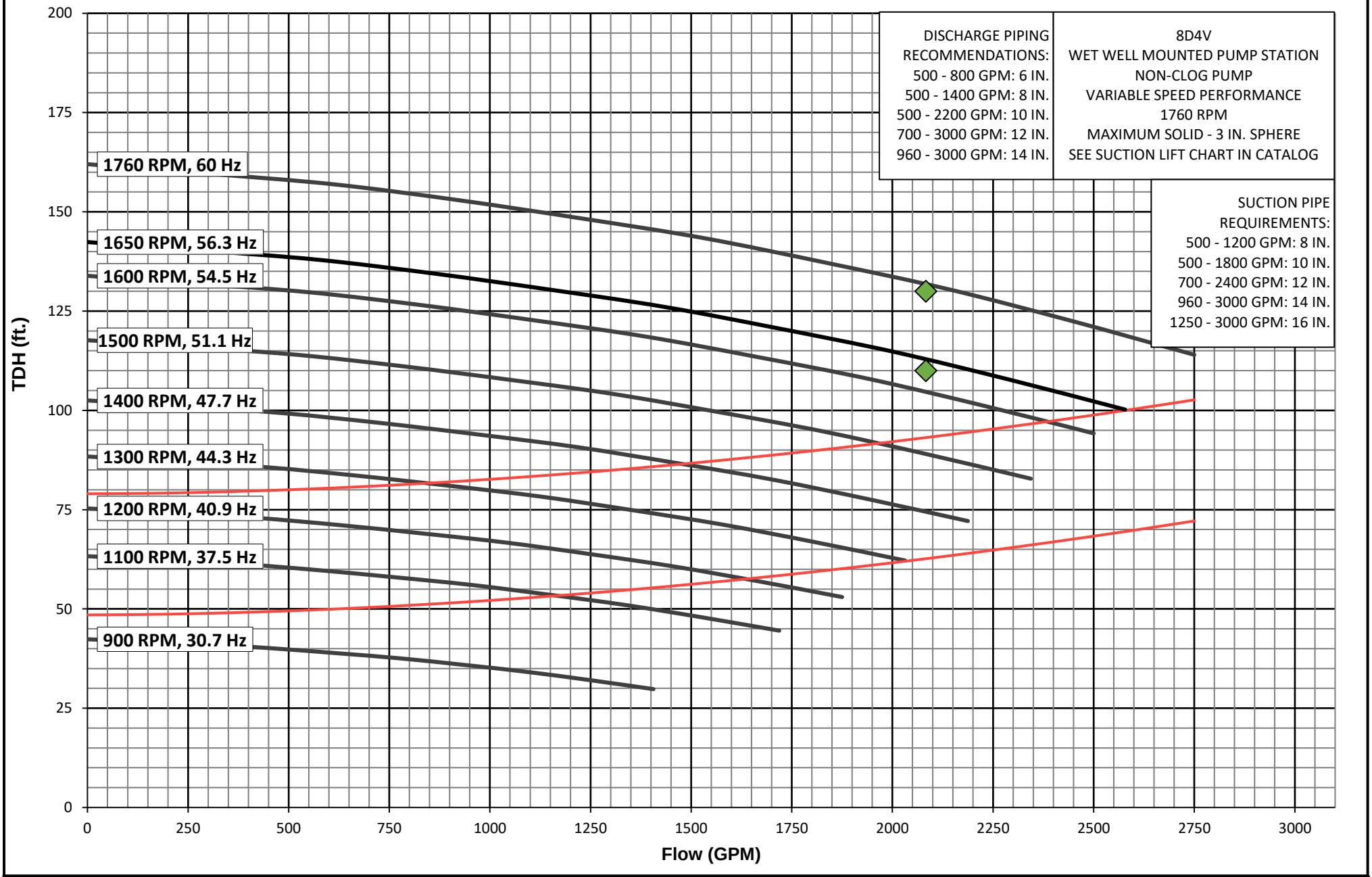
14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

Vacuum Priming Diagram
Vacuum Primed Pump Station
Drawing 87B504
March, 2009



Pump Curve

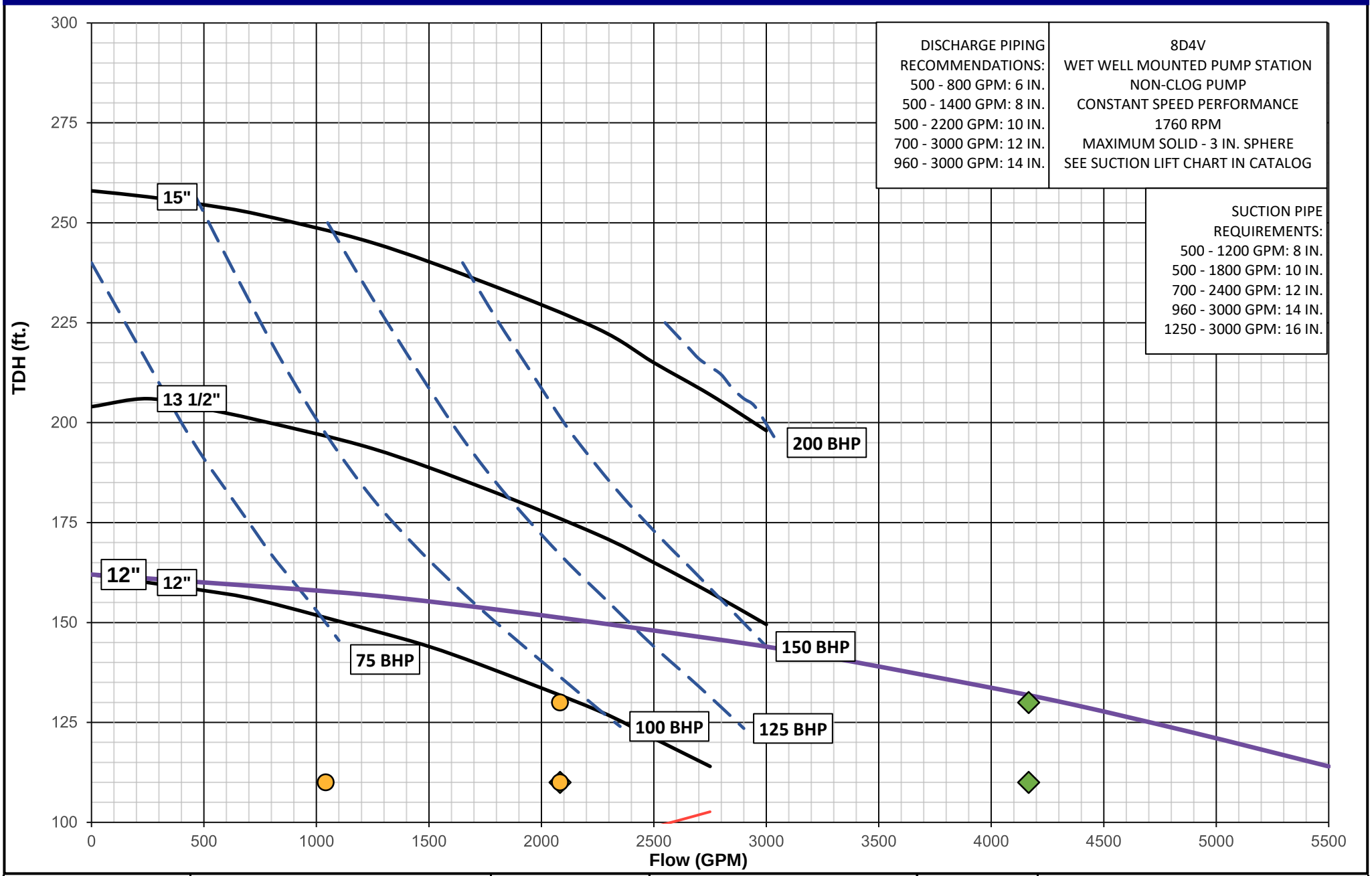
Smith & Loveless Inc.®



Location:		Design Point:	2083 GPM @ 130 ft.	Pump Model:	, 1760 RPM
Project Name:	Deep Run	Impeller Trim:	12 Inches	HP & Efficiency:	See Curve HP & 71.3%

Pump Curve

Smith & Loveless Inc.



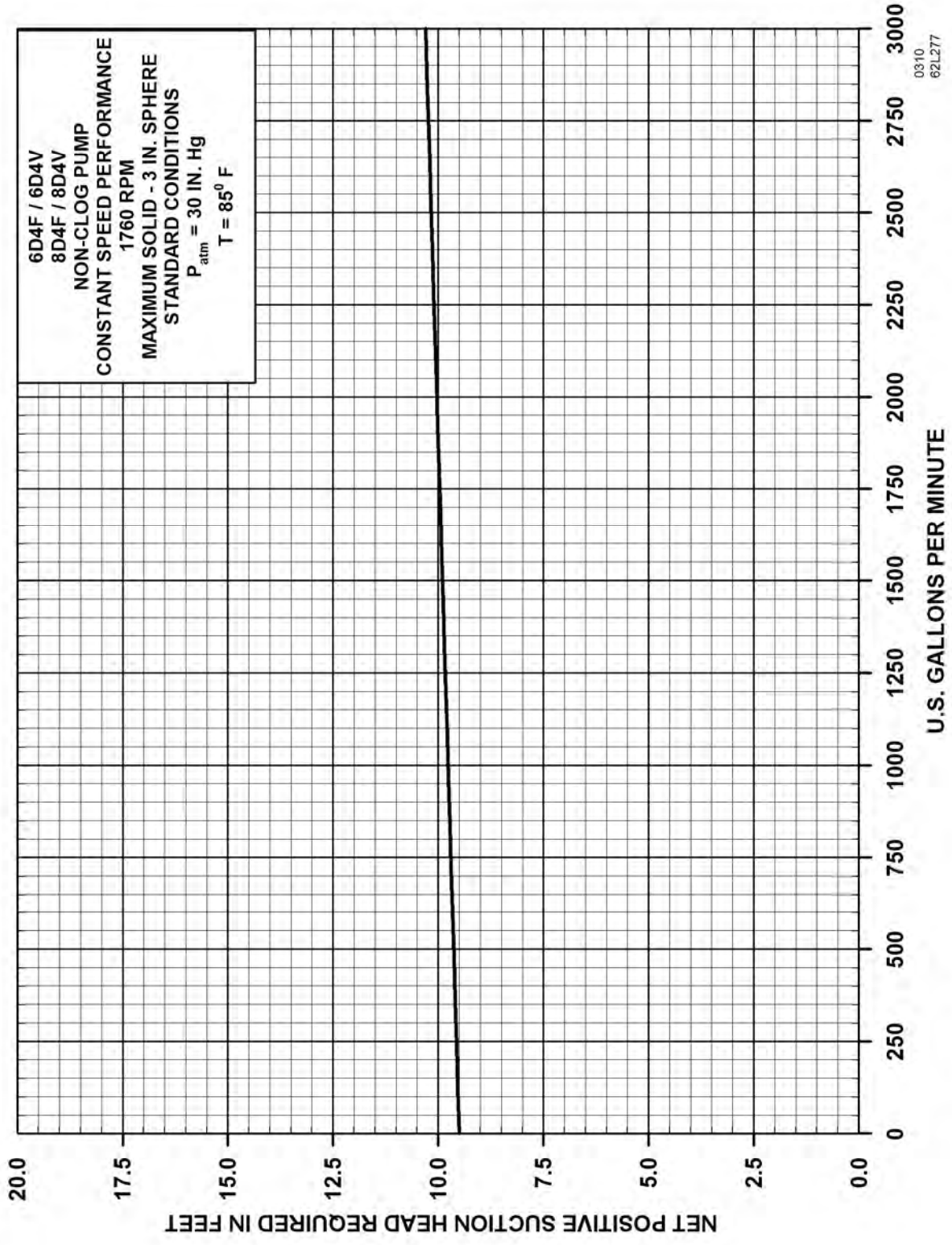
Location:		Design Point:	2083 GPM @ 130 ft.	Pump Model:	8D4V, 1760 RPM
Project Name:	Deep Run	Impeller Trim:	12 Inches	HP & Efficiency:	See Curve HP & 71.3%

ENGINEERING DATA

Smith &
Loveless, Inc.®

14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

NPSHR Curve
Non-Clog Pump
6D4F / 6D4V
8D4F / 8D4V – 1760 RPM
January, 2012



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Appendix B – City IPS/FMC/DR FM Manifold

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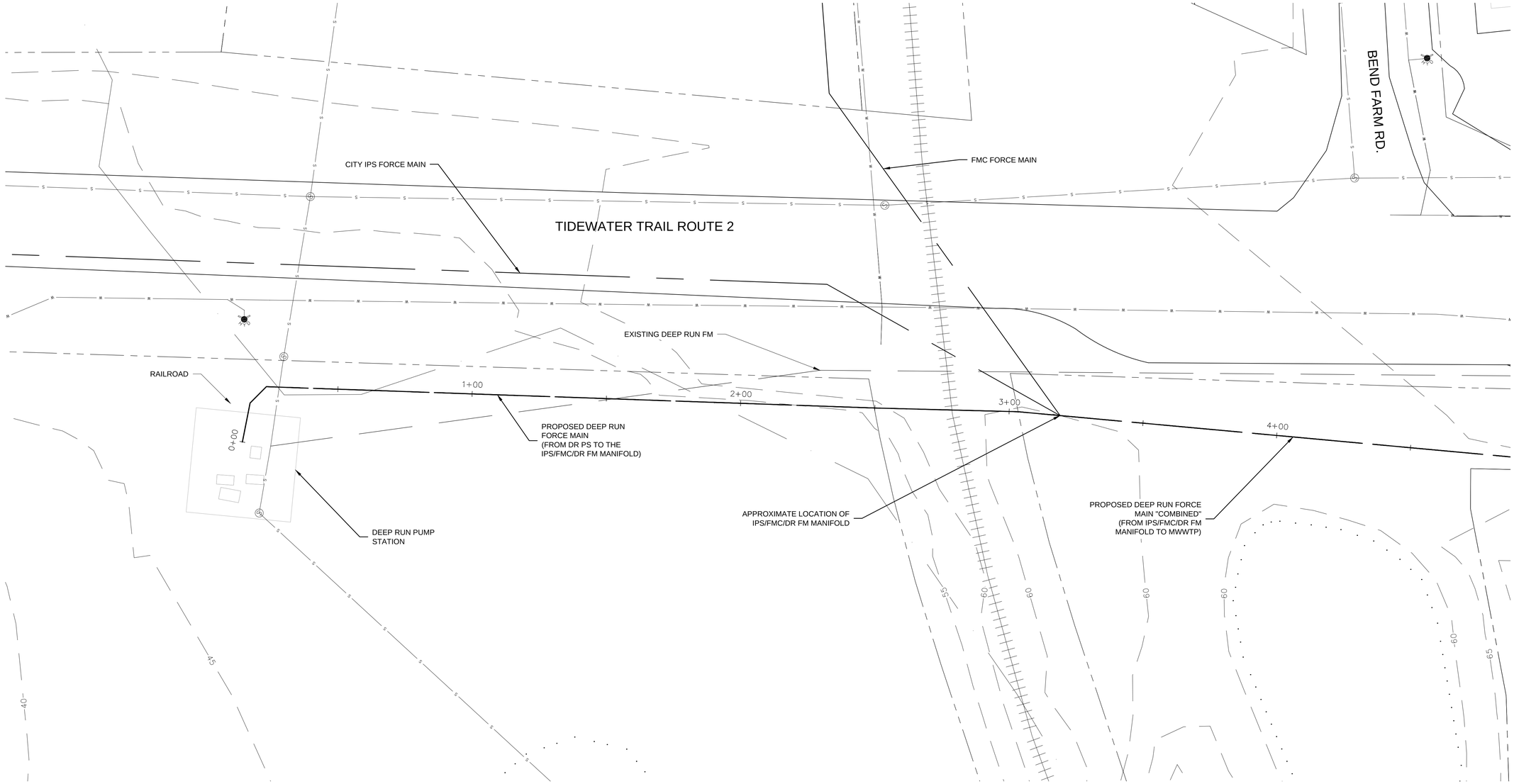

PLAN

1" = 20' 20' 0 20'

PRELIMINARY
NOT FOR CONSTRUCTION
DATE: JAN. 2020

CLIENT
SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

NO.	DATE	REVISION	INT.
B	FEBRUARY 2020	FINAL PER SUBMITTAL	WJM
A	JANUARY 2020	DRAFT PER SUBMITTAL	WJM

DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
W. MEINERT
DESIGNED BY
D. SIMMONS
CHECKED BY
M. WIMMER
DRAWN BY
D. SIMMONS
FILE NO.
5842.73802
DATE
JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
CITY IPS/FMC/DR FM MANIFOLD
DRAWING LOCATION
TIDEWATER TRAIL (ROUTE 2)

FIG. 1

I:\SPOTSYLVANIA-CO.5842\73802.DEEP-RUN-PS-PER\DOCS\DWG\SHEETS\5842.73802-PER01.DWG

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Appendix C – FEMA Firm Map

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Coastal base flood elevations apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD), and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of special flood hazard (100-year flood) include Zones A, AE, AH, AO, A99, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

For adjoining map panels see separately printed Map Index.

NOTE: The coordinate system used for the production of this Flood Insurance Rate Map (FIRM) is Universal Transverse Mercator (UTM), North American Datum of 1927 (NAD27), Clarke 1866 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the Universal Transverse Mercator projection, NAD27. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of the information shown on the FIRM.

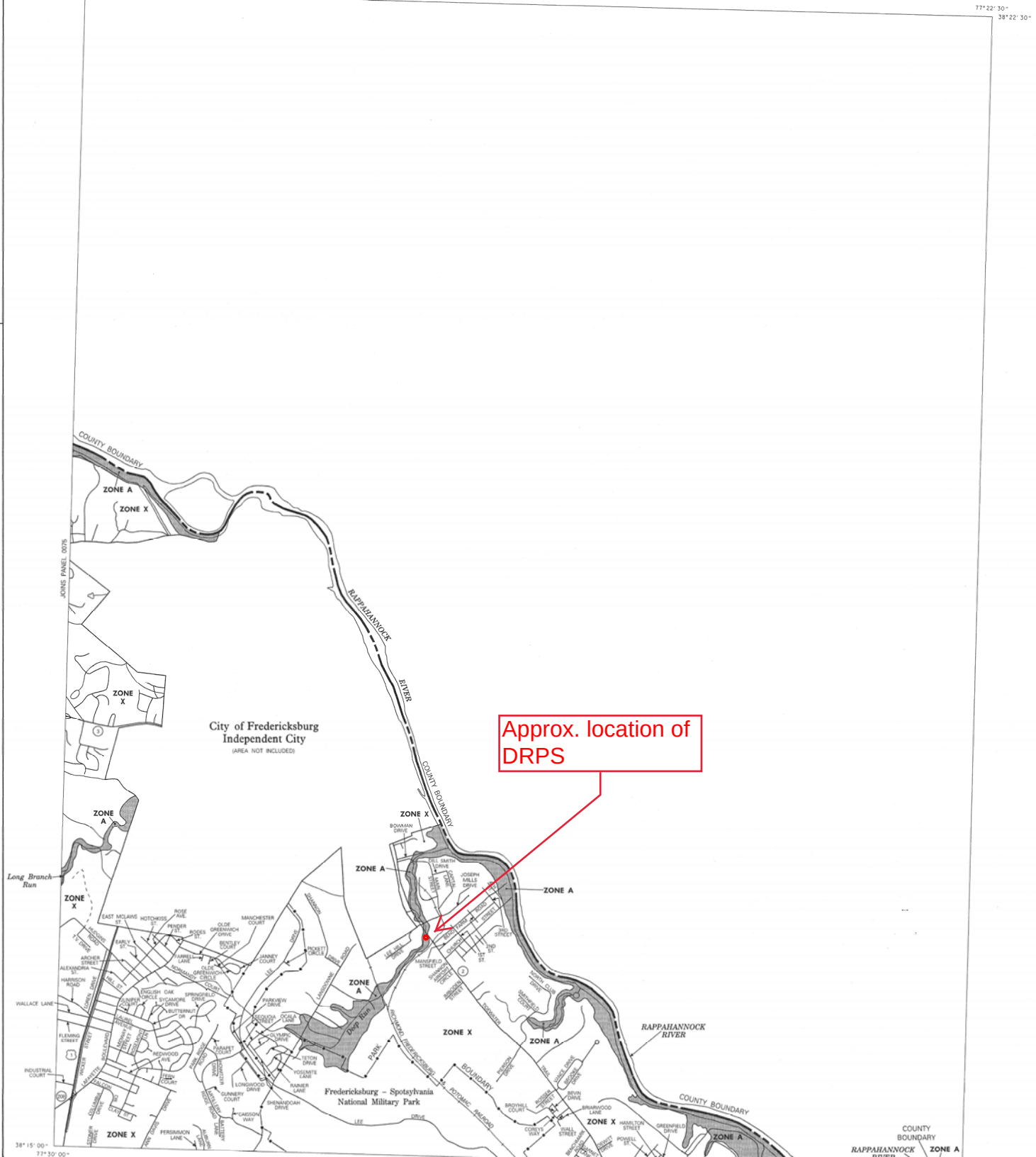
ATTENTION: Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, contact the National Geodetic Survey at the following address:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

BASE MAP SOURCE: Planimetric base map files were provided by Spotsylvania County. These files were derived from Spotsylvania County Tax Maps and U.S. Geological Survey 1:24,000 scale quadrangles. Additional information may have been derived from other sources. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

77° 22' 30"
38° 22' 30"

38° 15' 00"
77° 30' 00"



ZONE AE — Base flood elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 — To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.

ZONE V — Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X — Areas determined to be outside 500-year floodplain.

ZONE D — Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS*

Identified 1983 | Identified 1990 or Later | Otherwise Protected Areas Identified 1991 or Later

*Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet**

A — A — Cross Section Line

(EL. 987) — Base Flood Elevation in Feet Where Uniform Within Zone**

RM7 — Elevation Reference Mark

M1.5 — River Mile

**Referenced to the National Geodetic Vertical Datum of 1929

MAP REPOSITORY
Spotsylvania Environmental Engineering Office, 9104 Courthouse Road, Spotsylvania, Virginia 22553 (Maps available for reference only, not for distribution.)

INITIAL IDENTIFICATION:
JULY 11, 1975

FLOOD HAZARD BOUNDARY MAP REVISIONS:
APRIL 16, 1982

FLOOD INSURANCE RATE MAP EFFECTIVE:
DECEMBER 1, 1987

FLOOD INSURANCE RATE MAP REVISIONS:
February 18, 1998 – to change special flood hazard areas and to update map format.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE
2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SPOTSYLVANIA COUNTY, VIRGINIA
(UNINCORPORATED AREAS)

PANEL 100 OF 375
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY - PANEL NUMBER
510308 0100 C

MAP REVISED:

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Appendix D – Preliminary Pump Station and Force Main Plans

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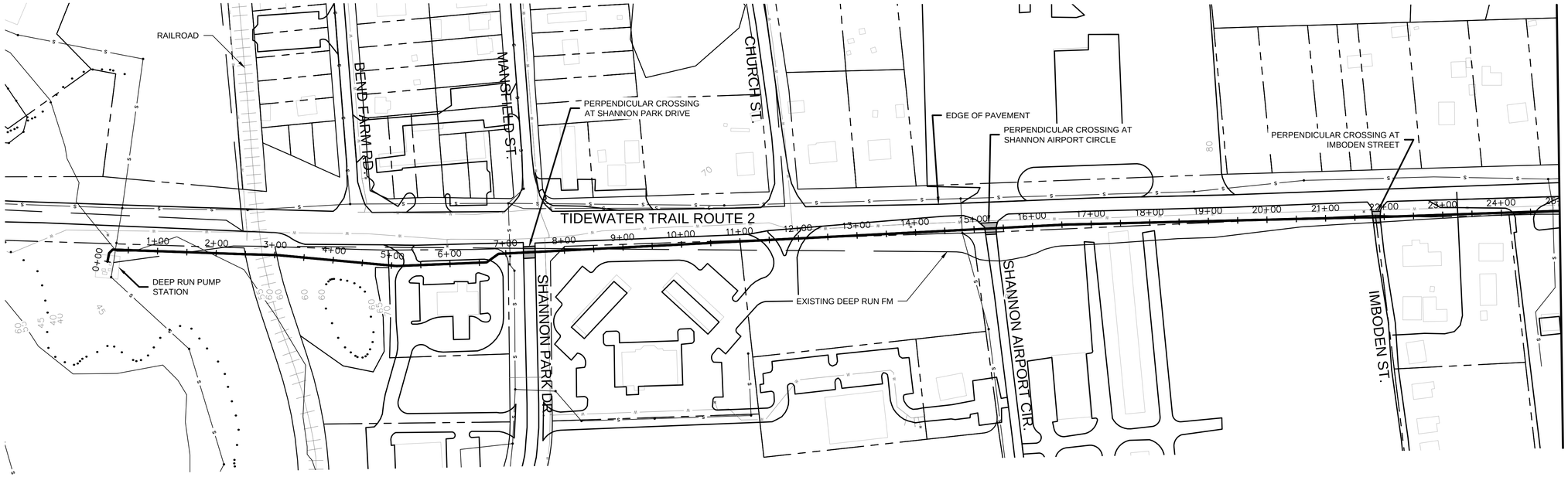
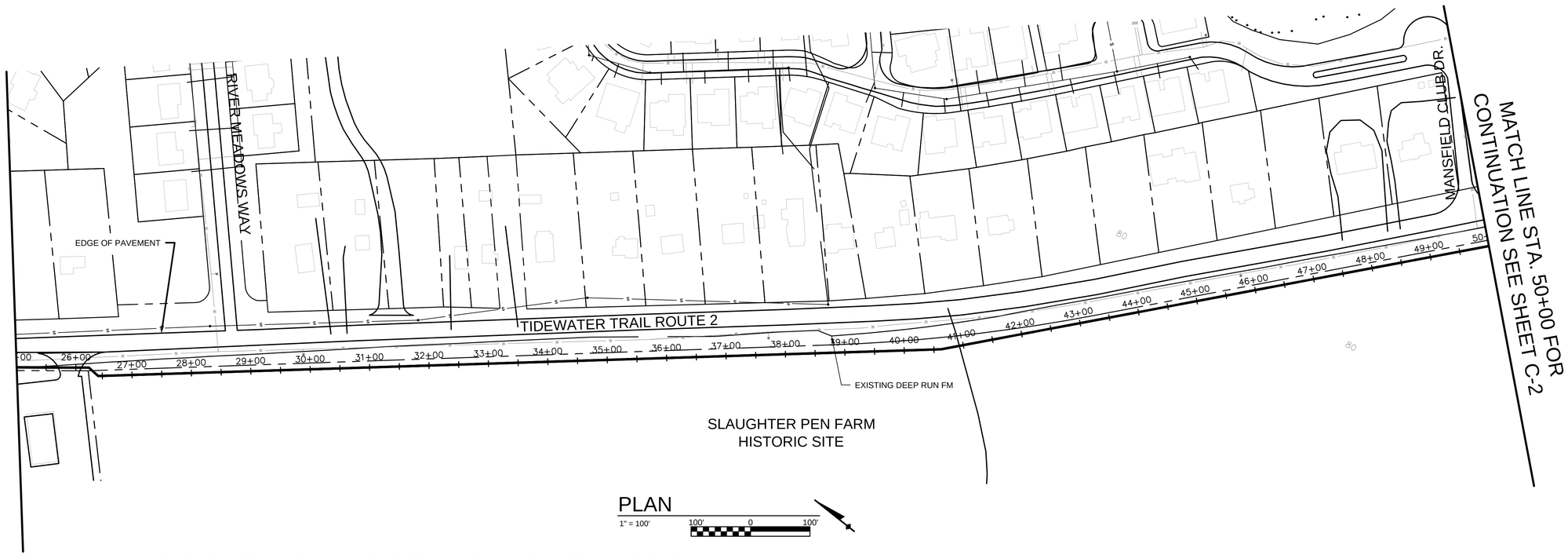
PLAN NOTES:

1. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



PLAN
1" = 100'
100' 0 100'



PLAN
1" = 100'
100' 0 100'

PRELIMINARY
NOT FOR CONSTRUCTION
DATE: JAN. 2020

CLIENT
SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

NO.	DATE	REVISION	INT.
B	FEBRUARY 2020	FINAL PER SUBMITTAL	WJM
A	JANUARY 2020	DRAFT PER SUBMITTAL	WJM

DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
W. MEINERT
DESIGNED BY D. SIMMONS
CHECKED BY M. WIMMER
DRAWN BY D. SIMMONS
FILE NO. 5842.73802
DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
FORCE MAIN ALIGNMENT 1 PLAN 1
DRAWING LOCATION
STA. 0+00 TO STA. 50+00

C-1

I:\SPOTSYLVANIA-CO.5842\73802.DEEP-RUN-PS-PER\DOCS\DWG\SHEETS\5842.73802-F01.DWG

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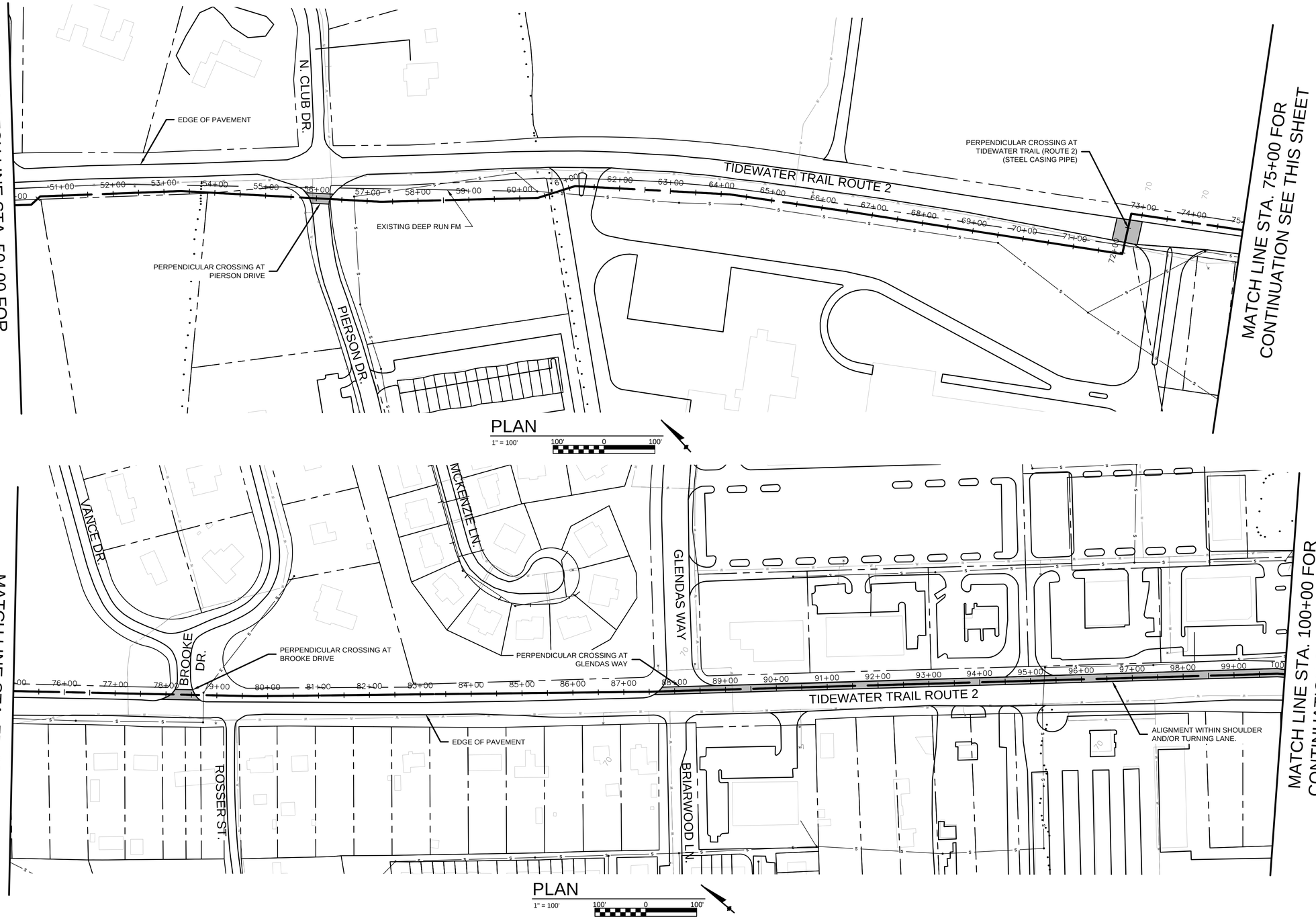
PLAN NOTES:

1. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



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D. SIMMONS
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M. WIMMER
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D. SIMMONS
FILE NO.
5842.73802
DATE
JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
FORCE MAIN ALIGNMENT 1 PLAN 2
DRAWING LOCATION
STA. 50+00 TO STA. 100+00

C-2

I:\SPOTSYLVANIA-CO.\5842\73802.DEEP-RUN-PS-PER\DOCS\DWG\SHEETS\5842.73802-F02.DWG

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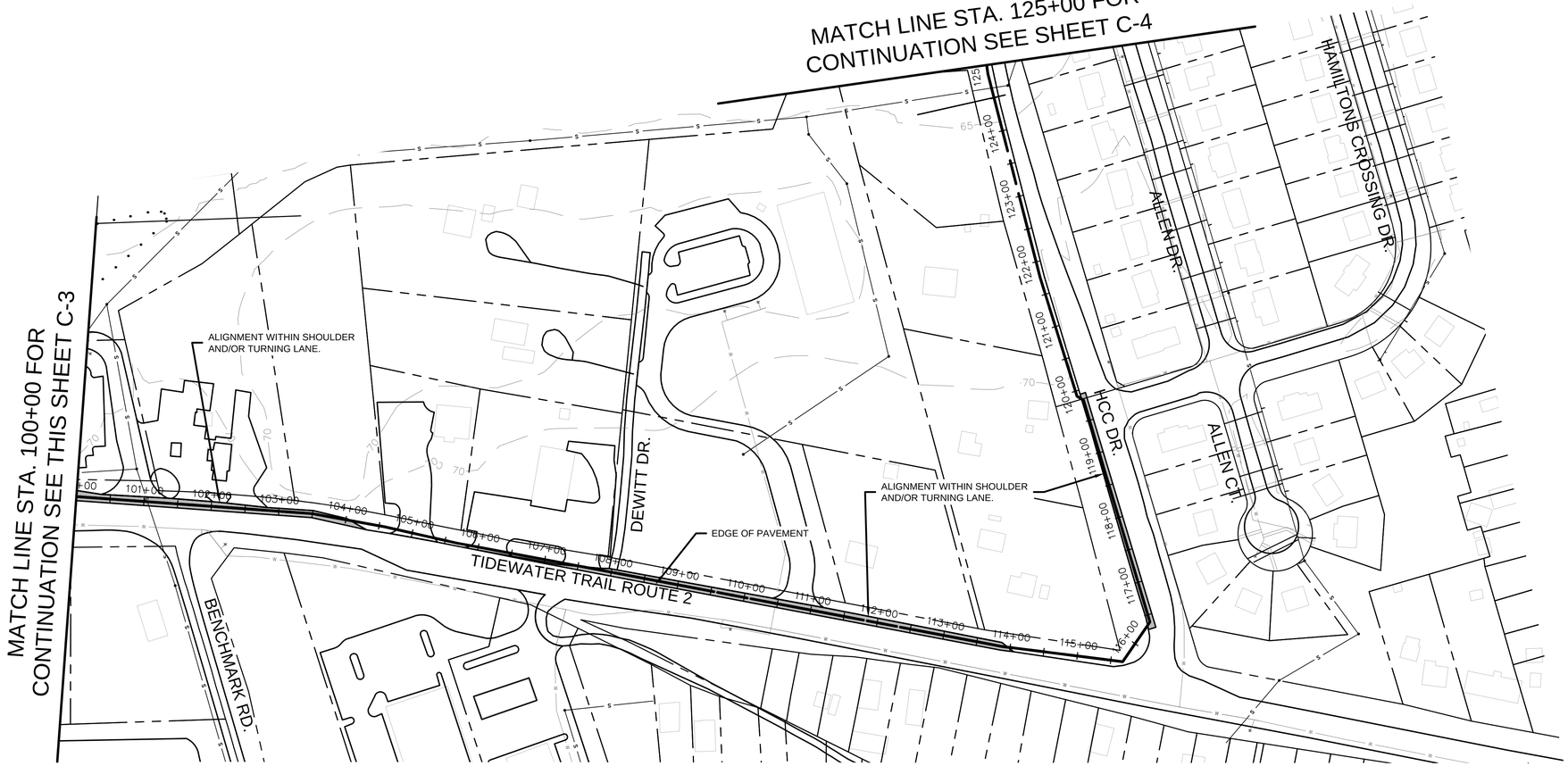
PLAN NOTES:

1. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



PLAN

1" = 100'

100' 0 100'

PRELIMINARY
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CONSTRUCTION

DATE: JAN. 2020

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A	JANUARY 2020	DRAFT PER SUBMITTAL	WJM

DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
W. MEINERT

DESIGNED BY D. SIMMONS
CHECKED BY M. WIMMER
DRAWN BY D. SIMMONS
FILE NO. 5842.73802
DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
FORCE MAIN ALIGNMENT 1 PLAN 3
DRAWING LOCATION
STA. 100+00 TO STA. 125+00

C-3

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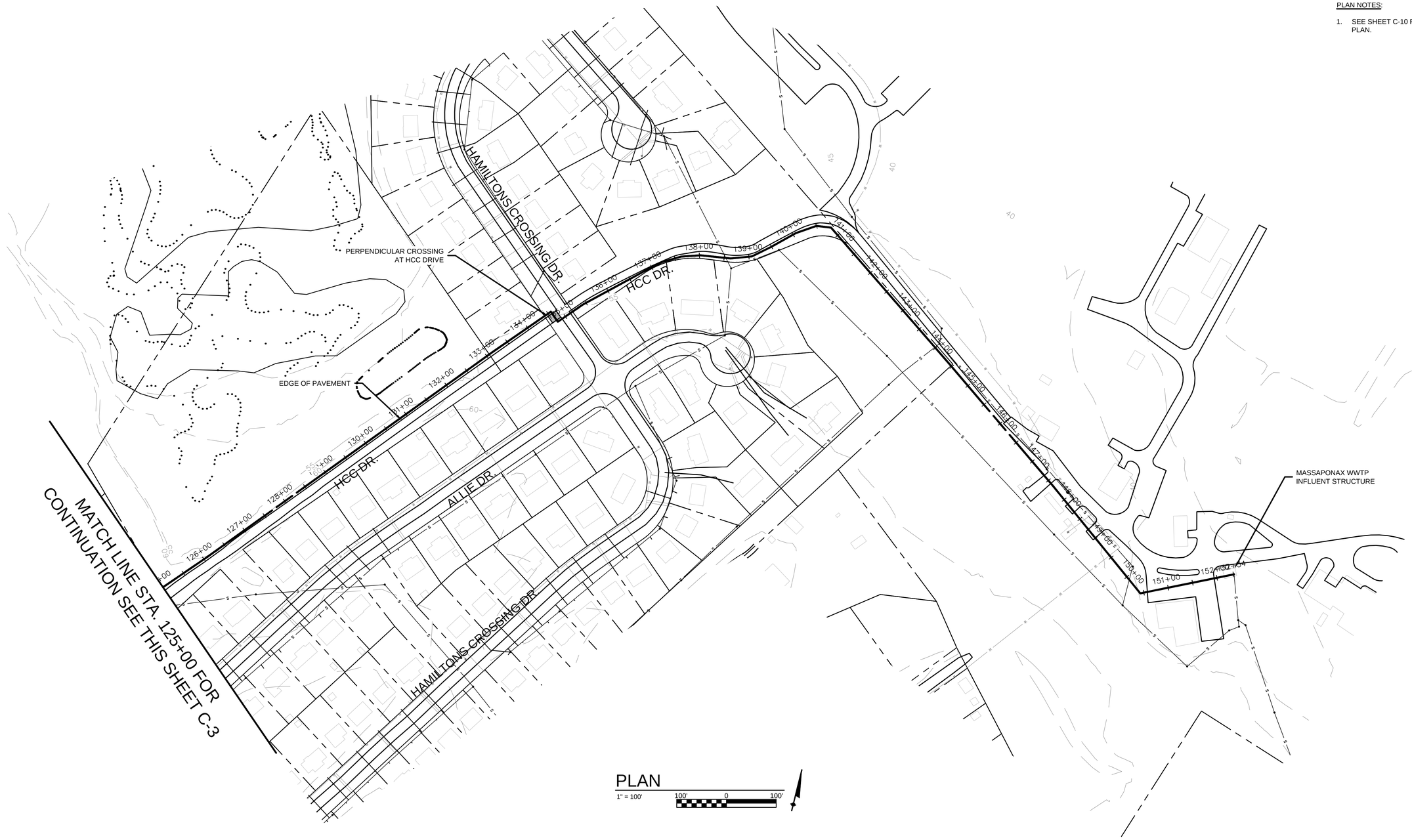
PLAN NOTES:

1. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



PLAN
1" = 100' 100' 0 100'

PRELIMINARY
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DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
W. MEINERT
DESIGNED BY D. SIMMONS
CHECKED BY M. WIMMER
DRAWN BY D. SIMMONS
FILE NO. 5842.73802
DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
FORCE MAIN ALIGNMENT 1 PLAN 4
DRAWING LOCATION
STA. 125+00 TO STA. 151+27

C-4

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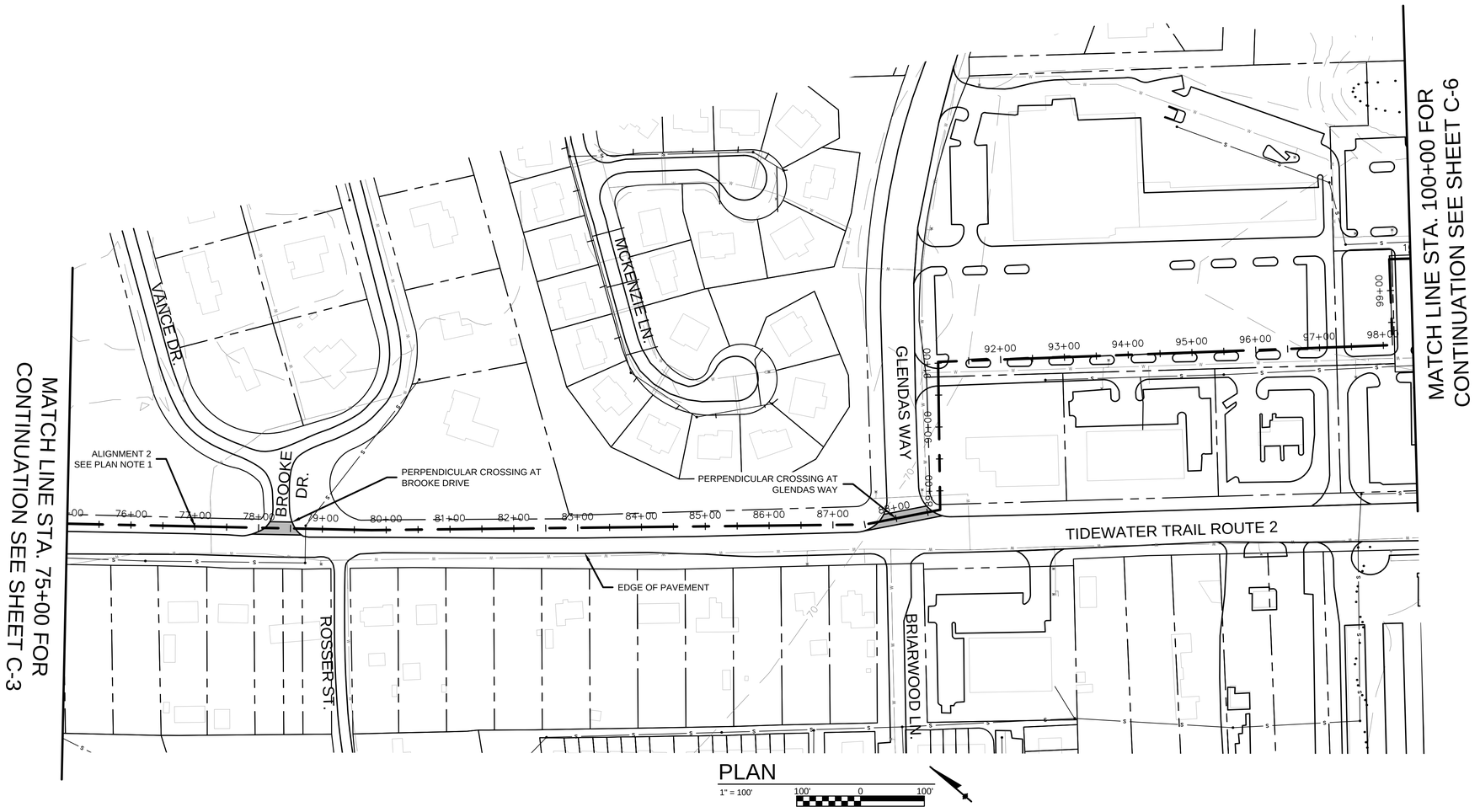
PLAN NOTES:

1. FROM STA. 0+00 TO STA. 87+50, ALIGNMENT 1 AND ALIGNMENT 2 ARE THE SAME. SEE SHEETS C-1 THROUGH C-3.
2. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



PLAN

1" = 100'

100' 0 100'

PRELIMINARY
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DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
W. MEINERT

DESIGNED BY D. SIMMONS
CHECKED BY M. WIMMER
DRAWN BY D. SIMMONS
FILE NO. 5842.73802
DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
FORCE MAIN ALIGNMENT 2 PLAN 1
DRAWING LOCATION
STA. 75+00 TO STA. 100+00

C-5

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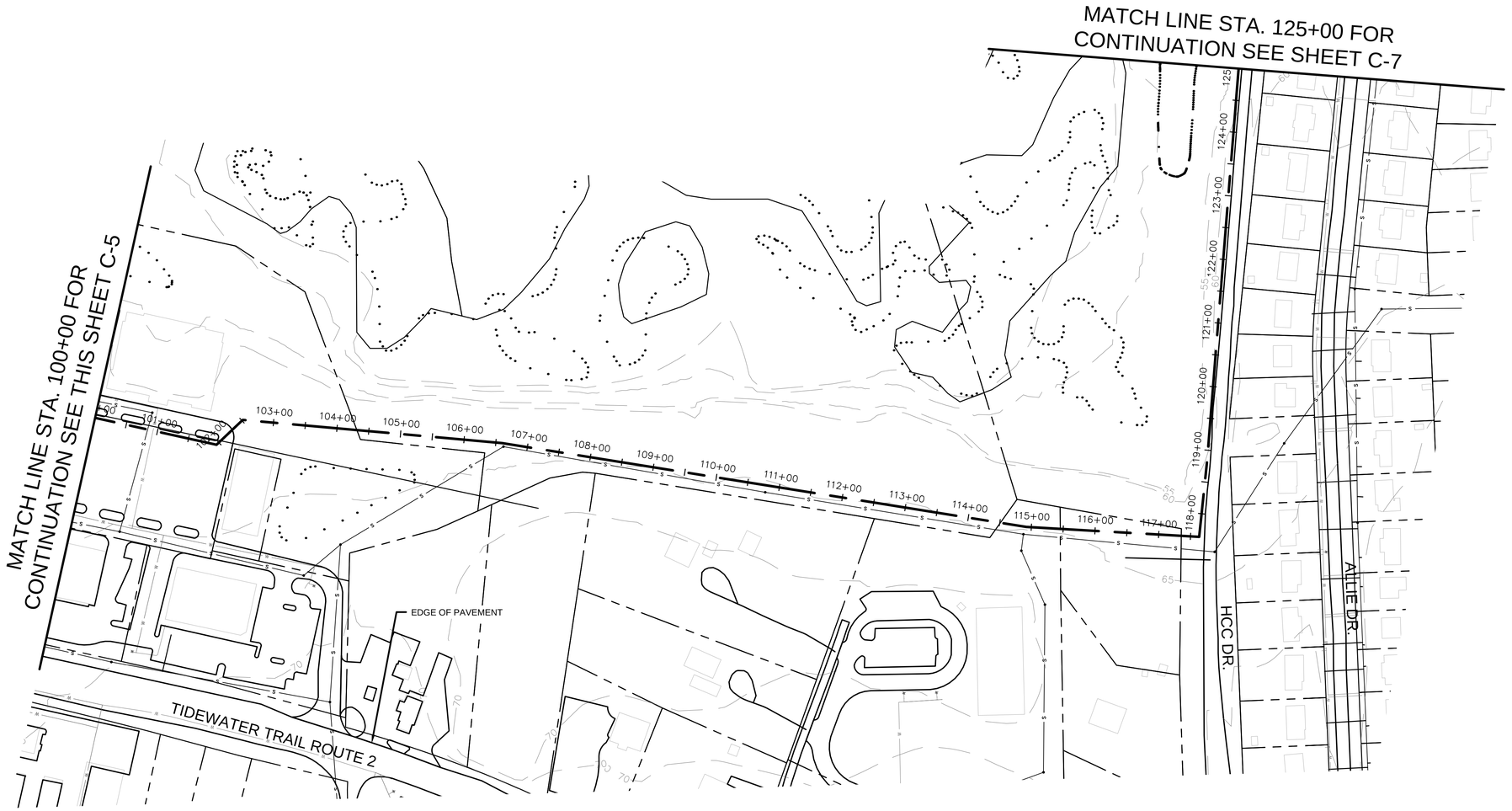
PLAN NOTES:

1. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



PLAN
1" = 100'
100' 0 100'

PRELIMINARY
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CONSTRUCTION
DATE: JAN. 2020

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A	JANUARY 2020	DRAFT PER SUBMITTAL	WJM

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W. MEINERT
DESIGNED BY D. SIMMONS
CHECKED BY M. WIMMER
DRAWN BY D. SIMMONS
FILE NO. 5842.73802
DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

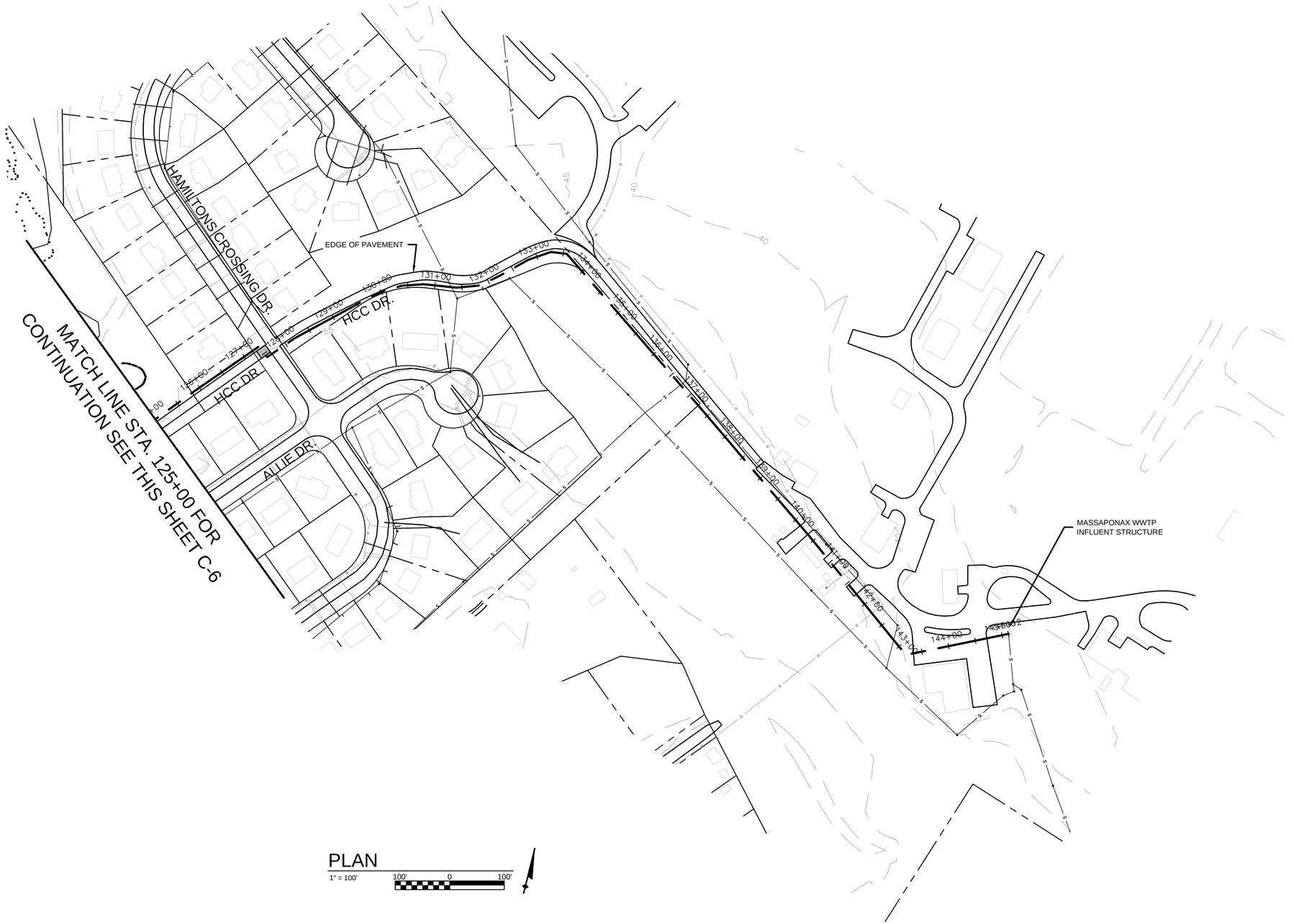
SHEET DESCRIPTION
FORCE MAIN ALIGNMENT 2 PLAN 2
DRAWING LOCATION
STA. 100+00 TO STA. 125+00

C-6

I:\SPOTSYLVANIA-CO.5842\73802.DEEP-RUN-PS-PER\DOCS\DWG\SHEETS\5842.73802-F06.DWG

PLAN NOTES:

1. SEE SHEET C-10 FOR PROPOSED DEEP RUN PUMP STATION PLAN.



PLAN

1" = 100' 100' 0 100'

PRELIMINARY
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DATE: JAN. 2020

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SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

NO.	DATE	REVISION	INT.
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A	JANUARY 2020	DRAFT PER SUBMITTAL	WJM

DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
W. MEINERT

DESIGNED BY D. SIMMONS
CHECKED BY M. WIMMER
DRAWN BY D. SIMMONS
FILE NO. 5842.73802
DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
FORCE MAIN ALIGNMNET 2 PLAN 3
DRAWING LOCATION
STA. 125+00 TO STA. 145+02

C-7

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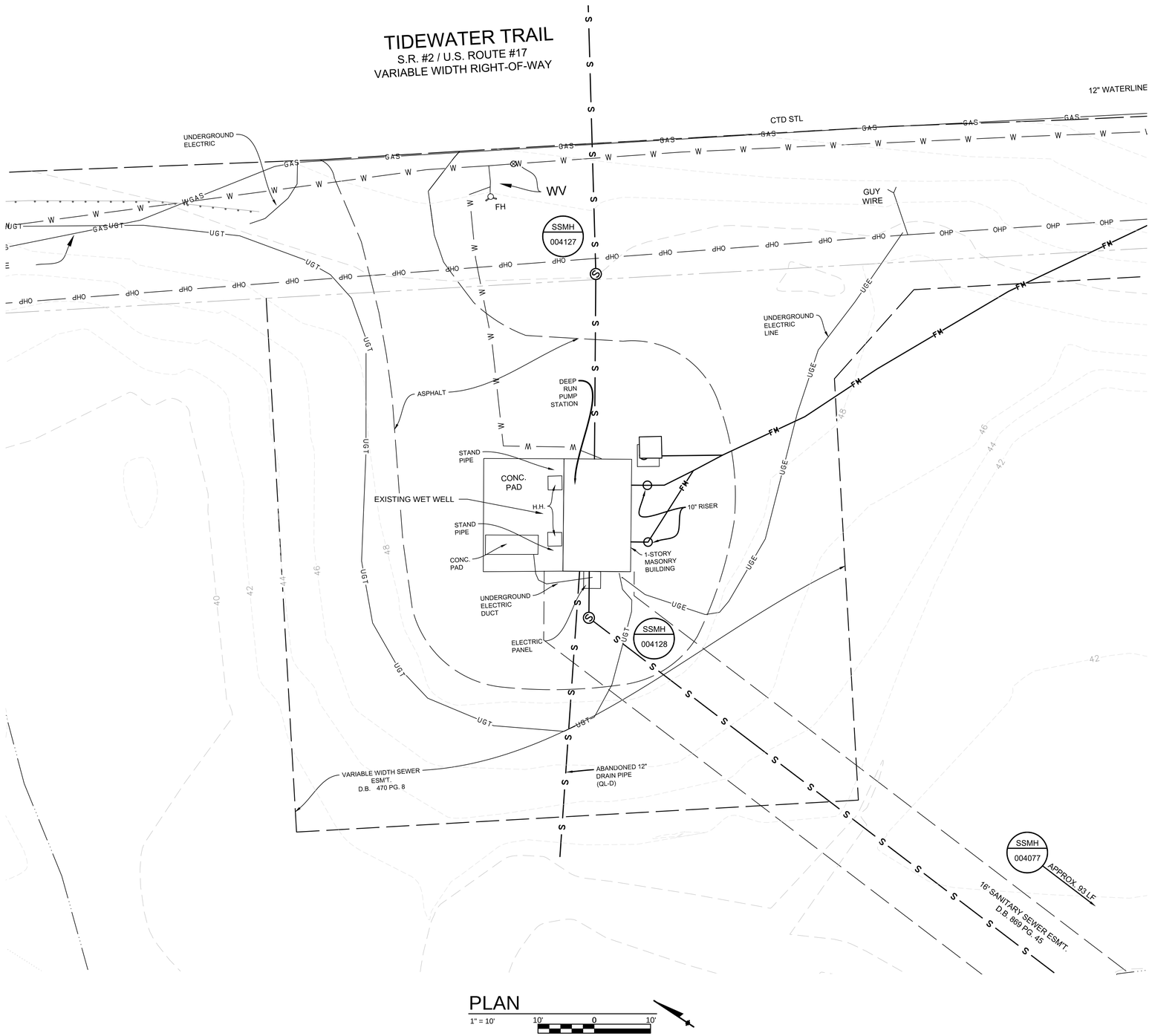
TIDEWATER TRAIL
S.R. #2 / U.S. ROUTE #17
VARIABLE WIDTH RIGHT-OF-WAY



PLAN NOTES:

1. SEE SHEET C-9 FOR DEMO PLAN.
2. SEE SHEET C-10 FOR PROPOSED SITE PLAN.
3. SEE SHEET C-11 FOR PS DETAILS AND PROFILES

SSMH 004127 — RIM = 50.07'
INV. IN = 40.63' (8")
INV. OUT = 40.56' (8")

SSMH 004128 — RIM = 48.84'
INV. IN = 36.93' (12")
INV. OUT = 36.80' (18")

SSMH 004077 — RIM = 44.15'
INV. IN = 39.01' (12")
INV. OUT = 38.05' (12")

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DATE: JAN. 2020

PLAN
1" = 10'

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DATE JAN. 2020

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
EXISING SITE PLAN
DRAWING LOCATION

C-8

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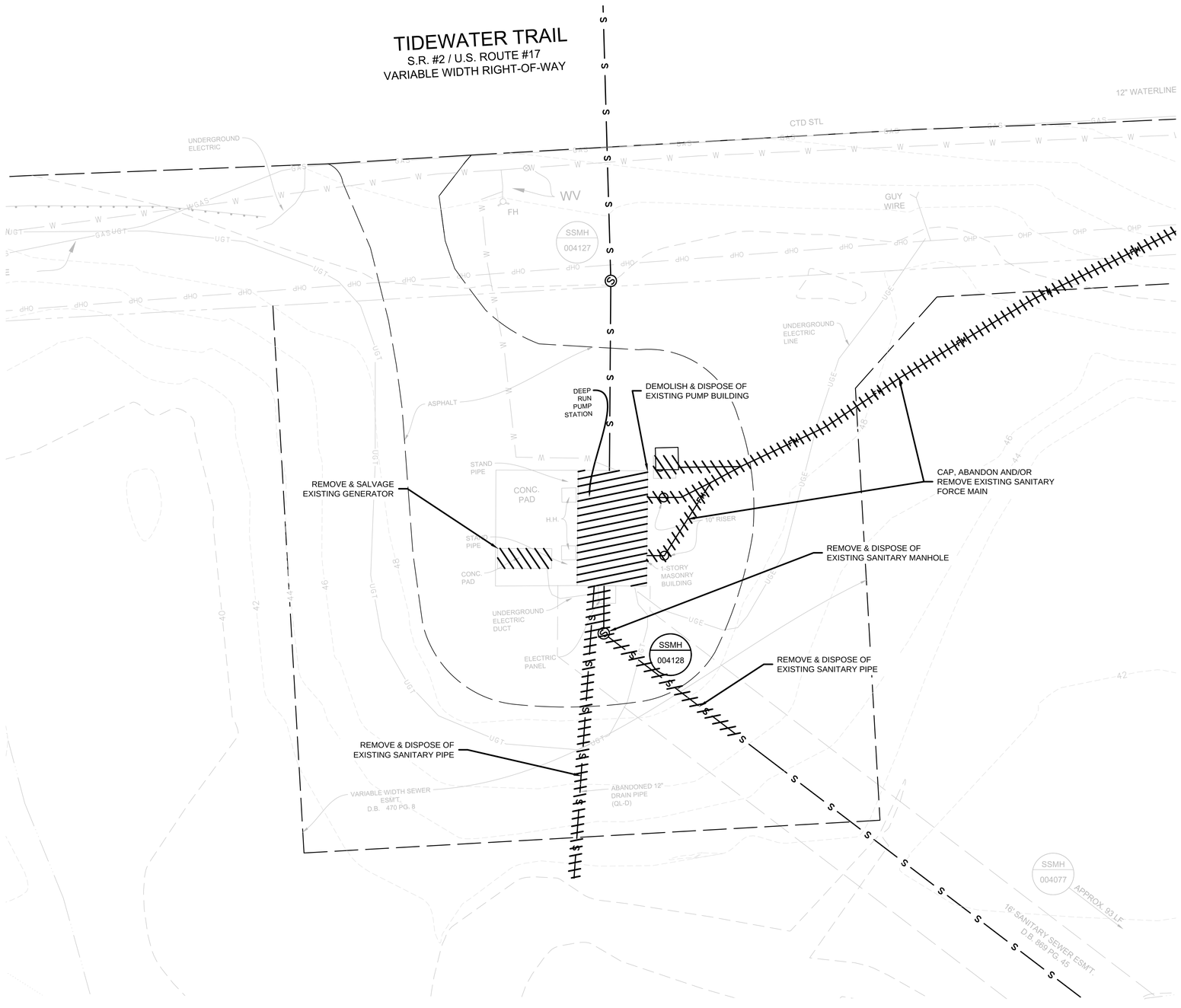
PLAN NOTES:

1. SEE SHEET C-8 FOR EXISTING SITE PLAN.
2. SEE SHEET C-10 FOR PROPOSED SITE PLAN.



PLAN
1" = 10'

10' 0 10'

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: JAN. 2020

CLIENT
SPOTSYLVANIA COUNTY
DEPT. OF UTILITIES /
PUBLIC WORKS

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A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

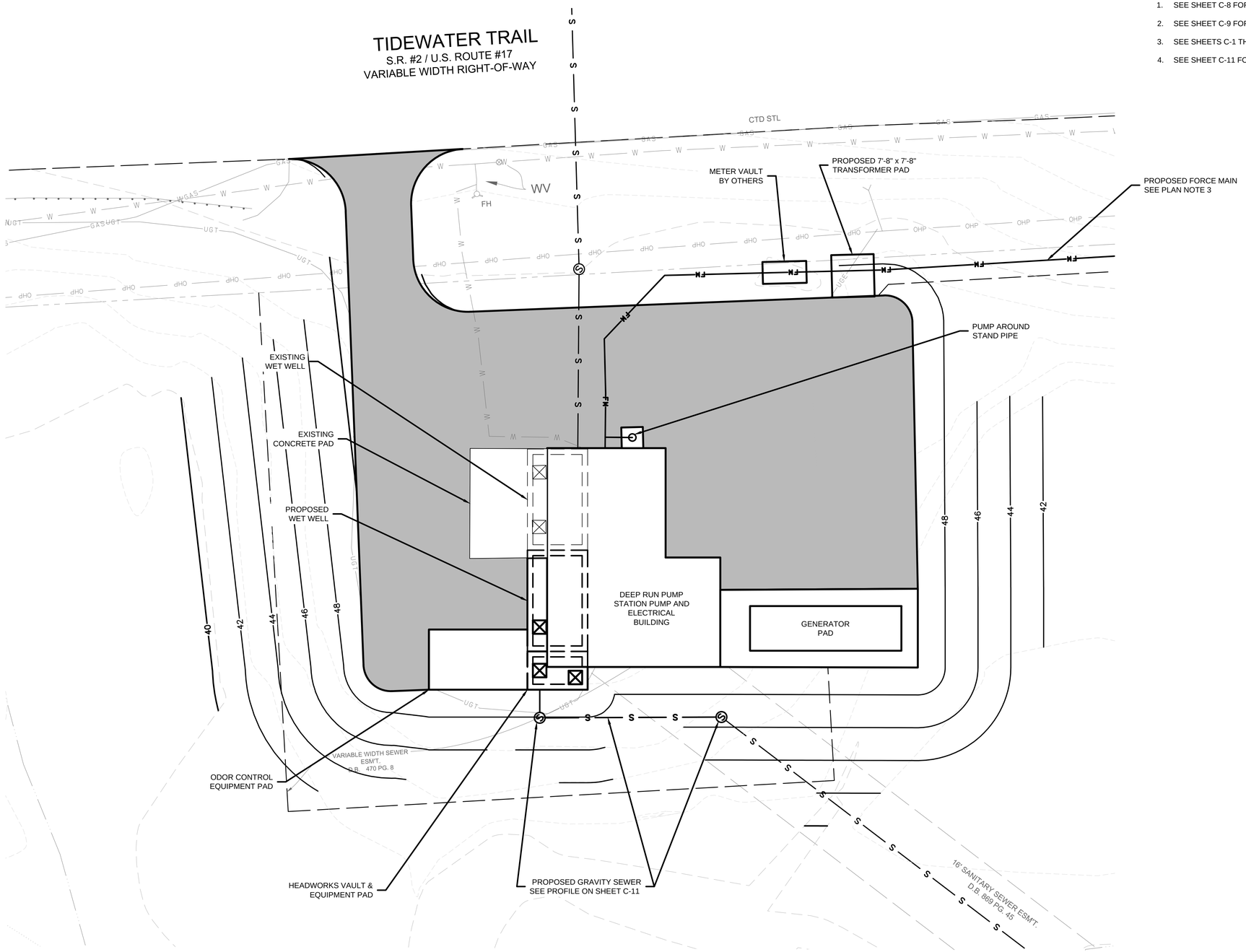
SHEET DESCRIPTION
DEMO PLAN
DRAWING LOCATION

C-9

I:\SPOTSYLVANIA-CO.\5842\73802.DEEP-RUN-PS-PER\DOCS\DWG\SHEETS\5842.73802-F09.DWG

PLAN NOTES:

1. SEE SHEET C-8 FOR EXISTING SITE PLAN.
2. SEE SHEET C-9 FOR PROPOSED SITE PLAN.
3. SEE SHEETS C-1 THROUGH C-7 FOR FORCE MAIN ALIGNMENTS.
4. SEE SHEET C-11 FOR PUMP PS DETAILS AND PROFILES.



PLAN

1" = 100'

10' 0 10'

PRELIMINARY
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RAMBOLL

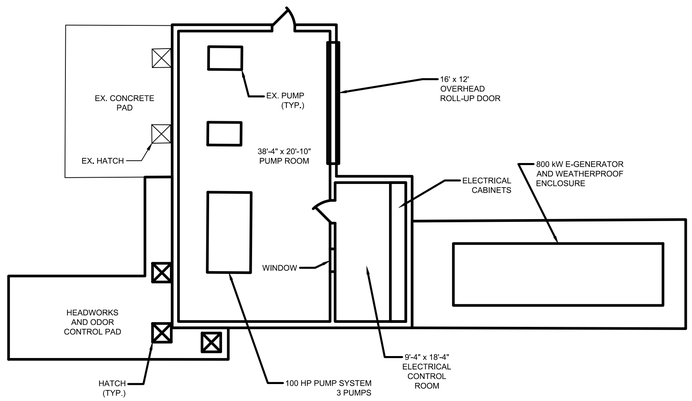
PROJECT
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
PROPOSED SITE PLAN
DRAWING LOCATION

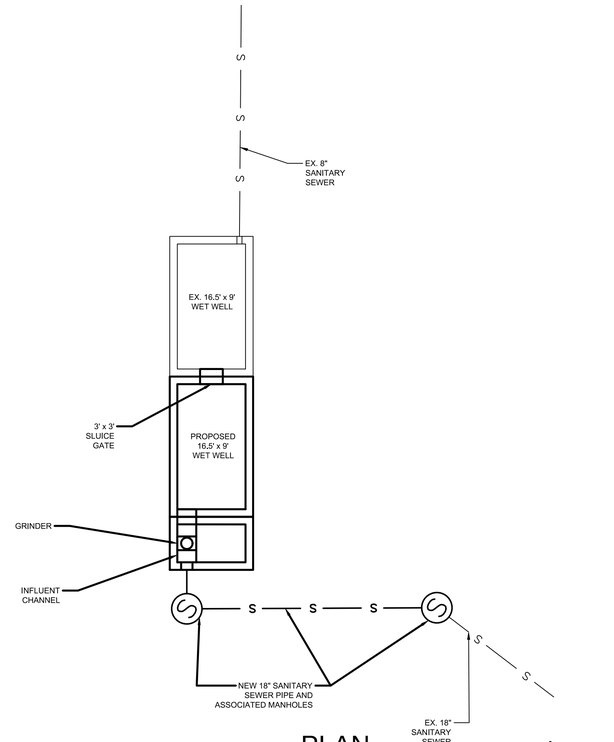
C-10

PLAN NOTES:

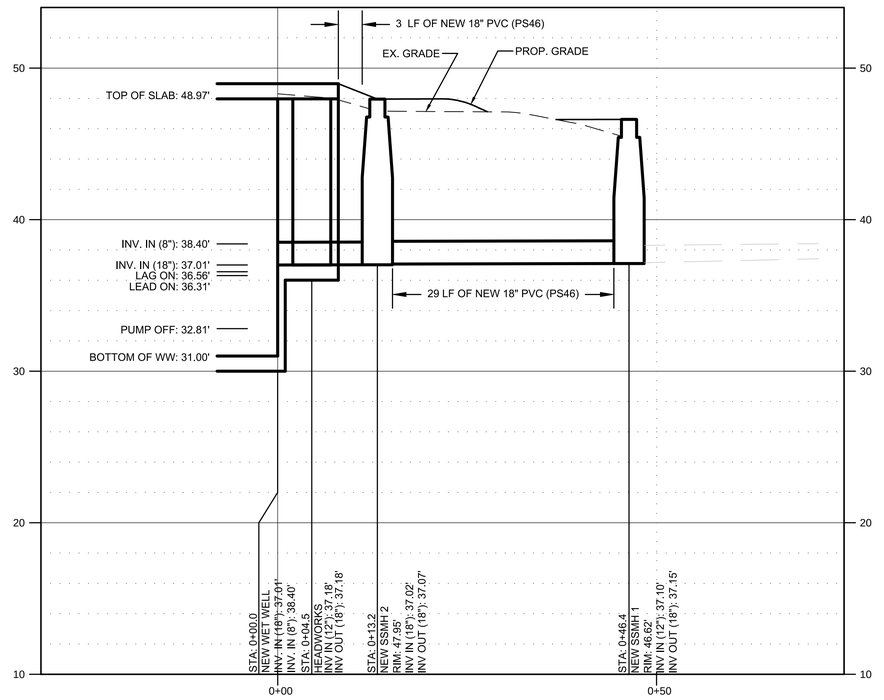
1. SEE SHEET C-8 FOR EXISTING SITE PLAN.
2. SEE SHEET C-9 FOR DEMO PLAN
3. SEE SHEET C-10 FOR PROPOSED SITE PLAN.
4. SEE SHEETS C-1 THROUGH C-7 FOR FORCE MAIN ALIGNMENT.



PLAN
1" = 100'
10' 0 10'

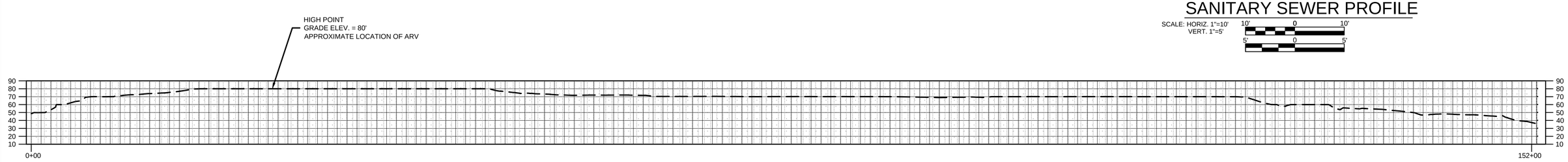


PLAN
1" = 100'
10' 0 10'



SANITARY SEWER PROFILE

SCALE: HORIZ. 1"=10'
VERT. 1"=5'
10' 0 10'
5' 0 5'



ALIGNMENT 1 - HYDRAULIC GRADE LINE
SCALE: NTS

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A RAMBOLL COMPANY

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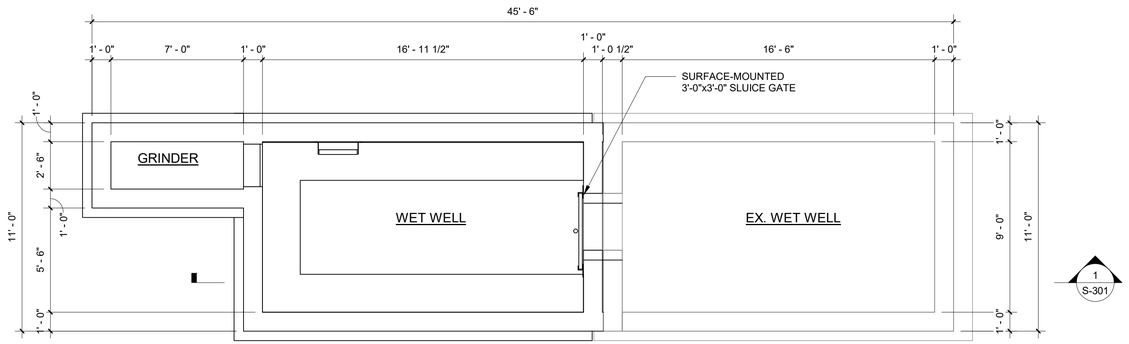
DEEP RUN CONVEYANCE IMPROVEMENTS
ADDRESS
FREDERICKSBURG, VIRGINIA

SHEET DESCRIPTION
PS DETAILS AND PROFILES
DRAWING LOCATION

C-11

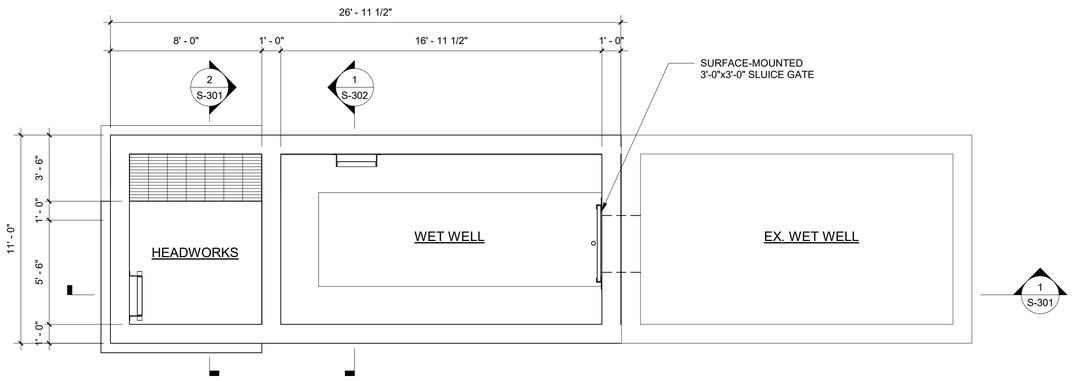
SAVED: 2/24/2020 2:05:58 PM



WET WELL PLAN

1/4" = 1'-0"

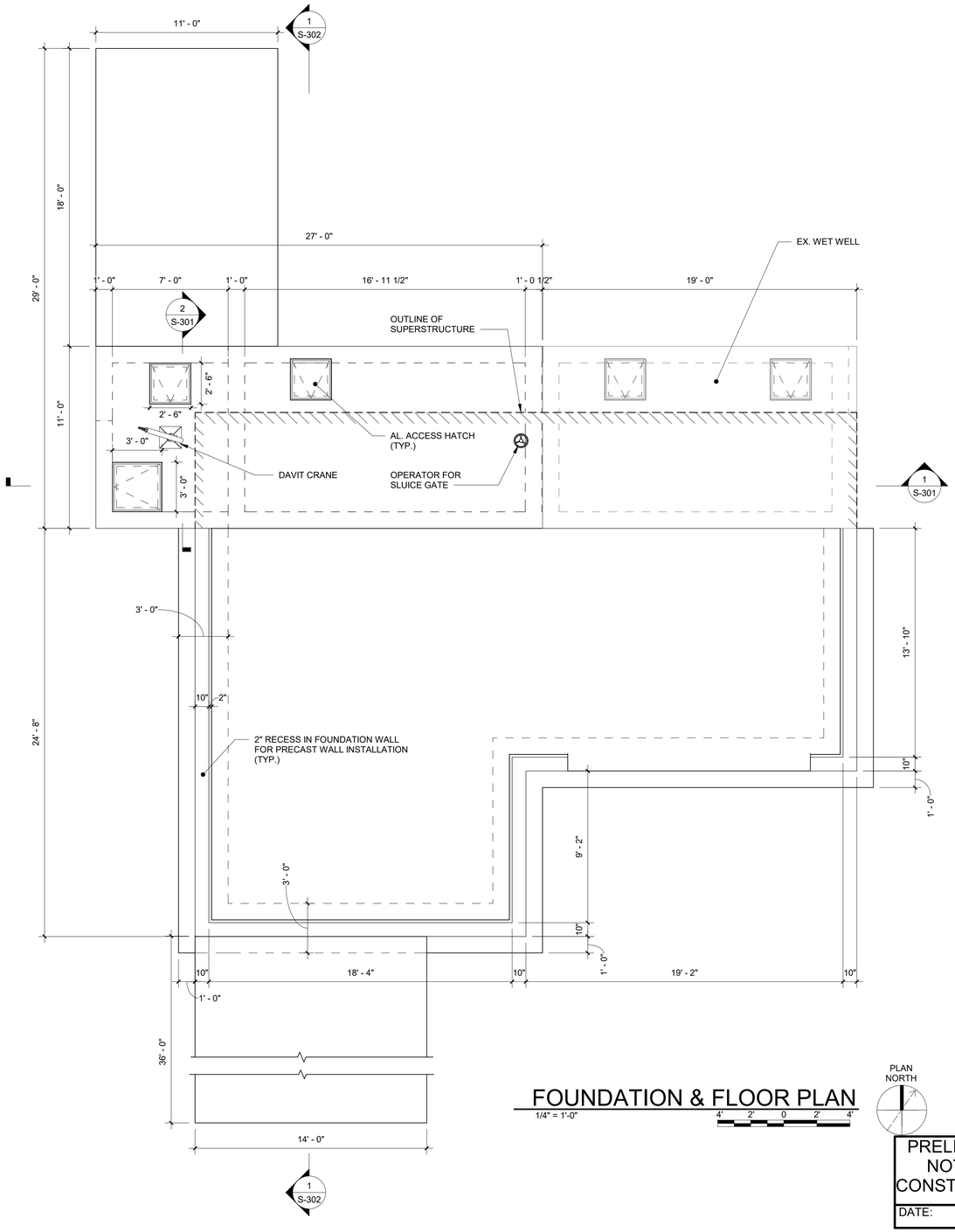
PLAN NORTH



HEADWORKS PLAN

1/4" = 1'-0"

PLAN NORTH



FOUNDATION & FLOOR PLAN

1/4" = 1'-0"

PLAN NORTH

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 1/31/2020

CLIENT
SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

NO.	DATE	REVISION	INT.
B	FEBRUARY 2020	FINAL PER SUBMITTAL	LWW
A	JANUARY 2020	DRAFT PER SUBMITTAL	LWW

DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
L. WOODS
DESIGNED BY: J. BOHNERT
CHECKED BY: T. KIVISTO
DRAWN BY: J. BOHNERT
FILE NO.: 5842.73802
DATE: MM/DD/YY

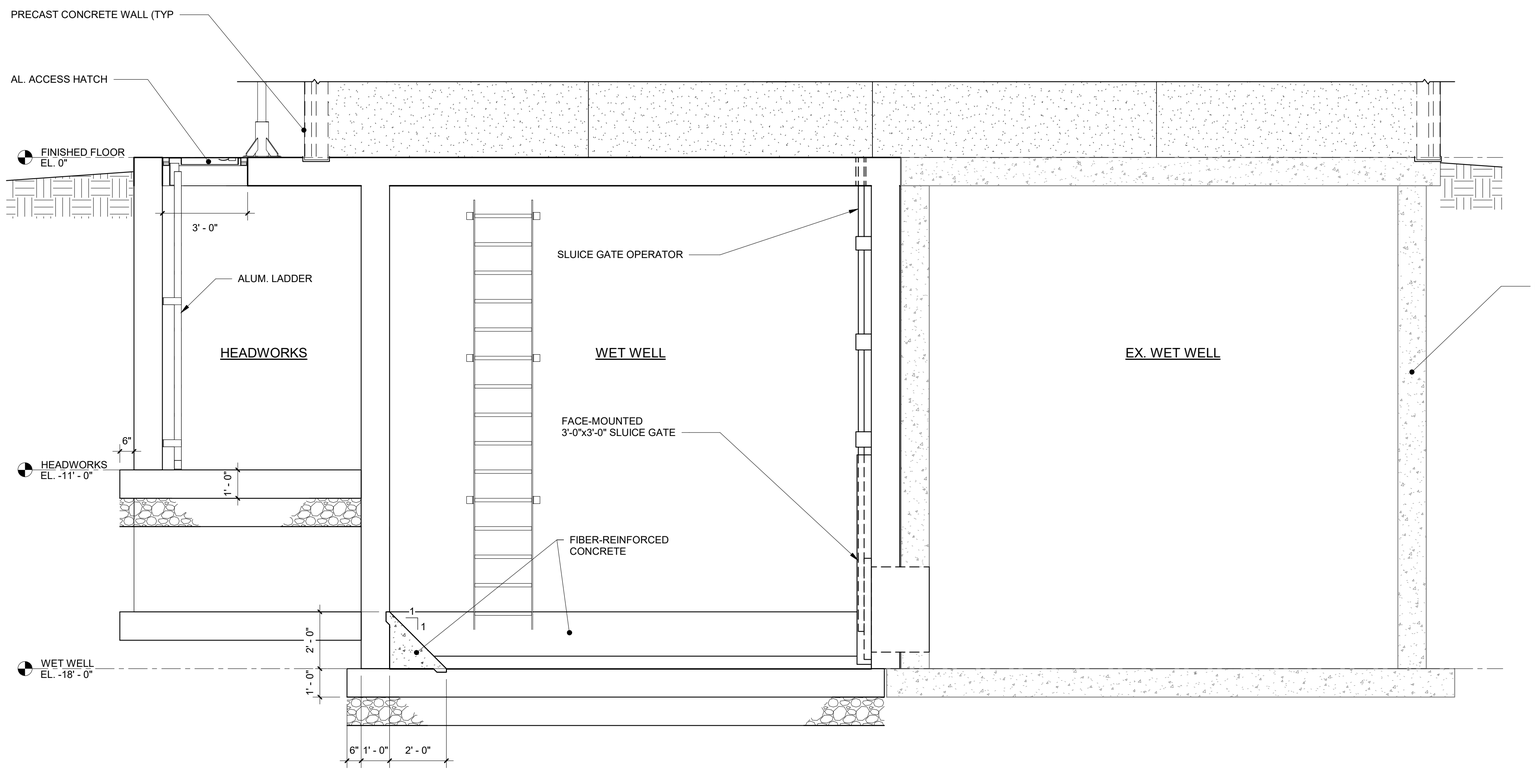
O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN
ADDRESS
FREDERICKSBURG, VA

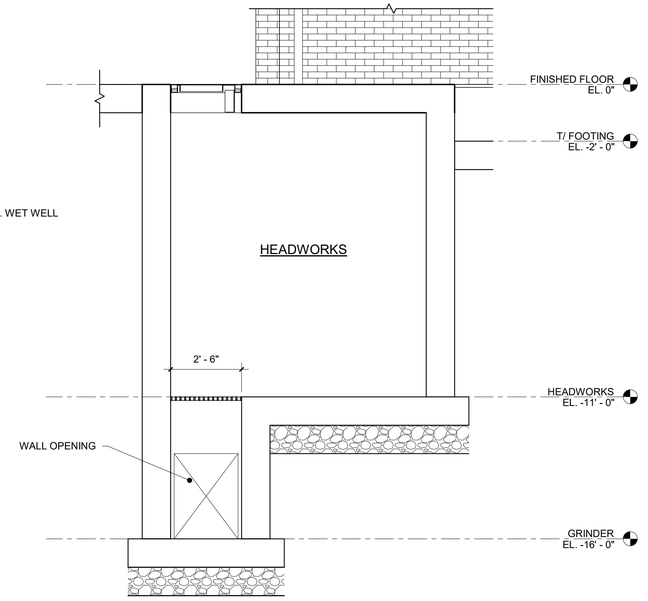
SHEET DESCRIPTION
PLANS
DRAWING LOCATION

S-101

SAVED: 2/24/2020 2:05:58 PM



1 SECTION
3/8" = 1'-0"
3' 2' 1' 0 1' 2' 3'



2 SECTION
3/8" = 1'-0"
3' 2' 1' 0 1' 2' 3'

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 1/31/2020

CLIENT
SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

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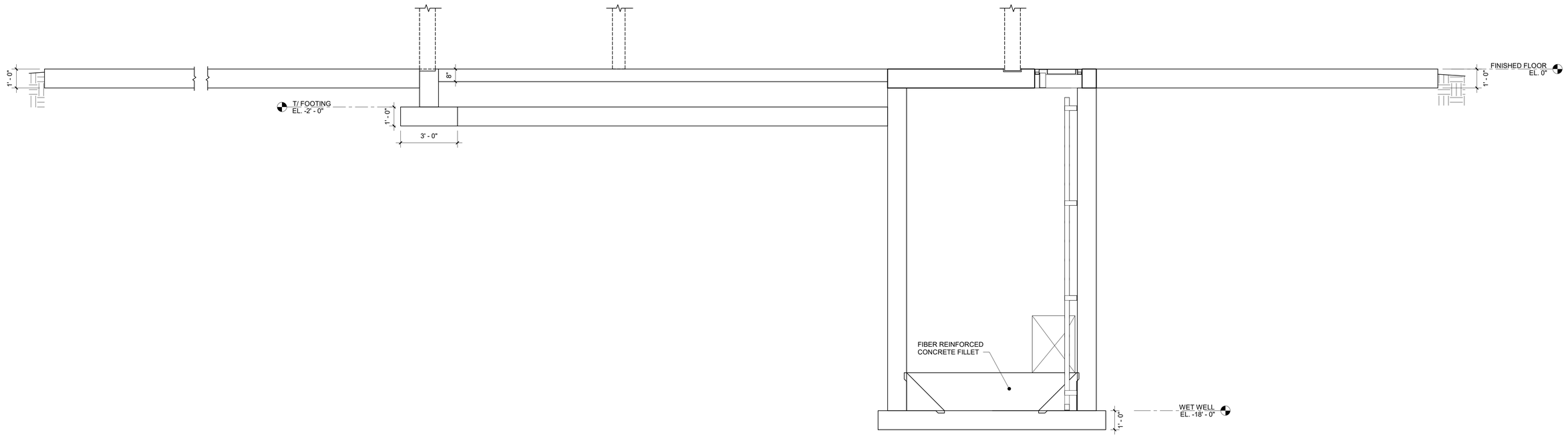
O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN
ADDRESS
FREDERICKSBURG, VA

SHEET DESCRIPTION
SECTIONS & DETAILS
DRAWING LOCATION

S-301

SAVED: 2/24/2020 2:05:58 PM



1 SECTION
3/8" = 1'-0"
3' 2' 1' 0 1' 2' 3'

PRELIMINARY
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DATE: 1/31/2020

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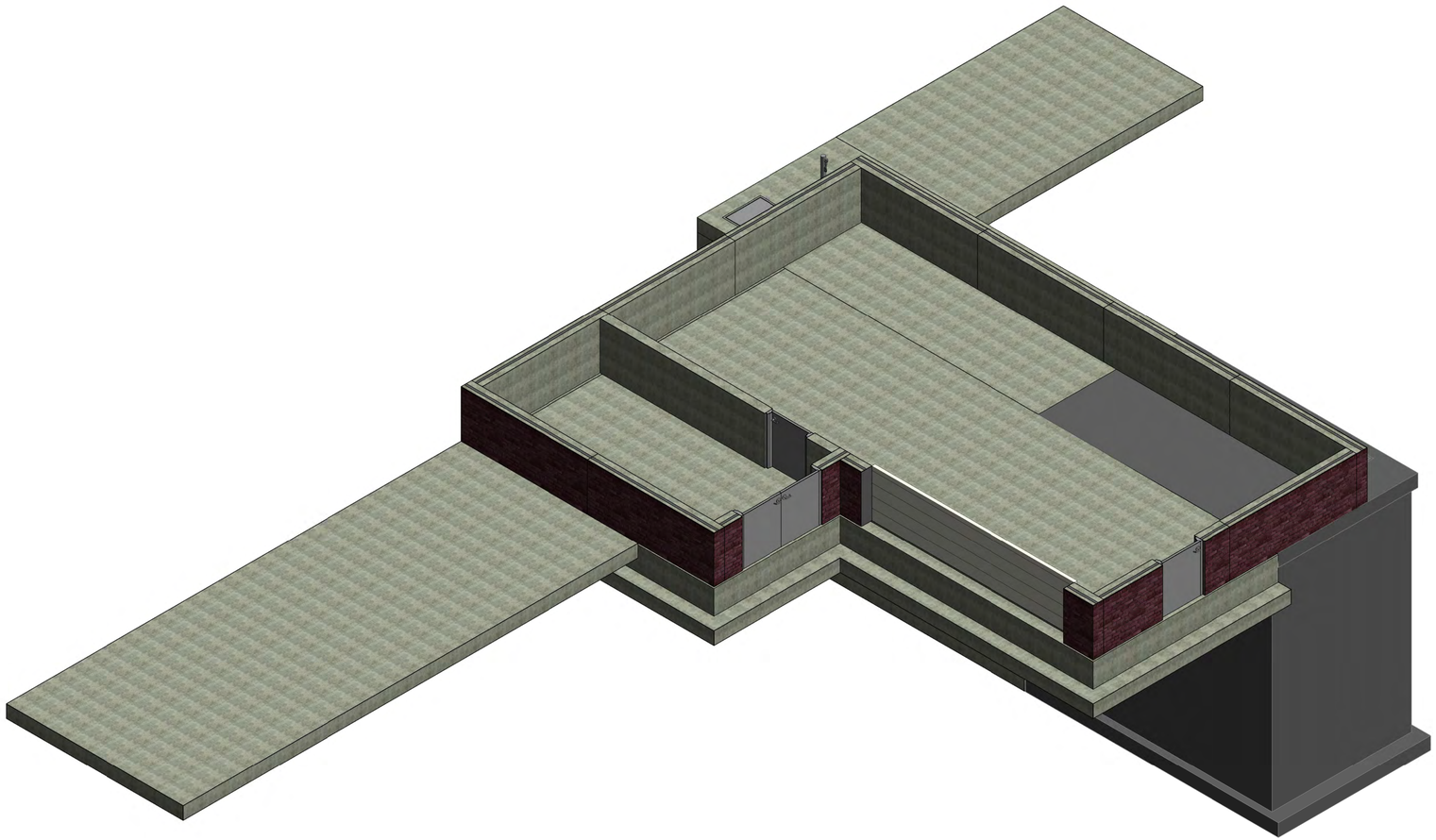
O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

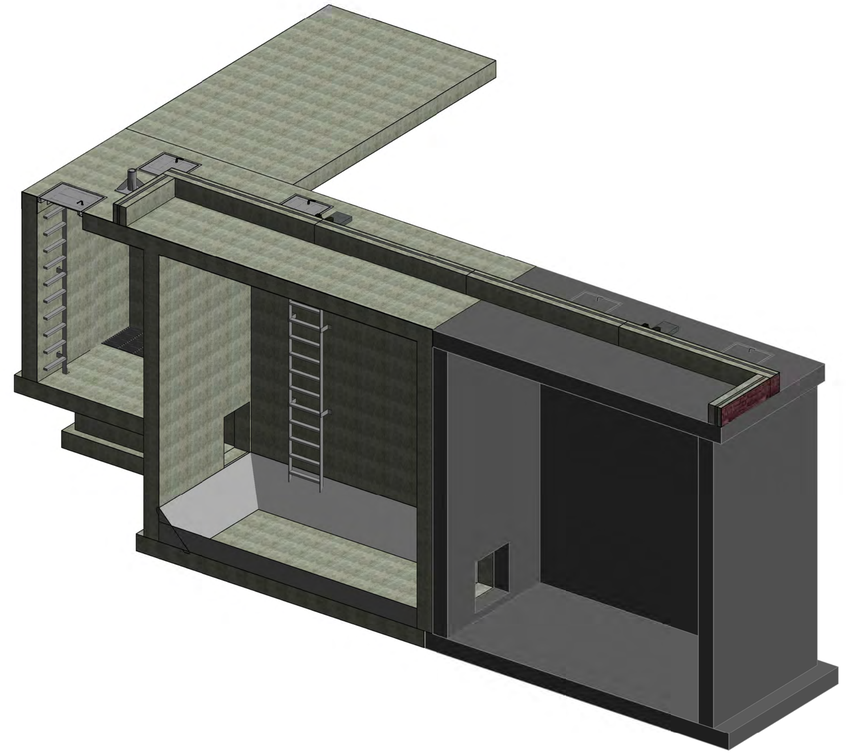
PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN
ADDRESS
FREDERICKSBURG, VA

SHEET DESCRIPTION
SECTIONS & DETAILS
DRAWING LOCATION

S-302

SAVED: 2/24/2020 2:06:02 PM





3D VIEWS
NOT TO SCALE

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 1/31/2020

CLIENT
SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

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DESIGNED BY
J. BOHNERT
CHECKED BY
T. KIVISTO
DRAWN BY
J. BOHNERT
FILE NO.
5842.73802
DATE
MM/DD/YY

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN
ADDRESS
FREDERICKSBURG, VA

SHEET DESCRIPTION
3D VIEW
DRAWING LOCATION

S-901

SAVED: 2/21/2020 3:18:07 PM

ARCHITECTURAL ABBREVIATIONS

"A"	
&	AND
@	AT
AB	ANCHOR BOLTS
ABR	ABRASIVE
ACT	ACOUSTICAL CEILING TILE
ADD'L	ADDITIONAL
ADJ	ADJUSTABLE
AFF	ABOVE FINISHED FLOOR
ALT	ALTERNATE
ALUM	ALUMINUM
APPD	APPROVED
APPROX	APPROXIMATE
ARCH	ARCHITECTURAL
ASPH	ASPHALT
"B"	
B OR BOT	BOTTOM
B/ OR BO	BOTTOM OF
BD	BOARD
BFF	BELOW FINISHED FLOOR
BIT	BITUMINOUS
BLDG	BUILDING
BLK	BLOCK / BLOCKING
BM	BEAM
BOD	BOTTOM OF DUCT
BOL	BOTTOM OF LOUVER
BOP	BOTTOM OF PIPE
BRG	BEARING
"C"	
CJ	CONTROL JOINT
CANT	CANTILEVER
CEM	CEMENT
CHAN	CHANNEL
CHEM	CHEMICAL RESISTANT
CL	FINISH CENTERLINE
CLG	CEILING
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
COMBO	COMBINATION
CONC	CONCRETE
CONST	CONSTRUCTION
CONST JT	CONSTRUCTION JOINT
CONT	CONTINUOUS
CONT'D	CONTINUED
CONTR	CONTRACT / CONTRACTOR
COORD	COORDINATE
CORR	CORRIDOR
CORRUG	CORRUGATED
CSK	COUNTERSINK
CSKSCR	COUNTERSUNK SCREW
CTR	CENTER
"D"	
DEG	DEGREE
DET	DETAIL
DEMO	DEMOLISH / DEMOLITION
DIA	DIAMETER
DIAG	DIAGONAL / DIAGRAM
DIM	DIMENSION
DIV	DIVISION
DL	DEAD LOAD
DN	DOWN
DR	DOOR
DWG	DRAWING
DWL	DOWEL
"E"	
EJ	EXPANSION JOINT
EA	EACH
EF	EACH FACE
ELEV	ELEVATION
ELEC	ELECTRIC / ELECTRICAL
ENGR	ENGINEER
EQ	EQUAL
EQUIP	EQUIPMENT
EQUIV	EQUIVALENT
EXP	EXPOSED
EW	EACH WAY
EXC	EXCAVATION
EXH	EXHAUST
EXIST	EXISTING
EXT	EXTERIOR

"F"	
FAC	FACTORY
FD	FLOOR DRAIN
FDN	FOUNDATION
FE	FIRE EXTINGUISHER
FF	FACTORY FINISH
FFE	FINISH FLOOR ELEVATION
FGR	FINISHED GRADE
FFL	FINISHED FLOOR
FIXT	FIXTURE
FIN	FINISH
FLR	FLOOR
FR	FRAME
FRT	FIRE RETARDANT TREATED
FT	FEET
FTG	FOOTING
FV	FIELD VERIFY
"G"	
GA	GAGE / GAUGE
GALV	GALVANIZED
GB	GRADE BEAM / GRAB BAR
GL	GLASS
GR	GRADE
GRD	GROUND
GS	GALVANIZED STEEL
GVL	GRAVEL
GWB	GYPSUM WALL BOARD
"H"	
HB	HOSE BIBB
HD	HEAD
HDW	HARDWARE
HGT	HEIGHT
HM	HOLLOW METAL
HMD	HOLLOW METAL DOOR
HMF	HOLLOW METAL FRAME
HORIZ	HORIZONTAL
HP	HIGH POINT
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
"I"	
I.F.	INSIDE FACE
INCL	INCLUDED / INCLUDING
IND	INDUSTRIAL
INFO	INFORMATION
INSUL	INSULATION / INSULATED
INT	INTERIOR
INV	INVERT
"J"	
JST	JOIST
JT	JOINT
"K"	
KD	KNOCK DOWN
KFS	KIPS PER SQUARE FOOT
KFT	KIP FOOT
KP	KICK PLATE
"L"	
L	ANGLE
LAM	LAMINATE
LB	POUND
LBS	POUNDS
LF	LINEAR FEET
LG	LENGTH / LONG
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LP	LOW POINT
LV	LOUVER
"M"	
MAN.	MANUAL
MATL	MATERIAL
MAX	MAXIMUM
MCP	METAL CLAD PANEL
MD	METAL DECK
MECH	MECHANICAL
MFG	MANUFACTURING
MFR	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
MOD	MODIFICATION
MP	METAL PANEL
MS	METAL STUD
MTD	MOUNTED
MTL	METAL

"N"	
N	NORTH
N/A	NOT APPLICABLE
NC	NON COMBUSTIBLE
NF	NEAR FACE
NIC	NOT IN CONTRACT
NO. OR #	NUMBER
NOM	NOMINAL
NS	NEAR SIDE
NTS	NOT TO SCALE
"O"	
OC	ON CENTER
O.F.	OUTSIDE FACE
OH	OVERHEAD
OPNG	OPENING
OPP	OPPOSITE
"P"	
PAR	PARALLEL
PART.	PARTITION
PERF	PERFORATED
PL	PLATE
PLWD	PLYWOOD
PLUMB.	PLUMBING
PNL	PANEL
PR	PAIR
PRE	POWER ROOF EXHAUSTER
PREFAB	PREFABRICATED
PREFIN	PRE FINISHED
PRI	PRIMARY
PRMLD	PRE MOLDED
P.T.	PRESSURE TREATED
PT	PAINT / PAINTED
PVC	POLYVINYL CHLORIDE
PVT	PAVEMENT
PWE	POWER WALL EXHAUSTER
"Q"	
QUAL	QUALITY
QTY	QUANTITY
"R"	
RAD	RADIUS
RB	ROOF BEAM
RD	ROOF DRAIN
RECT	RECTANGLE / RECTANGULAR
REF	REFERENCE
REINF	REINFORCE
REQ'D	REQUIRED
REV	REVISION / REVISED
RFG	ROOFING
RM	ROOM
RO	ROUGH OPENING
"S"	
S	SOUTH
S/C	SITE/CIVIL
SCH	SCHEDULE
SEC	SECOND
SECT	SECTION
SF	SQUARE FOOT
SIM	SIMILAR
SHT	SHEET
SIM REV	SIMILAR REVERSED
SJ	STEEL JOIST
SPEC	SPECIFICATION
SQ	SQUARE
SS	STAINLESS STEEL
STA	STATION
STD	STANDARD
STIFF	STIFFENER
STL	STEEL
STOR	STORAGE
STRUCT	STRUCTURE / STRUCTURAL
SUSP	SUSPEND / SUSPENDED
SYM	SYMMETRICAL / SYMMETRICALLY
"T"	
T	TOP
T/ OR T.O.	TOP OF
TBD	TO BE DETERMINED
TEMP	TEMPERATURE
TH	THICK
THRD	THREAD / THREADED
TOB	TOP OF BLOCK
TOD	TOP OF DUCT
TOF	TOP OF FOOTING
TOL	TOP OF LOUVER
TOS	TOP OF SLAB / TOP OF STEEL
TOT	TOTAL
TOW	TOP OF WALL
TYP	TYPICAL
"U"	
UNO	UNLESS NOTED OTHERWISE
U/S	UNDERSIDE
"V"	
VCT	VINYL COMPOSITION TILE
VERT	VERTICAL
"W"	
W/O	WITHOUT
W/	WITH
W	WEST
WD	WOOD
WF	WATER FOUNTAIN
WLD	WELD / WELDED
WP	WATER PROOFING
WT	WEIGHT

ARCHITECTURAL GRAPHIC CONVENTIONS

- BACKFILL
- BATT INSULATION
- BRICK
- CELL VENT/WEEP VENT
- CONCRETE, CAST STONE, AND/OR PRECAST CONCRETE
- CONC. MASONRY UNIT (CMU)
- GRAVEL
- GROUT OR MORTAR
- GYPSUM WALL BOARD
- MORTAR NET
- PLYWOOD
- RIGID BOARD INSULATION
- SHIM
- STEEL
- WOOD BLOCKING

ARCHITECTURAL SYMBOLS

- DIRECTION NORTH
- 120 — NEW DOOR SYMBOL
- W1 — EXTERIOR WINDOW TYPE DESIGNATION
- PUMP ROOM / 101 — ROOM NAME AND ROOM NUMBER DESIGNATION
- SLOPE
- DATUM
- LV-3 — LOUVER DESIGNATION
- A / A-101 / 2 — INTERIOR ROOM AND WALL ELEVATIONS WITH LOCATION SHEET DESIGNATOR
- FE — FIRE EXTINGUISHER
- 1 / A-5 — DETAIL INDICATOR
- 1 / A — STRUCTURAL COLUMN GRID LINES AND INDICATOR

METHOD OF SECTIONING

THE DRAWING UPON WHICH A SECTION, VIEW OR DETAIL HAS BEEN TAKEN AND THE DRAWING UPON WHICH THE SECTION, VIEW OR DETAIL HAS BEEN SHOWN IS CROSS-REFERENCED WITH SYMBOLS AS FOLLOWS:

DRAWING WHERE SECTION IS TAKEN

1 / A-301 — THE NUMBER IN THE UPPER HALF OF THE CIRCLE IS THE SECTION NUMBER. THE BOTTOM NUMBER REFERS TO THE DRAWING NUMBER ON WHICH THE SECTION CAN BE FOUND.

DRAWING WHERE SECTION IS SHOWN

1 SECTION — SCALE — SCALE BAR LOCATION — THIS IS SHOWN UNDER EACH SECTION. THE NUMBER IS THE SECTION NUMBER ON THE SHEET.

PRELIMINARY
NOT FOR CONSTRUCTION
DATE: FEBRUARY 2020

CLIENT
SPOTSYLVANIA COUNTY DEPT. OF UTILITIES / PUBLIC WORKS

NO.	DATE	REVISION	INT.
B	FEBRUARY 2020	FINAL PER SUBMITTAL	LWW
A	JANUARY 2020	DRAFT PER SUBMITTAL	LWW

DESIGNER / PROFESSIONAL ENGINEER RESPONSIBLE
L. WOODS
DESIGNED BY: B. TAYLOR
CHECKED BY: W. COTTER
DRAWN BY: B. TAYLOR
FILE NO: 5842.73802
DATE

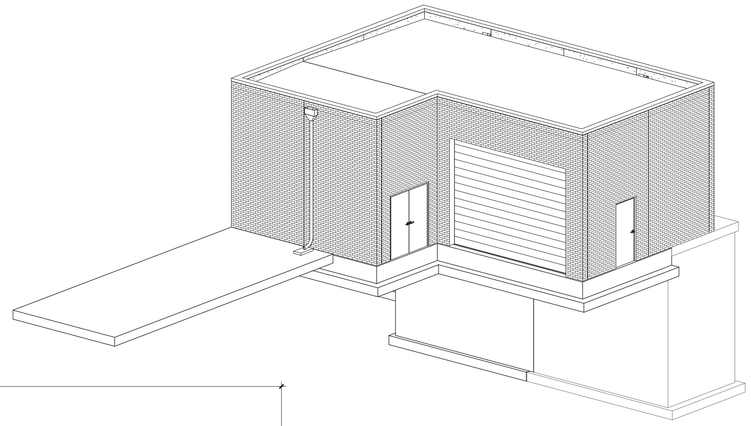
O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN
ADDRESS: FREDERICKSBURG, VA

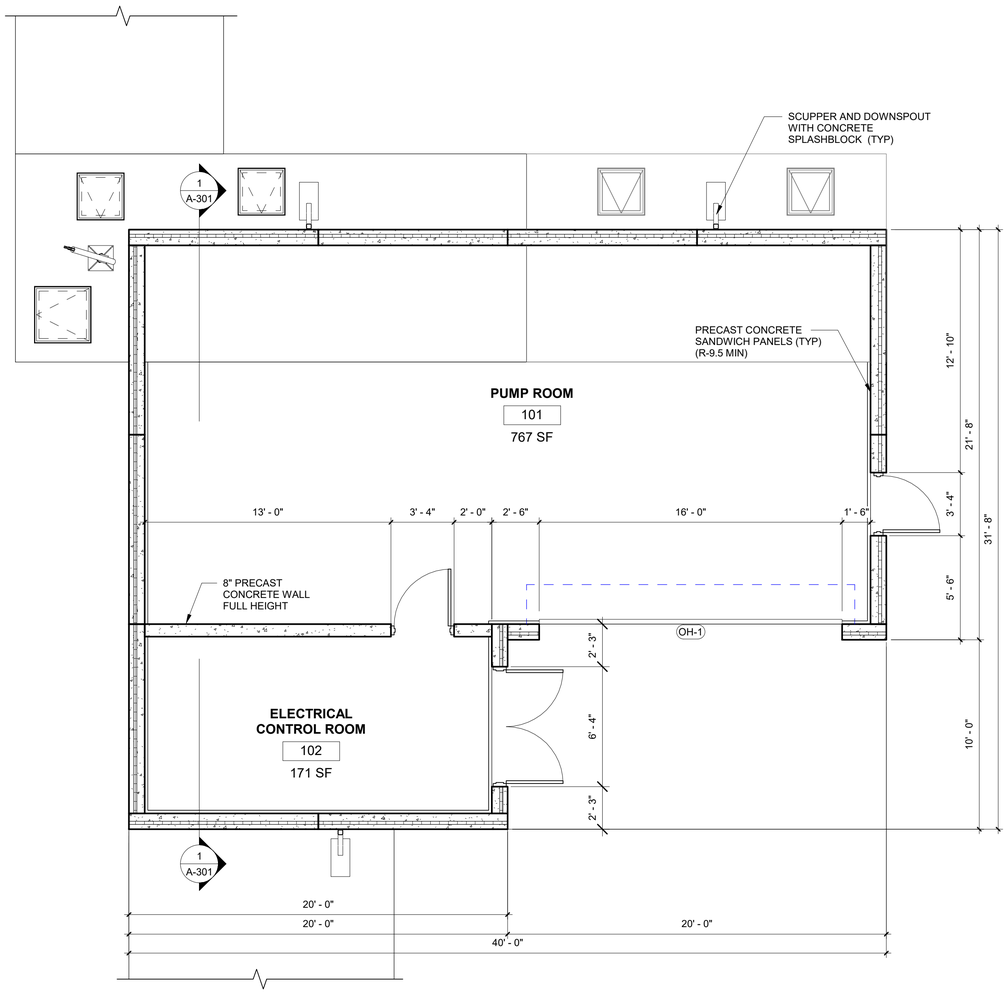
SHEET DESCRIPTION
ABBREVIATIONS AND SYMBOLS
DRAWING LOCATION

A-001

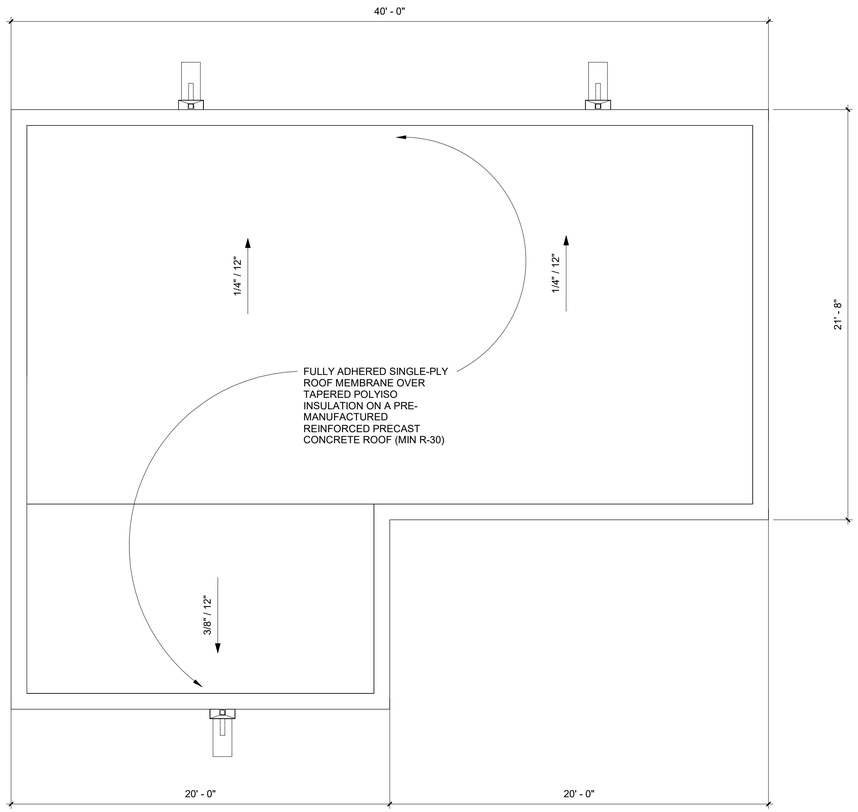
SAVED: 2/21/2020 3:18:07 PM



ISOMETRIC VIEW
NOT TO SCALE



FLOOR PLAN
1/4" = 1'-0"



ROOF PLAN
1/4" = 1'-0"

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O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY
RAMBOLL

PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN
ADDRESS
FREDERICKSBURG, VA

SHEET DESCRIPTION
FLOOR AND ROOF PLANS
DRAWING LOCATION

A-101

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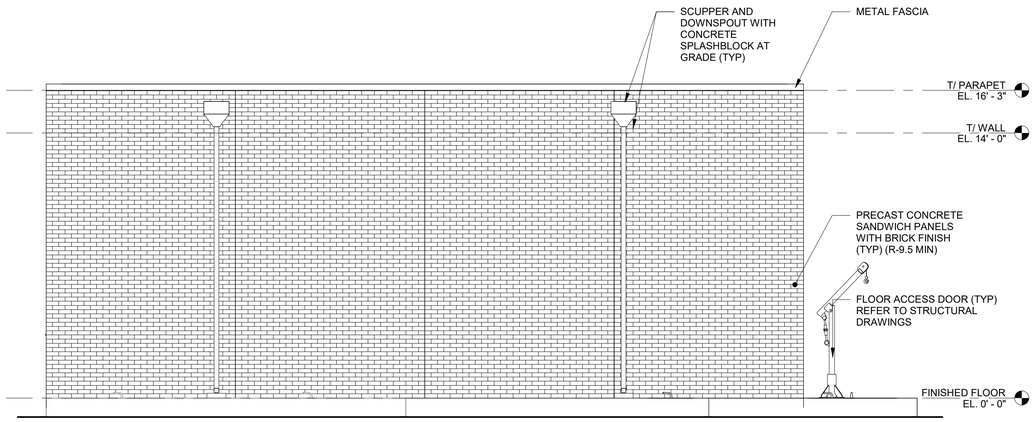
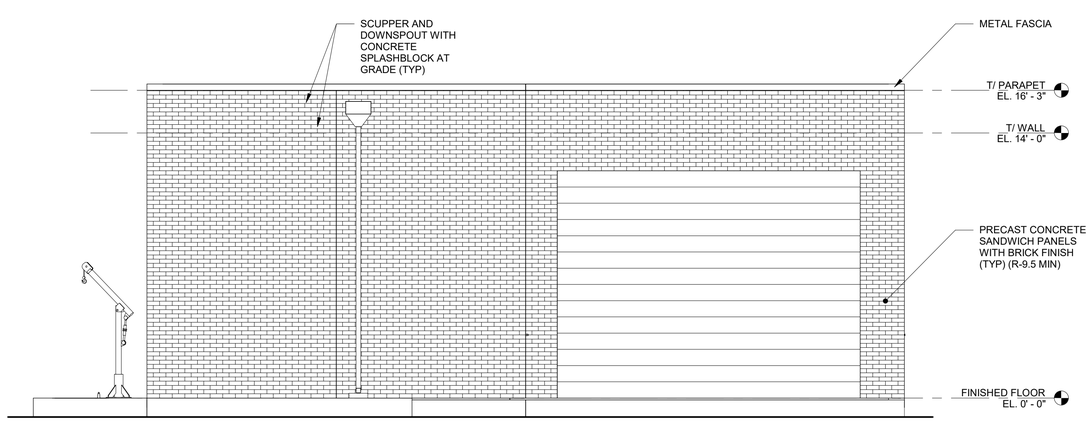


NORTH ELEVATION

1/4" = 1'-0"

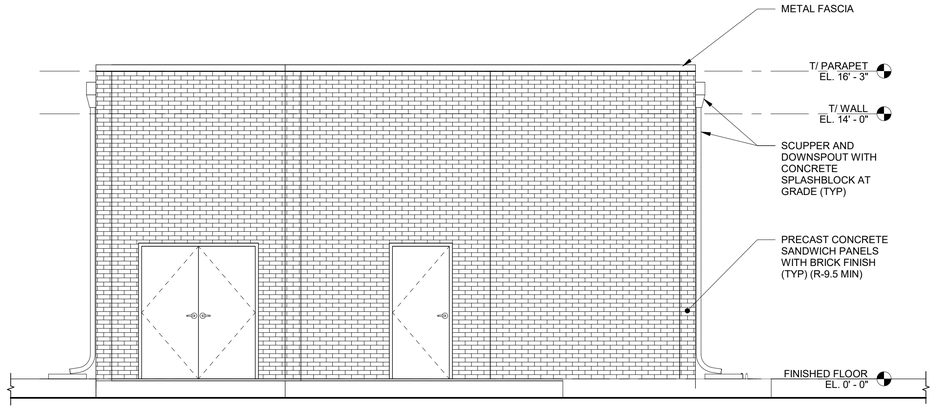
4' 2' 0 2' 4'



SOUTH ELEVATION

1/4" = 1'-0"

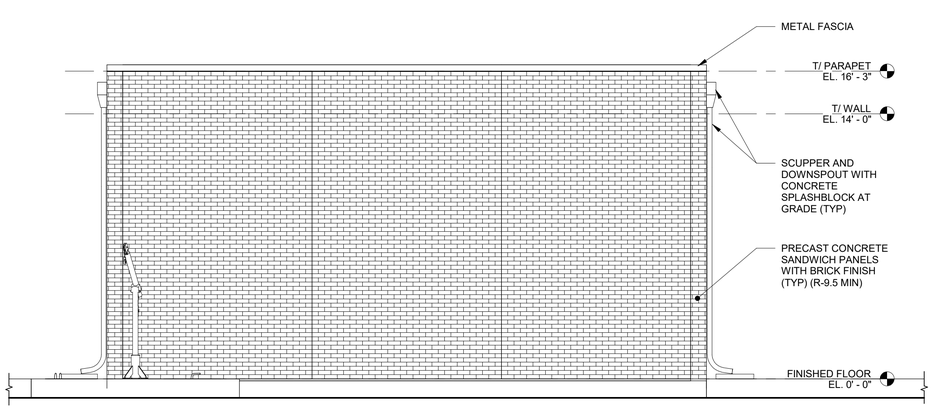
4' 2' 0 2' 4'



EAST ELEVATION

1/4" = 1'-0"

4' 2' 0 2' 4'



WEST ELEVATION

1/4" = 1'-0"

4' 2' 0 2' 4'

PRELIMINARY
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FILE NO.
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O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT
DEEP RUN PUMP STATION AND FORCE MAIN

ADDRESS
FREDERICKSBURG, VA

SHEET DESCRIPTION
ELEVATIONS

DRAWING LOCATION

A-201

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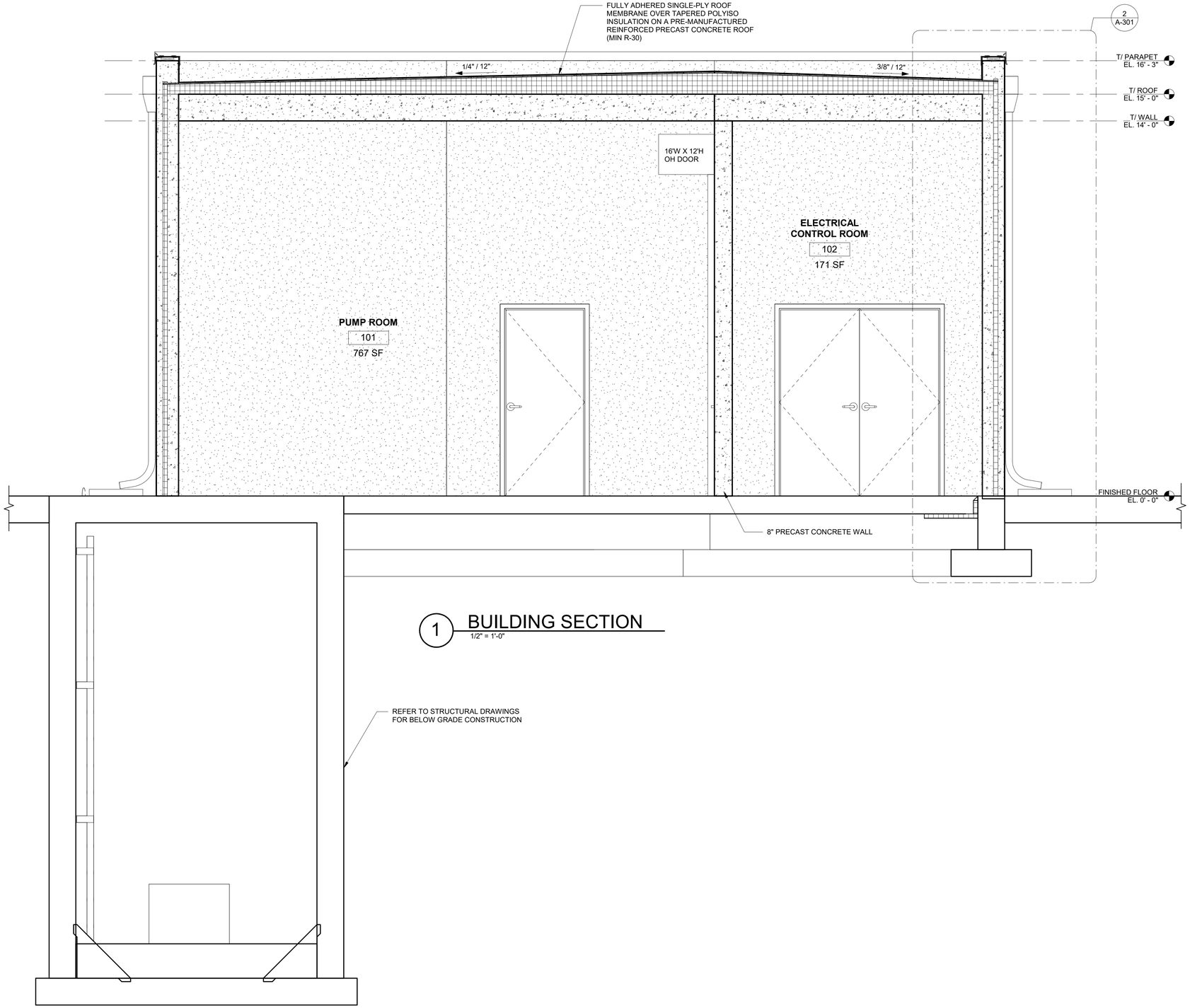
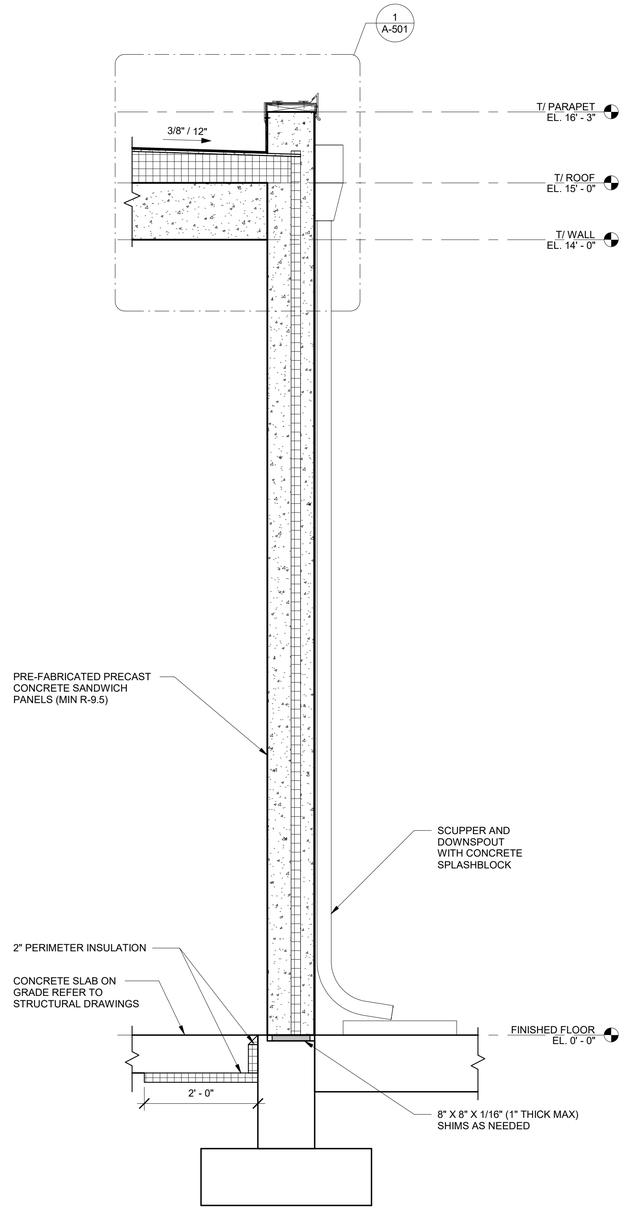


1 BUILDING SECTION
1/2" = 1'-0"



2 WALL SECTION
3/4" = 1'-0"

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A RAMBOLL COMPANY

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ADDRESS
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SHEET DESCRIPTION
SECTIONS
DRAWING LOCATION

A-301

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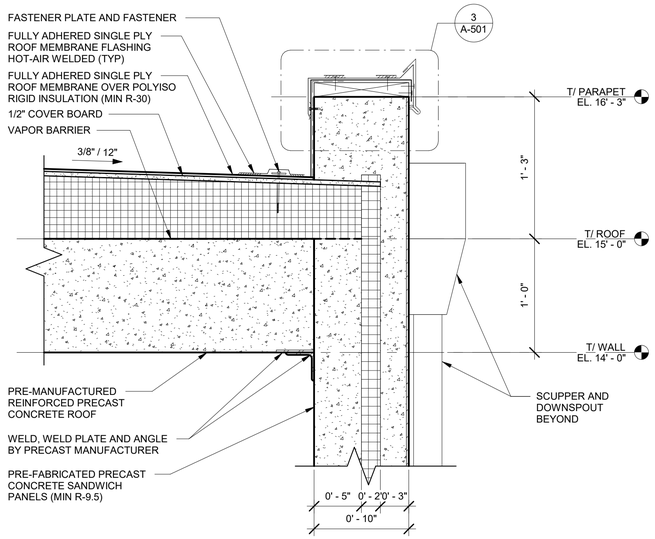
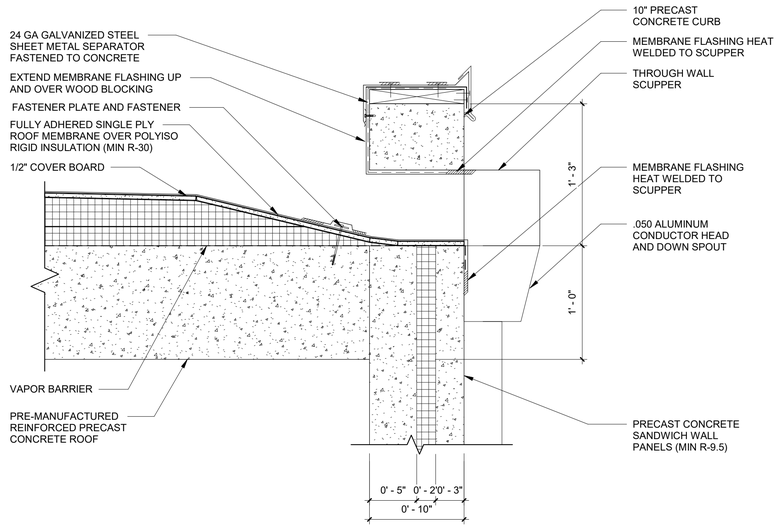
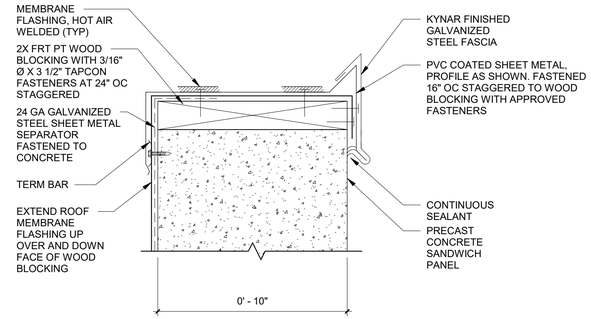


1 ROOF DETAIL
1 1/2" = 1'-0"



2 SCUPPER DETAIL
1 1/2" = 1'-0"



3 ROOF COPING DETAIL
3" = 1'-0"

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PROJECT
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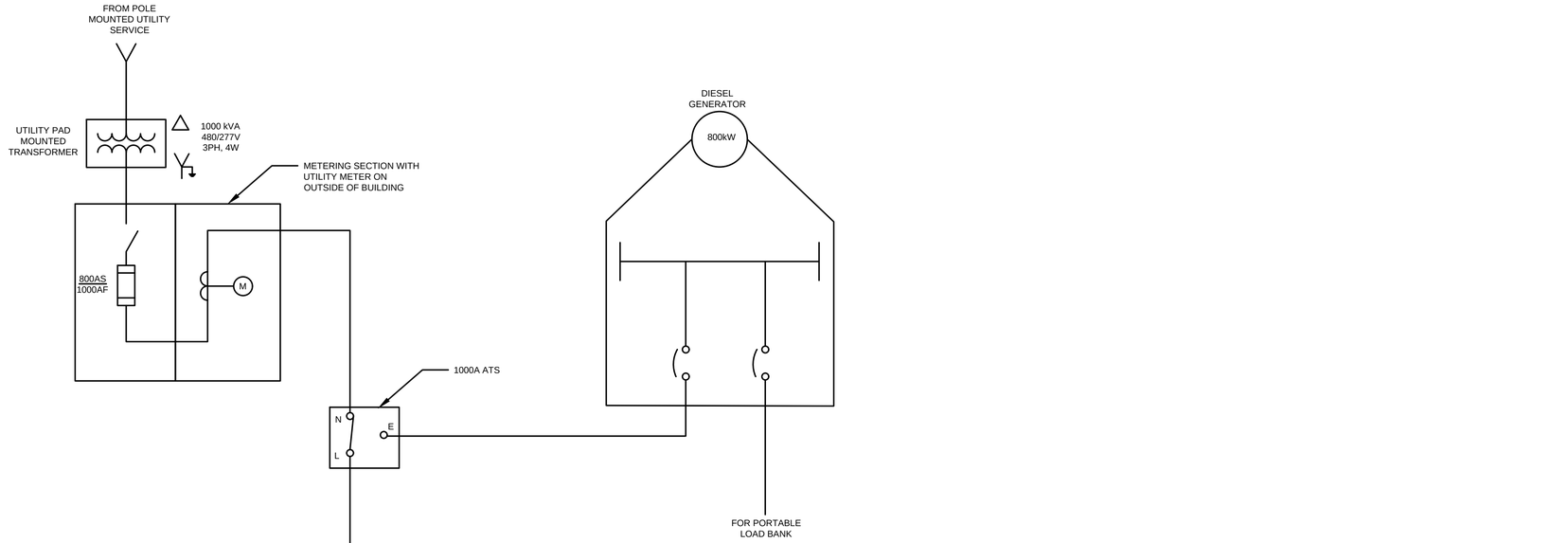
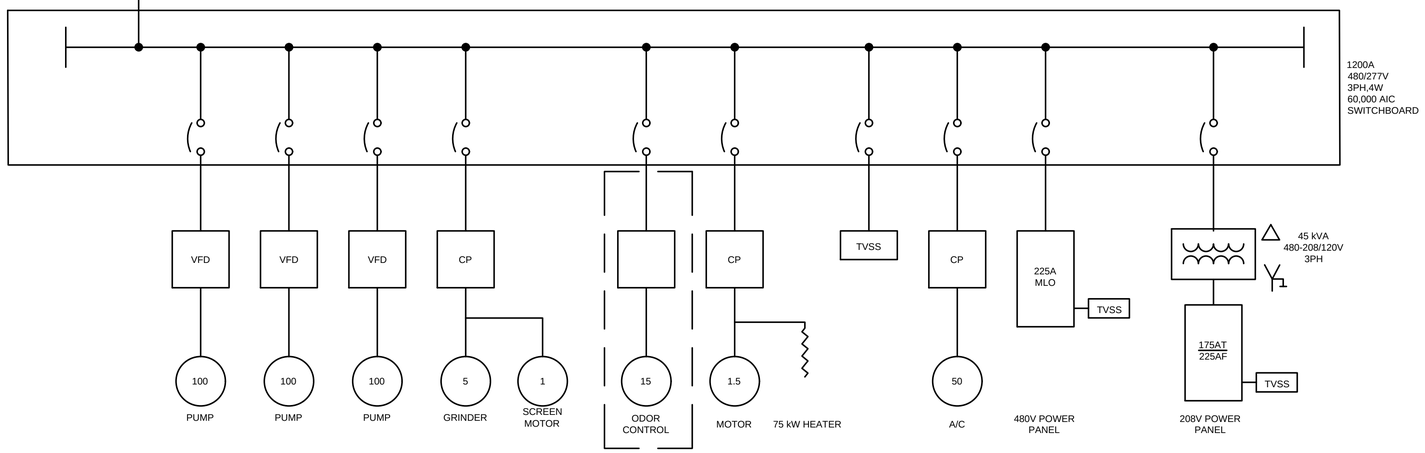
ADDRESS
FREDERICKSBURG, VA

SHEET DESCRIPTION
DETAILS
DRAWING LOCATION

A-501





PRELIMINARY
NOT FOR
CONSTRUCTION

DATE: JAN. 2020

IN CHARGE OF _____

DESIGNED BY _____

CHECKED BY _____

DRAWN BY _____

NO.	DATE	REVISION	INT.
B	FEBRUARY 2020	FINAL PER SUBMITTAL	RDD
A	JANUARY 2020	DRAFT PER SUBMITTAL	RDD

O'BRIEN & GERE

O'BRIEN & GERE ENGINEERS, INC

SPOTYLVANIA COUNTY
DEEP RUN CONVEYANCE IMPROVEMENTS

FREDERICKSBURG, VIRGINIA

ELECTRICAL

ONE-LINE

FILE NO. 5842.73802 -

DATE JAN. 2020

E-1

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Appendix E – Alignment
1 - Aerial Figures

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DEEP RUN PUMP STATION

MASSAPONAX WWTP

PRELIMINARY ALIGNMENT 1

FOURTH ST
THIRD ST
JOSEPH MILLS DR
MAIN ST
BEND FARM RD
OLIVER CT
EVAN DR
AREND CT
CARRIE CT
TERRA SPRINGS DR
HERONVIEW DR
RIVER MEADOWS WAY
SURBER CT
MANSFIELD CLUB DR
NORTH CLUB DR
SHANNON PARK DR
SHANNON AIRPORT CIR
IMBODEN ST
LEE HILL DR
PIERSON DR
VANCE DR
BROOKE DR
STACY RUN
SAMANTHA PL
MCKENZIE LN
GLENDAS WAY
MELISSA CT
JOSHUA LN
TRICIA PL
ROSSER ST
BEVIN DR
COREYS WAY
MELCHRIS CT
ALLIE PL
H C C DR
ALLIE DR
HAMILTONS CROSSING DR
POWELL ST
R B S RD
HAMILTON ST
GREENFIELD DR
SOUTH BROOKS DR
GERBER DR
DE WITT DR
COLES LN
TIDEWATER TRL
OPAL LN
GUILDERLAND CT
BOXMEER CT
LIMBURG CT
BENCHMARK RD
WALTHALL CT
NAPOLEON ST
CORNELL DR
SCHUMANN ST
CAHILL ST
WHITE STREET CT
SLINGERLAND DR
OCONNOR CT
FRANCIS CT
LEE DR

LEGEND

- Sewer Manholes
- Sewer Gravity Main
- Sewer Force Main
- Stream
- Railroad
- Tax Parcels
- Alignment 1

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS

SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 650 1,300 2,600 3,900 5,200
Feet

N

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020

FIGURE 2

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JOSEPH MILLS DR

BEND FARM RD

MANSFIELD ST

CHURCH ST

TIDEWATER TRL

SHANNON PARK DR

SHANNON AIRPORT CIR

PRELIMINARY ALIGNMENT 1

DEEP RUN PUMP STATION

LEGEND

- Sewer Manholes
- Railroad
- Sewer Gravity Main
- Tax Parcels
- Sewer Force Main
- Alignment 1
- Stream

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

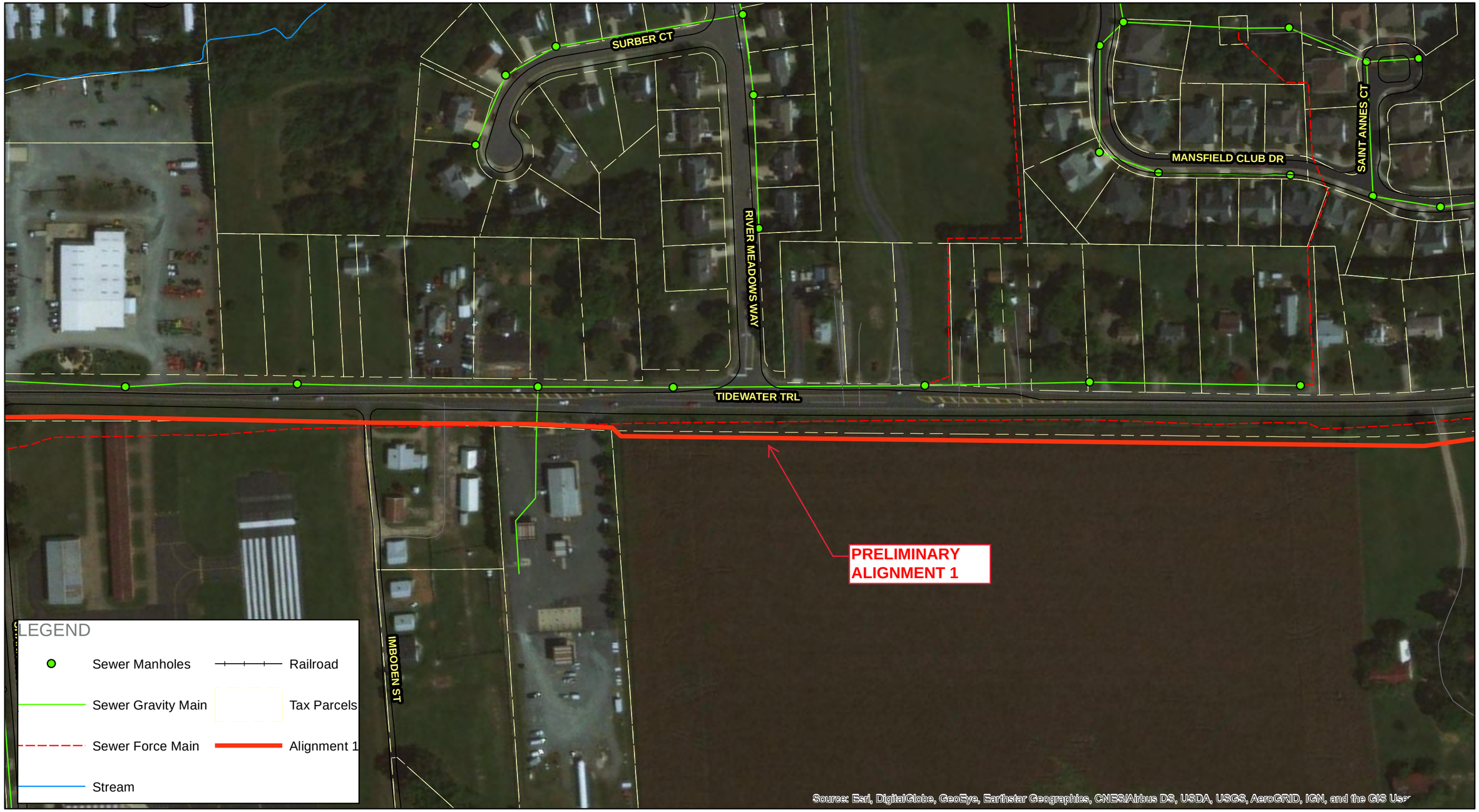
SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 115 230 460 690 920
Feet

N

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020



SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 115 230 460 690 920
Feet

N

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020

SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 115 230 460 690 920
Feet

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DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

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PRELIMINARY ALIGNMENT 1

NORTH CLUB DR

TIDEWATER TRL

VANCE DR

BROOKE DR

ROSSER ST

LEGEND

- Sewer Manholes
- Sewer Gravity Main
- Sewer Force Main
- Stream
- Railroad
- Tax Parcels
- Alignment 1

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 115 230 460 690 920
Feet

N

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020

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PRELIMINARY ALIGNMENT 1

VANCE DR
BROOKE DR
MCKENZIE LN
GLENDAS WAY
TIDEWATER TRL
BENCHMARK RD
BRIARWOOD LN
BEVIN DR
WALL ST
ROSSER ST
BROYHILL CT
COREYS WAY

LEGEND

- Sewer Manholes
- Railroad
- Sewer Gravity Main
- Tax Parcels
- Sewer Force Main
- Alignment 1
- Stream

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 115 230 460 690 920 Feet

N

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020

SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020

0 115 230 460 690 920 Feet

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MASSAPONAX WWTP

PRELIMINARY ALIGNMENT 1

MELCHRIS CT

ALLIE PL

HAMILTONS CROSSING DR

ALLIE DR

H C C DR

R B S RD

POWELL ST

HAMILTON ST

GREENFIELD DR

SOUTH BROOKS DR

BRANDON LN

EARLENE ST

GERBER DR

LEGEND

- Sewer Manholes
- Sewer Gravity Main
- Sewer Force Main
- Stream
- Railroad
- Tax Parcels
- Alignment 1

SPOTSYLVANIA COUNTY
DEEP RUN PUMP STATION

0 170 340 680 1,020 1,360
Feet

N

DEEP RUN PS
PRELIMINARY ALIGNMENT
OVERVIEW

JANUARY 2020

Appendix F – VDOT LUP-OC – Open-Cut Pavement Restoration Requirements

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LAND USE PERMIT
LUP-OC
Open-Cut Pavement Restoration Requirements

Any of the following provisions that may apply, shall apply:

1. The permittee shall be responsible for the restoration of pavement on state maintained highways in accordance with all applicable sections of the VDOT Road and Bridge Specifications, VDOT Road and Bridge Standards and this document.

2. Whenever existing pavement is permitted to be cut, not over one-half of the roadway width shall be disturbed at one time and the first open cut trench section shall be satisfactorily restored to allow for the passage of traffic prior to the second half of the roadway surface can be disturbed.

3. All trench backfill material shall be Select Material Type I having a minimum CBR of 30 and free from any wood, decaying material, asphalt, concrete, ice, frost, large clods, stone or debris.

4. Trench backfill material shall be compacted to a minimum of 95% of the theoretical maximum density at optimum moisture content, as determine by VDOT testing procedures (VTM1), using mechanical tamping throughout the depth of the trench in 6-inch lifts to ensure that the adequate support is provided for the aggregate sub-base layer is adequately supported.

5. For roadways with a bituminous concrete asphalt pavement section the compacted trench backfill shall be capped with 10 inches (10”) of Type I, Size 21-A or 21-B aggregate compacted to 100% of the theoretical maximum density at optimum moisture content covering the entire trench width and a minimum six inch (6”) bench on each side of the excavated trench or as determined by the district administrator’s designee.

6. A bituminous concrete asphalt base course (BM-25) having a minimum thickness of six inches (6”), or matching the existing base course thickness, shall be placed over the benched aggregate sub-base to the bottom elevation of the existing asphalt concrete surface course.

7. All sides of the excavated trench shall be saw-cut trimmed to neat straight lines and a tack coat of RC-250 liquid asphalt applied at a rate of 0.1 gallon per square yard (or as determined by the district administrator’s designee) prior to placing the bituminous concrete asphalt base course (BM-25.0) and/or replacement of the bituminous concrete asphalt surface course (SM-9.5A or SM-9.5D).

8. The existing pavement surface course adjacent to the excavated trench shall be milled and repaved with bituminous concrete asphalt (SM-9.5A or SM-9.5D) having of a minimum thickness of 1-1/2 inches (1.5”). This operation shall cover the entire trench width and extend 12 inches (12”) beyond the edge of the trench on longitudinal open cuts and 25 feet (25’) beyond the trench centerline on perpendicular open cuts, or as determined by the district administrator’s designee.

9. Open cuts in surface treated roadway sections with an aggregate base course shall be replaced with the same layer(s) as roadway sections with a bituminous concrete asphalt pavement structure except the sub-base layer (Type I, Size 21-A or 21-B) may be reduced to six inches (6”) and the bituminous concrete asphalt base layer (BM-25.0) may be reduced to four inches (4”) while maintaining the required six inch (6”) bench on both sides of the excavated trench. The surface course restoration material and thickness shall match the existing surface.

10. Replacement of all bituminous concrete asphalt and surface treated courses shall be rolled with equipment having a manufacturer’s rating of ten (10) tons until the aggregate is keyed into the bitumen. Where rolling is not possible, a mechanical tamper shall be utilized.

11. Full depth aggregate stone may be placed in the trench daily up to maximum length of 500 feet, at which time either temporary or permanent pavement restoration procedures must be implemented.

12. Should the application of the bituminous concrete asphalt surface course be delayed due to adverse weather conditions, the contractor shall provide and maintain a temporary pavement section that is acceptable to the district administrator's designee until such time as the appropriate permanent pavement restoration can be achieved.

13. The permittee shall be responsible for any settlement in the backfill or pavement for a period of two (2) years after the completion date of permit and for the continuing maintenance of the facilities placed within the highway right-of-way.

14. A one-year restoration warranty period may be considered, provided the permittee adheres to the following criteria:

    - The permittee retains the services of a professional engineer (or certified technician under the direction of the professional engineer) to observe the placement of all fill embankments, pavement, and storm sewer and utility trench backfill.
    - The professional engineer (or certified technician under the direction of the professional engineer) performs any required inspection and testing in accordance with all applicable sections of VDOT's Road and Bridge Specifications.
    - The professional engineer submits all testing reports for review and approval, and provides written certification that all restoration procedures have been completed in accordance with all applicable sections of VDOT's Road and Bridge Specifications prior to completion of the work authorized by the permit.

15. The district administrator's designee may request and review the backfill compaction test results and/or authorize an inspector to monitor the trench backfill and compaction operations.

16. The use of steel plates to provide a temporary riding surface will not be allowed between November 1 and April 1. The use of steel plates between April 2 and October 31 shall be in accordance with VDOT standards and specifications.

17. Traffic shall be maintained at all times in accordance with the Virginia Work Area Protection Manual and a VDOT approved Maintenance of Traffic (MOT) plan.

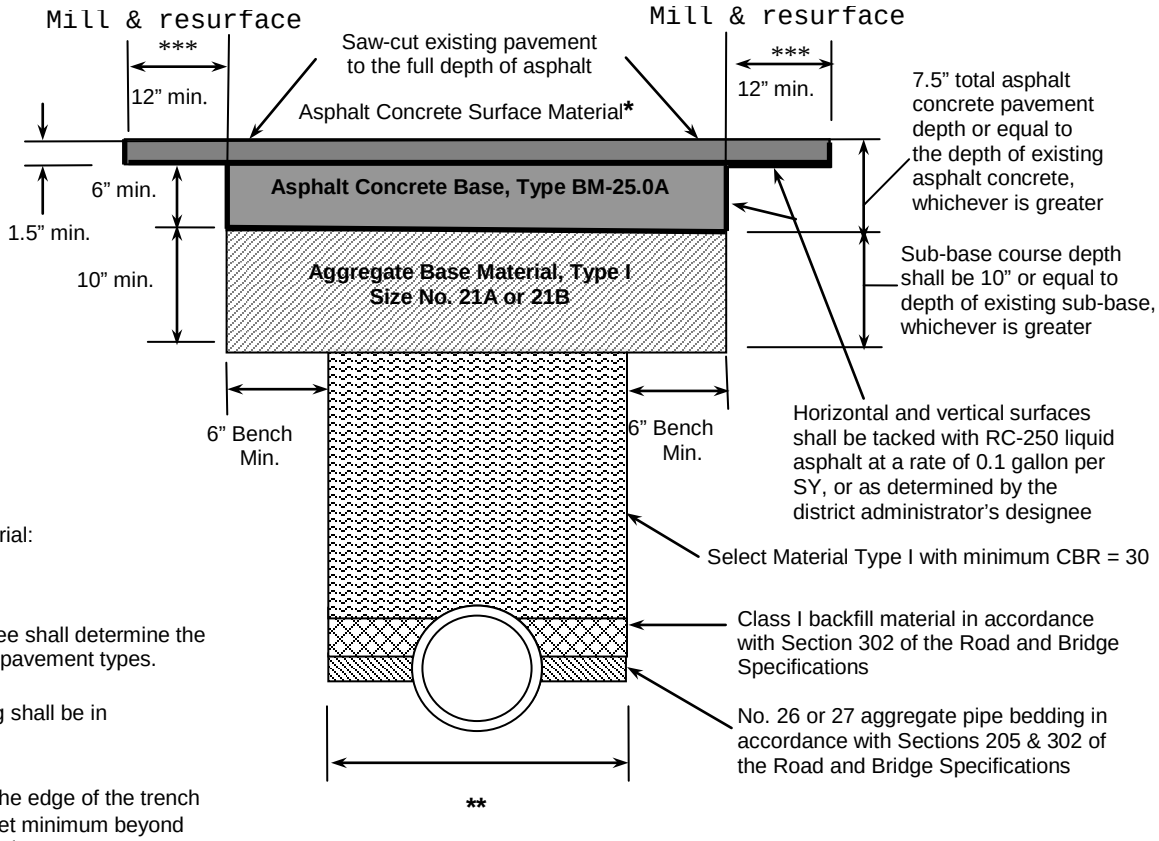
18. The permittee shall notify the district administrator's designee a minimum of 72 hours prior to initiating any pavement open cutting operations.

19. The trench to be backfilled shall be made as dry as practicable at the time of backfilling by pumping, bailing, draining, or other approved dewatering method.

20. All asphalt pavement restoration activities shall be in accordance with the Asphalt Pavement Restoration Detail for Open Cut Utility Installations contained herein.

LAND USE PERMIT
LUP-OC
Open-Cut Pavement Restoration Requirements

Asphalt Pavement Restoration Detail for Open Cut Utility Installations



NOTES:

***** Asphalt Concrete Surface Material:
SM-9.5A for ADT < 10,000
SM-9.5D for ADT > 10,000

The district administrator's designee shall determine the restoration requirements for other pavement types.

****** Trench width and pipe bedding shall be in accordance with VDOT Std. PB-1

******* 12 inches minimum beyond the edge of the trench on longitudinal open cuts, or 25 feet minimum beyond the trench centerline on perpendicular open cuts, or as determined by the district administrator's designee.

Date: August 27, 2014

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Appendix H – Report of Geotechnical Study

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FROEHLING & ROBERTSON, INC.

Report of Preliminary Geotechnical Study

Deep Run Pump Station
Spotsylvania County, Virginia
F&R Project No. 74X0208

Prepared For:
OBG
4435 Waterfront Drive, Suite 205
Glen Allen, Virginia 23060

Prepared By:
Froehling & Robertson, Inc.
10909 Houser Drive
Fredericksburg, Virginia 22408

February 3, 2020

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SINCE
1881

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881

10909 Houser Drive
Fredericksburg, Virginia 22408
T 540-891-2771 I F 540-891-2776

February 3, 2020

Don Simmons
OBG, part of Ramboll (OBG)
4435 Waterfront Drive, Suite 205
Glen Allen, Virginia 23060

Reference: **Report of Preliminary Geotechnical Study**
Deep Run Pump Station
Spotsylvania County, Virginia
F&R Project No. 74X0208

Dear Mr. Simmons:

The purpose of this study is to present the results of the subsurface exploration program and preliminary geotechnical engineering evaluation undertaken by Froehling & Robertson, Inc. (F&R) in connection with the construction of the Deep Run Pump Station project in Fredericksburg, Spotsylvania County, Virginia. Our services were performed in general accordance with F&R Proposal No. 1974-00273 dated December 4, 2019, as authorized by you. The attached report presents our understanding of the project, reviews our exploration procedures, describes existing site and general subsurface conditions, and presents our geotechnical evaluations and recommendations.

We have enjoyed working with you on this project, and we are prepared to assist you with the recommended quality assurance monitoring and testing services during construction. Please contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

Jolie Erickson, P.E.
Geotechnical Engineer

Jeff Morris, P.E.
Senior Engineer

TABLE OF CONTENTS

SECTION		PAGE
EXECUTIVE SUMMARY		1
1.0	PURPOSE & SCOPE OF SERVICES	2
2.0	PROJECT INFORMATION	2
2.1	Site Description	2
2.2	Proposed Construction	2
3.0	EXPLORATION PROCEDURES	3
3.1	Subsurface Exploration	3
3.2	Laboratory Testing	4
4.0	REGIONAL GEOLOGY & SUBSURFACE CONDITIONS	4
4.1	Regional Geology	4
4.2	Subsurface Conditions	5
4.2.1	General	5
4.2.2	Asphalt and Gravel	5
4.2.3	Fill Soils	5
4.2.4	Alluvial Deposits	5
4.3	Subsurface Water	6
4.4	Laboratory and Environmental Testing Results	6
5.0	PRELIMINARY GEOTECHNICAL DESIGN RECOMMENDATIONS	7
5.1	General	7
5.2	Shallow Foundation Recommendations	7
5.2.1	Settlement (Shallow Foundations)	8
5.3	Slab-on-Grade Recommendations	8
5.4	Mat Foundation Recommendations	9
5.5	Seismic Design Criteria	10
5.6	Lateral Earth Pressures	10
6.0	GEOTECHNICAL CONSTRUCTION RECOMMENDATIONS	12
6.1	Site Preparation	12
6.2	Structural Fill Placement and Compaction	12
6.3	Foundation Construction	13
6.4	Surface Water/Groundwater Control	14
6.5	Temporary Excavation Recommendations	14
7.0	CONTINUATION OF SERVICES	15
8.0	LIMITATIONS	15

APPENDICES

APPENDIX I

Site Vicinity Map, Drawing No. 1
Geological Vicinity Map, Drawing No. 2
Boring Location Plan, Drawing No. 3

APPENDIX II

Classification of Soils for Engineering Purposes
Key to Soil Classification
Unified Soil Classification Chart
Boring Logs (B-1 and B-2)

APPENDIX III

Laboratory Test Results
Environmental Test Results

APPENDIX IV

GBA Document “Important Information about Your Geotechnical Engineering Report”

EXECUTIVE SUMMARY

This Executive Summary is provided as a brief overview of our geotechnical engineering evaluation for the project and is not intended to replace more detailed information contained elsewhere in this report. As an overview, this summary inherently omits details that could be very important to the proper application of the provided geotechnical design recommendations. This report should be read in its entirety prior to implementation into design and construction.

- The project consists of construction of a wet well that will be approximately 19 feet below exterior grade, improvements to the existing superstructure, and rerouting of the influent sanitary sewer.
- A subsurface exploration consisting of two borings drilled to 50 feet below current site grades was conducted to evaluate the characteristics of the soils.
- The subsurface soil profile encountered consisted of asphalt pavement, fill, and alluvial soil deposits.
- We recommend that a shallow foundation system be used for support of any above-grade structures. Shallow foundations may be designed for a net allowable bearing pressure of 2,000 psf bearing on suitable existing fill materials, approved natural soils and/or newly placed structural fill.
- The wet well may be constructed on a mat foundation system. The mat foundation for the wet well may be designed for a net allowable bearing pressure of 3,000 psf bearing on undisturbed alluvial soils and/or newly placed structural fill.
- Lateral earth parameters for the proposed wet well are provided in Section 5.6 of this report.
- Based on the boring data, and in general accordance with section 1613.5.2 of the IBC, a Site Class “D” should be used to develop the project’s Seismic Design Category for further evaluations relative to earthquake load design.

1.0 PURPOSE & SCOPE OF SERVICES

The purpose of the subsurface exploration and geotechnical engineering evaluation was to explore the subsurface conditions in the area of the current pump station and provide preliminary geotechnical engineering design and construction recommendations for the proposed Deep Run Pump Station improvements. These recommendations can be used during the design and construction of the proposed pump station.

F&R's scope of services included the following:

- Completion of two (2) Standard Penetration Test (SPT) borings drilled to planned depths of 50 feet below the existing ground surface, or auger refusal;
- Preparation of typed boring logs;
- Performing geotechnical laboratory testing on representative soil samples;
- Performing environmental laboratory testing on select bore hole samples;
- Performing a geotechnical engineering evaluation of the subsurface conditions with regard to their suitability for the proposed construction;
- Preparation of this geotechnical report by professional engineers.

Our scope of services did not include rock coring, a survey of the boring locations, permitting, environmental recommendations, engineering design, sheeting/shoring design or design parameters, pavement design recommendations, property notifications, or site clearing/modification.

2.0 PROJECT INFORMATION

2.1 Site Description

The site for the Deep Run Pump Station is located approximately 250 feet northwest of the intersection of Tidewater Trail and Main Street in Spotsylvania County, Virginia, as shown on the Site Location Plan (Drawing No. 1) included in Appendix I of this report. The site is bordered on the northeast side by Tidewater Trail. A creek, named Deep Run, borders the west and north sides of the site.

In the area of the existing structures, the site is relatively flat. The site slopes gently upward toward Tidewater Trail on the northeast side of the site. On the north and west sides of the site, the topography slopes downward toward the creek.

2.2 Proposed Construction

Our understanding of the project is based on information provided by your office. We understand that the project consists of construction of a new wet well that is expected to extend approximately

19 feet below the exterior grade, rerouting of the influent sanitary sewer, and improvements to the existing pump station.

At the time of this report, no loading or site grading information was available. For any improvements to the existing pump station, we have assumed maximum column and wall loads of 150 kips and 4 kips per linear foot (klf), respectively. If these loads are not representative of the design for the site, we should be notified to modify the geotechnical recommendations contained herein.

3.0 EXPLORATION PROCEDURES

3.1 Subsurface Exploration

The subsurface exploration program was performed on December 30 and 31, 2019, and consisted of two soil test borings, designated B-1 and B-2. The borings were drilled to the planned depth of 50 feet. The borings were staked in the field by F&R personnel by overlaying the provided site plan on aerial images. The overlay was used to space borings and gather coordinates. The coordinates were used in conjunction with a handheld GPS device to locate the borings in the field. The approximate locations of the borings are shown on the attached Boring Location Plan (Drawing No. 3, Appendix I). Approximate elevations were obtained from Google Earth. In consideration of the methods used in their determination, the boring locations shown on the attached Boring Location Plan and the elevations shown on the attached boring logs should be considered approximate.

The soil test borings were performed in accordance with generally accepted practice, using an ATV-mounted CME-55 rotary drill rig. The test borings were advanced using hollow-stem augers to pre-selected depths, the center plug was removed, and representative soil samples were recovered with a standard split-spoon sampler (1 3/8 in. ID, 2 in. OD) in general accordance with ASTM D 1586, the Standard Penetration Test. The split-spoon sampler was driven into the soil by freely dropping a weight of 140 pounds from a height of 30 inches. The number of blows required to drive the split-spoon sampler three consecutive 6-inch increments is recorded, and the blows of the second and third increments are summed to obtain the Standard Penetration Resistance (N-value). The N-value provides a general indication of in-situ soil conditions and has been correlated with certain engineering properties of soils. Standard Penetration Testing was conducted using a safety hammer and cathead.

Subsurface water level readings were taken during drilling, upon removal of augers, and 24 hours after drilling. Periodic observation of the borings should be performed, as the boring backfill could settle over time and result in subsidence of the ground at and around the boreholes.

Split-spoon samples recovered from this project will be stored at F&R's office for a period of 60 days. The samples will be discarded after 60 days, unless prior notification is provided to us in writing.

3.2 Laboratory Testing

Representative portions of the split-spoon soil samples collected throughout the exploration program were placed in glass jars and transported to our laboratory. In the laboratory, the soil samples were evaluated by a member of our engineering staff, in general accordance with techniques outlined in the visual-manual identification procedure (ASTM D 2488) and the Unified Soil Classification System. The soil descriptions and classifications discussed in this report and shown on the attached boring logs are based on visual observation and should be considered approximate. Copies of the boring logs are provided and classification procedures are further explained in Appendix II.

Our service included laboratory testing to aid in identifying and evaluating soils that may affect the structure design or construction. In accordance with our proposal, the following tests were performed on representative soil samples collected during our subsurface exploration.

- 4 Atterberg Limits Tests (ASTM D 4318)
- 4 #200 Wash Tests (ASTM D 6913)
- 4 Natural Moisture Content Tests (ASTM D 2216)
- 1 Standard Proctor Test (ASTM D 698)

In addition to the laboratory tests performed above, environmental testing was performed by Microbac Laboratories. Tests included Diesel Range Organics, Gasoline Range Organics, TCLP Heavy Metals, and Polychlorinated Biphenyls.

The laboratory test results and environmental test information are presented in Section 4.4.

4.0 REGIONAL GEOLOGY & SUBSURFACE CONDITIONS

4.1 Regional Geology

The Geologic Map of Virginia (1993) reports that the project site is located within the Coastal Plains Physiographic Province of Virginia. The topography of the Coastal Plain is a terraced landscape that stair-steps down to the coast and to the major rivers. The risers (scarps) are former shorelines and the treads (flat parts) are emergent bay and river bottoms. The higher, older plains in the western part of the Coastal Plain are more dissected by stream erosion than the lower, younger terrace treads. The landscape was formed over the last few million years as sea level rose and fell in response to the repeated melting and growth of large continental glaciers and as the Coastal Plain slowly uplifted. Based on the Geologic Map of Virginia (1993), the project site lies within the Quaternary-aged (2.58 million years old to today) Shirley Formation in the Coastal Plain Physiographic Province of Virginia. These soil deposits are briefly described below.

The Shirley Formation is characterized by light gray to dark gray, bluish gray, and brown sand, gravel, silt, clay, and peat. Fluvial-estuarine facies comprises a lower pebble to boulder sand overlain by fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in-situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to medium bedded to thick bedded, clayey and sandy silt and silty clay. Our findings coincide with these characteristics although we did not identify the presence of organic material in our alluvial soil samples.

4.2 Subsurface Conditions

4.2.1 General

The subsurface conditions discussed in the following paragraphs and those shown on the attached Boring Logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. The transitions between different soil strata are usually less distinct than those shown on the boring logs. Although individual soil test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Data from the specific soil test borings are shown on the attached boring logs in Appendix II.

The general subsurface profile encountered consists of asphalt and gravel overlying fill and alluvial deposits. These materials are generally discussed in the following paragraphs.

4.2.2 Asphalt and Gravel

Asphalt was encountered in both borings and extended to depths of approximately 2 inches. Beneath the asphalt, approximately 4 to 6 inches of gravel was encountered.

4.2.3 Fill Soils

Fill may be any material that has been transported and deposited by man. Fill soils were encountered in both borings, extending to approximately 5.5 feet. These soils were generally described as clayey SAND (SC). The field Standard Penetration Test (SPT) N-values range from 8 to 15 blows per foot (bpf) and indicate that these soils are loose to medium-dense in relative density. An average SPT N-value of 12 bpf was recorded for the soils in this stratum.

4.2.4 Alluvial Deposits

Alluvial deposits were encountered beneath the fill materials and extended to the termination depths for both borings. These soils were generally described as elastic fat CLAY (CH), clayey SAND (SC), and Silty SAND (SM). The field SPT N-values range from 6 to 100+ bpf and indicate that these soils are firm to very hard in consistency and medium-dense to very dense in relative density. Excluding outliers, an average SPT N-value of 39 bpf was recorded for the soils in this stratum.

4.3 Subsurface Water

The test borings were monitored during drilling operations to obtain subsurface water information. Subsurface water was observed during drilling, after auger removal, and after at least 24 hours. Cave-in depths were also noted. In boring B-1, the subsurface water level was not able to be observed because of the thickness of the mud in the borehole. Subsurface water and cave-in depths are shown in the table below.

Boring No.	Boring Depth (ft)	Depth Encountered during Drilling (ft)	Depth Measured after Auger Removal (ft)	Depth Measured after 24 Hours (ft)	Cave-in Depth (ft)
B-1	50.0	28.5	--	7.8	35.8
B-2	50.0	23.5	18.0	10.0	35.2

It should be noted that the location of the subsurface water table could vary by several feet because of seasonal fluctuations in precipitation, evaporation, surface water runoff, local topography, perched water, and other factors not immediately apparent at the time of this exploration. Normally, the highest subsurface water levels occur in the late winter and spring and lowest levels occur in the late summer and fall.

4.4 Laboratory and Environmental Testing Results

As discussed in Section 3.2, laboratory testing was performed on soil samples collected during our subsurface exploration. The results from the laboratory testing are summarized in the table below, and are presented in Appendix III of this report.

Boring No.	Sample Depth (ft)	Water Content (%)	% Retained on No. 4 Sieve	% Finer than No. 200 Sieve[b]	Atterberg Limits[a]			Maximum Dry Density/Optimum Moisture (pcf/%)[c]	USCS Classification[d]
					L.L.	P.L.	P.I.		
B-1	0.0-5.0	12.9	20.2	41.3	36	18	18	120.2/12.3	SC
B-1	8.5-10.0	31.6	0.2	99.1	68	31	37	--	CH
B-1	28.5-35.0	24.8	0.0	22.1	34	22	12	--	SC
B-2	8.5-10.0	39.9	10.4	57.8	67	23	44	--	CH

(a) Liquid Limit and Plasticity Index from Atterberg Limits test (ASTM D 4318)
(b) Percentage of fines (silt and/or clay) from #200 Sieve Wash (ASTM D 6913)
(c) Maximum Dry Density and Optimum Moisture from Standard Proctor (ASTM D 698)
(d) Unified Soil Classification System

Composite soil samples were obtained during the site exploration. The composite soil samples were representative of the soils encountered on-site and were kept on ice and transported to Microbac Laboratories for environmental laboratory testing for disposal purposes of Investigative Derived Waste. The composite samples contained detectable amounts of Barium metal. The concentration levels of these materials were below the cut off concentrations for disposal of the soils at conventional landfills. Please note that the samples obtained represent a small portion of the proposed construction area and that additional composite sampling during construction would help

better determine contaminants found in the on-site soils. The results from the environmental testing are summarized in Appendix III of this report.

5.0 PRELIMINARY GEOTECHNICAL DESIGN RECOMMENDATIONS

5.1 General

The following evaluations and recommendations are based on our observations at the site, interpretation of the field data obtained during this exploration, and our experience with similar subsurface conditions and projects. Soil penetration data has been used to estimate an allowable bearing pressure and associated settlement using established correlations. Subsurface conditions in unexplored locations may vary from those encountered. If the structures' locations, loads, or elevations are changed, we should be notified and requested to confirm and, if necessary, re-evaluate our recommendations.

Design of an appropriate foundation system for a given structure is dependent on the proposed structural loads, soil conditions, settlement tolerances, and construction constraints such as proximity to other structures, etc. The subsurface exploration aids the geotechnical engineer in identifying the soil stratum appropriate for structural support. This identification includes considerations with regard to both allowable bearing pressure and compressibility of the soil strata. In addition, since the method of construction greatly affects the soils intended for structural support, consideration must be given to the implementation of suitable methods of site preparation, fill compaction, and other aspects of construction.

5.2 Shallow Foundation Recommendations

Any above-grade structures can be designed for a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) bearing on suitable existing fill, approved natural soils, or newly placed structural fill. Exterior footings should bear at least 24 inches below finished grades for frost protection considerations. To reduce the possibility of localized shear failures, spread column and strip footings should be a minimum of 3 feet and 2 feet wide, respectively.

If unsuitable soils are encountered during structure foundation construction, these soils should be undercut and replaced with structural fill up to the proposed foundation depth. As an alternate, the foundations can be extended. During construction of the proposed structures, an experienced engineer or his/her representative should be on site to confirm that the in-situ bearing conditions at the bottom of each footing excavation are adequate for the design bearing pressure recommended in this report.

In general, care should be exercised when constructing adjacent structures in order to avoid foundations from adjacent structures undermining each other's foundations. A footing is considered to be undermined when the soil located below a hypothetical line extending

downward from the bottom of the footing at a 1.0 horizontal to 1.0 vertical slope is disturbed. It is preferable to found footings of adjacent structures at the same elevation whenever possible. In cases where adjacent structure foundations will not bear at the same elevation, the shallower foundations should be stepped down to match the elevation of the deeper foundations. When stepping-down of the foundations is not possible, then the effect of the surcharge loads should be added to the recommended earth pressures to determine total lateral stresses on the deeper of the adjacent foundations.

5.2.1 Settlement (Shallow Foundations)

Our settlement analysis was performed on the basis of the assumed structural loading and information as discussed in the project information section of this report. Actual settlements experienced by a structure and the time required for these soils to settle can be influenced by undetected variations in subsurface conditions, actual structural loads, final grading plans, and the quality of fill placement and foundation construction.

Based on the boring data and assumed loading information, we estimate that total settlements will be less than one inch, with differential settlement of up to one-half the estimated total settlement. The magnitude of differential settlements will be influenced by the variation in excavation requirements across the foundation footprint, the distribution of loads, and the variability of underlying soils.

5.3 Slab-on-Grade Recommendations

Ground floor slabs may be designed as a slab-on-grade supported by suitable fill soils or newly placed controlled fill. If the existing soils are used for support of the slab-on-grade, a proofroll should be performed to locate soft, weak, or excessively wet soils present at the time of construction (see Construction Recommendations, Section 6). Any unsuitable materials observed during the evaluation and proofrolling operations should be undercut and replaced with compacted fill and/or stabilized in place.

A vapor retarder should be used beneath ground floor slabs that will be covered by tile, wood, carpet, impermeable floor coatings, and/or if other moisture-sensitive equipment or materials will be in contact with the floor. However, the use of vapor retarders may result in excessive curling of floor slabs during curing. We refer the floor slab designer to ACI 302.1R-15, Sections 5.2.3 and 13.11, for further discussion on vapor retarders, curling, and the means to minimize concrete shrinkage and curling.

We recommend that ground floor slabs have a minimum thickness of 4 inches and be reinforced with welded wire fabric. Ground floor slabs may have to be greater in thickness for support of vehicles. We recommend that the slab-on-grade be underlain by a minimum of 4-inches of well-compacted granular materials, which should conform to an open graded aggregate (such as VDOT

No. 57 Stone). This granular material provides a capillary break between the subgrade and slab-on-grade; while also providing a uniform bearing surface.

Proper jointing of the ground floor slab is also essential to minimize cracking. ACI suggests that unreinforced, plain concrete slabs may be jointed at spacings of 24 to 36 times the slab thickness, up to a maximum spacing of 18 feet. Floor slab construction should incorporate isolation joints along bearing walls and around column locations to allow minor movements to occur without damage. Utility or other construction excavations in the prepared floor subgrade should be backfilled with controlled fill placed in accordance with the recommendations of this report to provide uniform floor support.

Structural analyses and design of floor slab foundation may require the use of a vertical modulus of subgrade reaction (k). We note that typical practice for slab-on-grade design is to provide a "k" value based on published correlation with soil types and California Bearing Ratio (CBR) test values. Such correlations are based on empirical data from plate load tests. The plate load test sufficiently models typical floor and wheel loads that exert stresses on the order of 3 to 5 feet. Based on published correlations, we estimate that a design modulus of subgrade reaction (k) = 100 pci is appropriate for floor slab design calculations, provided that a 4-inch subbase is used.

5.4 Mat Foundation Recommendations

A mat foundation can be used for the wet well. We recommend that the wet well foundation be designed for a maximum net allowable contact pressure of 3,000 psf bearing on suitable alluvial soils or structural fill. The depth of the proposed wet well mat foundation is located below the water levels encountered in the borings at the site. Please note that after 24 hours, groundwater was observed at 7.8 feet in boring B-1 and 10.0 feet in boring B-2. We have assumed a water table elevation of 8 feet based on our subsurface exploration and observation of the recovered soil samples. Water table depths should be verified during construction. Therefore, the structural engineer should account for hydrostatic uplift forces acting on the proposed below-grade structure located beneath the water table. Typically, hydrostatic uplift forces can be resisted by the dead weight of the wet well structure. If the dead weight of the structure is not enough to resist the forces, then the base thickness of the structure should be increased and extended beyond the sides to provide additional uplift resistance. If the proposed bearing depth of the structures has to be revised, we request that the revised depth be provided to us in order to confirm or revise the bearing recommendations provided. If needed for design, we recommend that a design modulus of subgrade reaction (k) = 70 pci be used for the wet well mat foundation.

Based on the boring data and assumed loading information, we estimate total foundation settlement of the well of less than one inch, with differential settlement of half the calculated total. The magnitude of total and differential settlements will be influenced by the variation in excavation requirements across the footprint, the distribution of loads, and the variability of underlying soils.

Our settlement analyses were performed on the basis of assumed structural loads as well as the provided excavation information discussed in the project information section of this report. Actual settlements experienced by the structure and the time required for these soils to settle will be influenced by undetected variations in subsurface conditions and actual structural loads.

If soft materials are encountered at mat foundation bearing elevations or the soils are allowed to soften due to wet conditions, we recommend that these materials be over excavated and replaced with controlled structural fill, crushed stone, lean concrete, and/or flowable fill.

5.5 Seismic Design Criteria

The following Seismic Site Class Definition was established in general accordance with Table 20.3-1 of the ASCE 7-10 as set forth in the International Building Code (IBC) 2012. Our scope of services did not include a seismic conditions survey to determine site-specific shear wave velocity information, however, ASCE 7-10, Chapter 20 provides a methodology for interpretation of Standard Penetration Test resistance values (N-values) to determine a Site Class Definition. Based on the SPT soil testing, and our experience in the area, we recommend that a Seismic Site Class "D" be used in accordance with ASCE 7-10 for the proposed structures.

We note that the above provided Site Classification is based on preliminary information, including SPT borings advanced to depths of 50 feet. Should this classification be so onerous to the project cost that further study is warranted, we can perform deeper subsurface exploratory soil test borings and/or a site-specific geo-physical survey to attain sufficient detail to refine the project's Seismic Site Class Definition.

5.6 Lateral Earth Pressures

The following information is to aid in analysis of soil loads on the below-grade walls for the proposed wet well. Earth pressures on walls below grade are influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction, and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as freestanding walls, where some movement and rotation may occur to mobilize shear strength. Walls that are rigidly restrained, such as basement, pit, pool, and tunnel walls, should be designed for the structure requiring the use of at-rest pressures.

A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Because significant wall movements are required to develop the passive pressure, the total calculated passive pressure should be reduced by one half to two thirds for design purposes.

We recommend the following lateral earth pressure coefficients and other parameters in the table below be used for design of the below-grade wet well walls on this site. We have included our recommendations for active, at-rest, and passive parameters. For the wet well, with rigid constraint at the top of the well, we recommend using the at-rest earth pressure. The parameters provided in the tables below should be used for the soils encountered on the site.

Design Parameters	On-site SC or more granular
Moist unit weight of backfill (pcf)	120
Buoyant unit weight (pcf)	57.6
Angle of Internal Friction (ø)	28°
Equivalent Fluid Unit Weight (pcf), Active	43
Equivalent Fluid Unit Weight (pcf), At Rest	64
Coefficient of Earth Pressure at Rest (K_o)	0.53
Coefficient of Passive Earth Pressure (K_p)	2.77
Coefficient of Active Earth Pressure (K_a)	0.36
Coefficient of Friction [Concrete on Soil](μ)	0.3

Our recommendations assume that the ground surface above the well is level. The recommended equivalent fluid pressures in the tables above assume that hydrostatic pressures are not present between walls and the on-site alluvial soils. However, the proposed elevation of the wet well is at approximately 19 feet below the surface, and water was encountered above those elevations during our site exploration. Therefore, lateral earth pressures below the water table should be determined using the buoyant weight of the soil. Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design. We have assumed a water table elevation of 8.0 feet based on our subsurface exploration and observation of the soil jars. The subsurface water elevation should be verified during construction. Surcharge loads due to the above-grade pump station should be accounted for in the design of the below grade walls.

Heavy equipment should not operate within 5 feet of below-grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loads are located a short distance outside the building walls, they may also exert appreciable additional lateral pressures. Surcharge loads should be evaluated using the appropriate active or at-rest pressure coefficients provided above. The effect of surcharge loads should be added to the recommended earth pressures to determine total lateral stresses.

6.0 GEOTECHNICAL CONSTRUCTION RECOMMENDATIONS

6.1 Site Preparation

Before proceeding with construction, any surficial soils, pavements, and other deleterious non-soil materials should be stripped or removed from the proposed construction area. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water. Underground utilities should be re-routed to locations a minimum of 10 feet outside of the proposed new structures' footprints.

After stripping, areas intended to support new fill, slabs, and foundations should be carefully evaluated by a geotechnical engineer. At that time, the engineer may require proofrolling of the subgrade with a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Proofrolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. For the wet well, where proofrolling may not be feasible, other methods such as the use of a probe rod and DCP may be considered. The purpose of the proofrolling and subgrade evaluation is to locate soft, weak, or excessively wet soils present at the time of construction. Any unsuitable materials observed during the evaluation and proofrolling operations should be undercut and replaced with compacted fill and/or stabilized in-place.

The proofrolling process provides a good opportunity to identify areas of poorer support materials intermediate of the test boring locations, if present. If encountered, low-consistency materials may require undercutting and/or in-place stabilization. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer at the time of construction. Once the site has been properly prepared, at-grade construction may proceed.

6.2 Structural Fill Placement and Compaction

Controlled fill may be required for general site work, slab-on-grade support, and to fill the excavations for the below grade wet well. Controlled fill may be constructed using the non-organic on-site soils and/or an off-site borrow source having a classification of SC, SM, ML, CL, or better, as defined by the Unified Soil Classification System. Fill materials and non-plastic fill soils should have a maximum liquid limit of 40 and plasticity index less than 20. It should be noted that any import material that is intended for use as structural fill should be tested to verify that it meets these criteria prior to its import or use. Other materials may be suitable for use as controlled structural fill material and should be individually evaluated by the geotechnical engineer. Controlled fill should be free of boulders, organic matter, debris, or other deleterious materials and should have a maximum particle size no greater than 3 inches. In addition, we recommend a minimum standard Proctor (ASTM D 698) maximum dry density of approximately 100 pounds per cubic feet for fill materials. A mixture of on-site soils and boulders/cobbles is not an acceptable fill material.

After acceptance of the soil subgrade, fill materials should be placed in horizontal lifts with a maximum height of 8 inches loose measure. New fill should be adequately keyed into stripped and scarified subgrade soils and should, where applicable, be benched into the existing slopes. During fill operations, positive surface drainage should be maintained to prevent the accumulation of water. We recommend that structural fill be compacted to at least 95 percent of the standard Proctor maximum dry density. In confined areas, such as utility trenches, portable compaction equipment and thin lifts of 3 to 4 inches may be required to achieve specified degrees of compaction.

In general, we recommend that the moisture content of fill soils be maintained within three percentage points of the optimum moisture content as determined from the standard Proctor density test. Excessively wet or excessively dry soils should not be used as fill material without proper drying or wetting. We recommend that the contractor have equipment on site during earthwork for both drying and wetting of fill soils. Each lift of fill should be tested in order to confirm that the recommended degree of compaction is attained.

Where construction traffic or weather has disturbed the subgrade, the upper 8 inches of soils intended for structural support should be scarified and re-compacted. Each lift of fill should be tested in order to confirm that the recommended degree of compaction is attained. Field density tests to verify fill compaction should be performed for every 2,500 square feet (approximately 50 feet square) of fill area, with a minimum of two tests per lift. In confined areas, a greater frequency may be required.

6.3 Foundation Construction

All foundation subgrades should be observed, evaluated, and verified for the design bearing pressure by the geotechnical engineer after excavation and prior to reinforcement steel placement. If low consistency soils are encountered during foundation construction, localized undercutting and/or in-place stabilization of foundation subgrades will be required. The actual need for and extent of undercutting should be based on field observations made by the geotechnical engineer at the time of construction.

Excavations for footings should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. Foundation concrete should not be placed on frozen or saturated subgrades. If such materials are allowed to remain below foundations, settlements will increase. Foundation excavations should be concreted as soon as practical after they are excavated. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Water should not be allowed to pond in any excavation.

6.4 Surface Water/Groundwater Control

Subsurface water for the purposes of this report is defined as water encountered below the existing ground surface. Subsurface water was encountered in both borings during drilling operations. Subsurface water was observed at depths ranging from 7.8 to 28.5 feet. The proposed wet well will be located beneath the subsurface water on site. Therefore, the contractor should be prepared to dewater and develop a dewatering system during construction. Dewatering operations may be performed through the use of drainage trenches, sumps, pumping, perimeter dewatering wells, or other proposed methods. Fluctuations in subsurface water levels and soil moisture can be anticipated with changes in precipitation, runoff, and season.

An important aspect to consider during development of this site is surface water control. During construction, we recommend that steps be taken to enhance surface flow away from any excavations and promote rapid clearing of rainfall and runoff water following rain events. Also, pumping of groundwater will be required to maintain a stable bearing surface for the below grade wet well during construction. It should be incumbent on the contractor to maintain favorable site drainage during construction to reduce deterioration of otherwise stable subgrades.

6.5 Temporary Excavation Recommendations

Construction of the wet well is expected to require an excavation at least 19 feet below the surrounding ground surface. Therefore, a temporary excavation support system will be required. The type and design of the temporary earth support system should be the responsibility of the contractor. It is expected that internally braced steel sheet piles is a feasible method to support the excavation. The interlocking sheets will also limit groundwater infiltration from the sides of the excavation.

Mass excavations and other excavations required for construction of this project must be performed in accordance with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) guidelines (29 CFR 1926, Subpart P, Excavations) or other applicable jurisdictional codes for permissible temporary side-slope ratios and/or shoring requirements. The OSHA guidelines require daily inspections of excavations, adjacent areas, and protective systems by a competent person for evidence of situations that could result in cave-ins, indications of failure of a protective system, or other hazardous conditions. All excavated soils, equipment, building supplies, etc., should be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. F&R cautions that the actual excavation slopes will need to be evaluated frequently each day by the competent person and flatter slopes or the use of shoring may be required to maintain a safe excavation depending upon excavation specific circumstances. The contractor is responsible for providing the competent person and all aspects of site excavation safety. F&R can evaluate specific excavation slope situations if we are informed and requested by the owner, designer, or contractor's competent person.

7.0 CONTINUATION OF SERVICES

We recommend that we be given the opportunity to review the foundation plans, grading plan, and project specifications when construction documents approach completion. This review evaluates whether the recommendations and comments provided herein have been understood and properly implemented. We also recommend that Froehling & Robertson, Inc. be retained for additional subsurface exploration and professional and construction materials testing services during construction of the project. Our continued involvement on the project helps provide continuity for proper implementation of the recommendations discussed herein.

The Geotechnical Engineer of Record should be retained to monitor and test earthwork activities and subgrade preparations for foundations, excavations, and floor slabs. It should be noted that the actual soil conditions at the various subgrade levels and footing bearing grades will vary across this site and thus the presence of the Geotechnical Engineer and/or the engineer's representative during construction will serve to validate the subsurface conditions and recommendations presented in this report. We recommend that F&R be employed to monitor the earthwork and foundation construction, and to report that the recommendations contained in this report and the subsequent specifications are completed in a satisfactory manner. Our involvement on the project will aid in the proper implementation of the recommendations discussed herein. To reiterate, the following is a recommended scope of services:

- Review of project plans and construction specifications to verify that the recommendations presented in this report have been properly interpreted and implemented;
- Observe and perform testing during earthwork to document that subsurface conditions encountered during construction are consistent with those anticipated in this report;
- Observe subgrade preparation including any proofrolling operations, undercutting of soft/loose unsuitable soils, installation of drainage materials, geotextiles and fill placement;
- Observe all foundation excavations and footing bearing grades for compliance with the geotechnical recommendations.

These services are not included in our current scope of services and can be rendered for an additional cost.

8.0 LIMITATIONS

This report has been prepared for the exclusive use OBG, or their agent, for specific application to the Deep Run Pump Station project, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our evaluations and recommendations are based on design information furnished to us, the data obtained from the previously described subsurface exploration program, and generally accepted geotechnical engineering practice. The evaluations and recommendations do not reflect variations in subsurface

conditions which could exist intermediate of the boring locations or in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our recommendations based upon on-site observations of the conditions.

There are important limitations to this and all geotechnical studies. Some of these limitations are discussed in the information prepared by GBA, which is included in Appendix IV. We ask that you please review this GBA information.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should evaluate earthwork and foundation construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

In the event that changes are made in the design or location of the proposed structures, the recommendations presented in the report shall not be considered valid unless the changes are reviewed by our firm and conclusions of this report modified and/or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid.

APPENDIX I

FROEHLING & ROBERTSON, INC.

SITE VICINITY MAP

Drawing No. 1

Project No: 74X-0208
Client: OBG
Project: Deep Run Pump Station
County/State: Spotsylvania County, Virginia

Source: Google Earth
Scale: As Shown
Date: February 2020

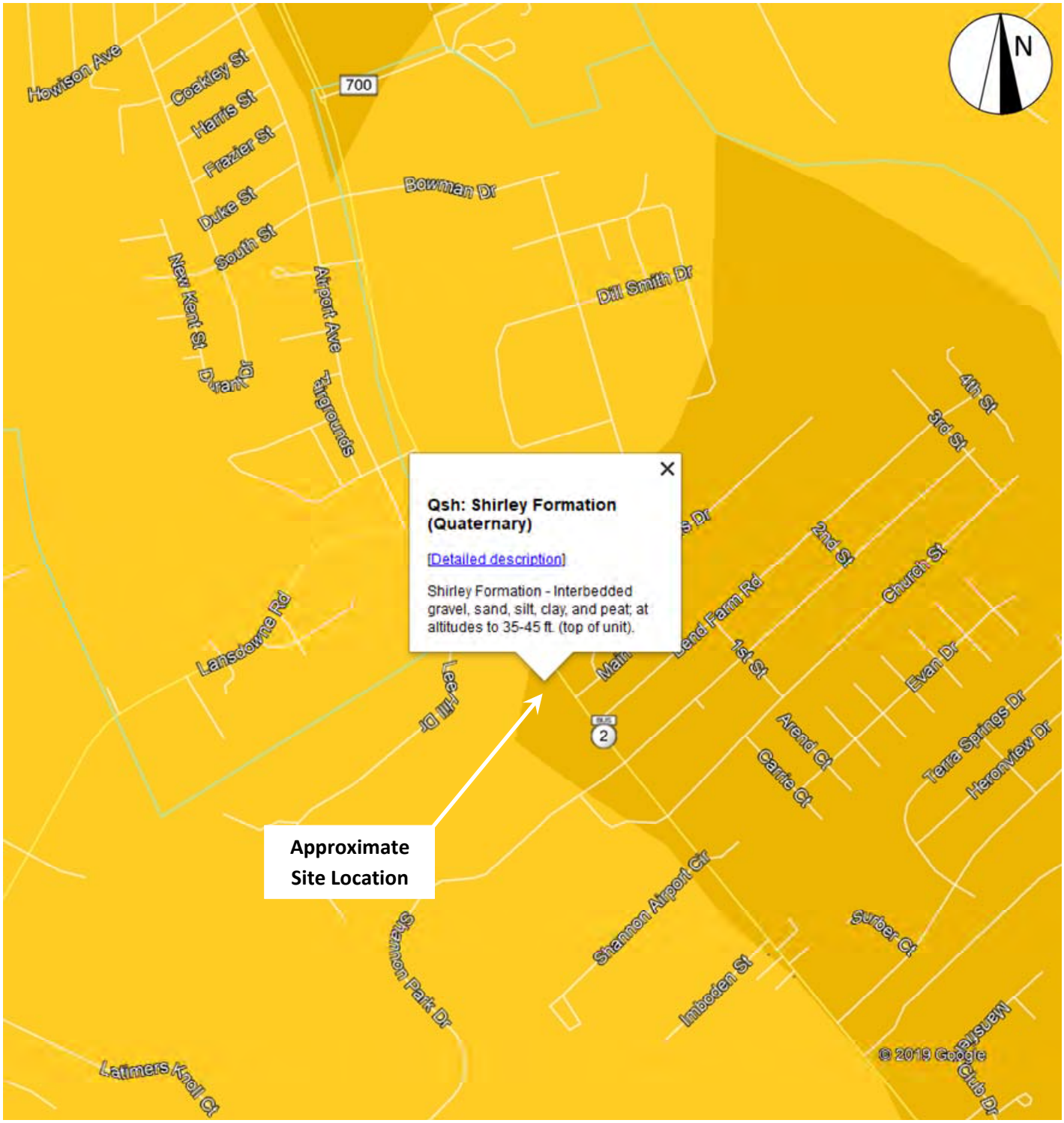
FROEHLING & ROBERTSON, INC.

GEOLOGICAL VICINITY MAP

Drawing No. 2

Project No: 74X-0208
Client: OBG
Project: Deep Run Pump Station
County/State: Spotsylvania County, Virginia

Source: Google Earth
Scale: As Shown
Date: February 2020



FROEHLING & ROBERTSON, INC.

BORING LOCATION PLAN

Drawing No. 3

Project No: 74X-0208
Client: OBG
Project: Deep Run Pump Station
County/State: Spotsylvania County, Virginia

Source: Google Earth
Scale: As Shown
Date: February 2020

- Approximate Boring Locations

APPENDIX II

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487

(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retaining on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines More than 12 % fines[C]	Fines classify as ML or MH	GM	Silty gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel [F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand [G,H,I]
			Fines classify as CL or CH	SC	Clayey sand [G,H,I]
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	Silts and Clays Liquid Limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K,L,M]
		Organic	Liquid limit - oven dried <0.75 Liquid limit - not dried	OL	Organic clay [K,L,M,N]
					Organic silt [K,L,M,O]
	Silts and Clays Liquid Limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic silt [K,L,M]
		Organic	Liquid limit - oven dried <0.75 Liquid limit - not dried	OH	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in (75 mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10}*D_{60})$

[F] If soil contains ≥ 15% sand, add "with sand" to the group name

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM

[H] If fines are organic, add "with organic fines" to the group name

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name

[J] If Atterberg limits plot in hatched area, soils is a CL-ML, silty clay

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant

[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name

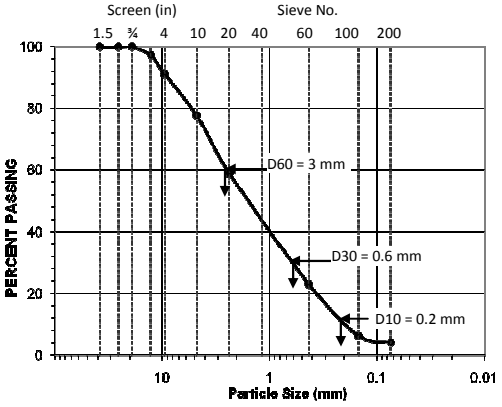
[N] PI ≥ 4 and plots on or above "A" line

[O] PI < 4 or plots below "A" line

[P] PI plots on or above "A" line

[Q] PI plots below "A" line

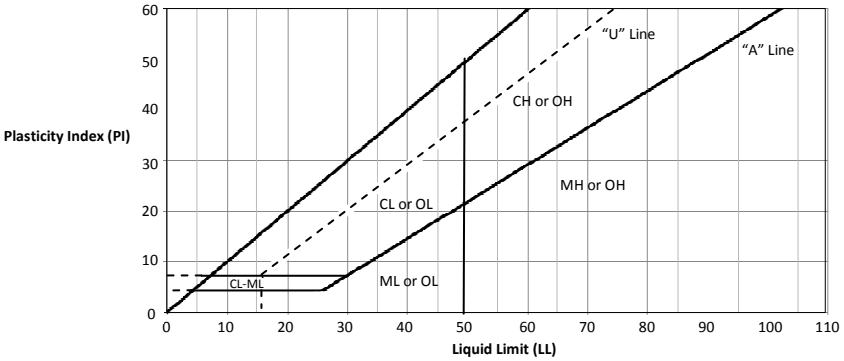
SIEVE ANALYSIS



$Cu = D_{60}/D_{10} = (3/0.2) = 15$

$Cc = (D_{30})^2/(D_{10}*D_{60}) = (0.6^2)/(0.2*3) = 0.6$

For classification of fine-grained soils and fine-grained fraction of coarse-grained soils:



Equation of "A" line: Horizontal at PI = 4 to LL = 22.5, then PI = 0.73*(LL-20)

Equation of "U" line: Vertical at LL = 16 to PI = 7, then PI = 0.9*(LL-8)

KEY TO SOIL CLASSIFICATION

Correlation of Penetration Resistance with Relative Density and Consistency

Sands and Gravels		Silts and Clays	
No. of Blows, N	Relative Density	No. of Blows, N	Consistency
0 - 4	Very loose	0 - 2	Very soft
5 - 10	Loose	3 - 4	Soft
11 - 30	Medium dense	5 - 8	Firm
31 - 50	Dense	9 - 15	Stiff
Over 50	Very dense	16 - 30	Very stiff
		31 - 50	Hard
		Over 50	Very hard

Particle Size Identification

(Unified Classification System)

Boulders:	Diameter exceeds 12-in. (300-mm)
Cobbles:	3-in. (75-mm) to 12-in. (300-mm) diameter
Gravel:	**Coarse** - ¾-in. (19-mm) to 3 in. (75-mm) diameter **Fine** - No. 4 (4.75-mm) sieve to ¾-in. (19-mm) diameter
Sand:	**Coarse** – No. 10 (2.0-mm) to No. 4 (4.76 mm) sieve **Medium** – No. 40 (0.425-mm) to No. 10 (2.0-mm) sieve **Fine** - No. 200 (0.075-mm) to No. 40 (0.425-mm) sieve
Silt and Clay:	Less than No. 200 (0.075-mm) sieve

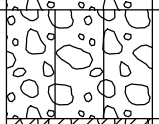
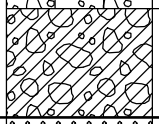
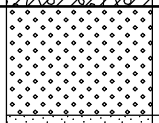
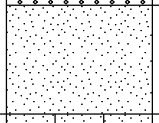
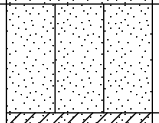
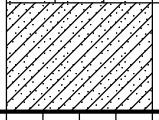
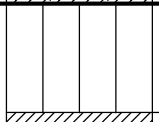
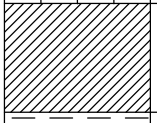
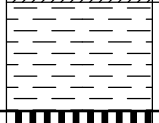
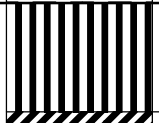
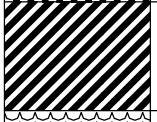
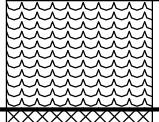
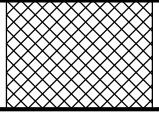
Modifiers

The modifiers provide our estimate of the amount of silt, clay or sand size particles in the soil sample.

Approximate Content	Modifiers
≤ 5%:	Trace
5 to 10%:	Few
15 to 25%:	Little
30 to 45%:	Some
50 to 100%	Mostly

Field Moisture	Description
Dry	Absence of moisture, dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
EXISTING FILL				FILL	EXISTING FILL MATERIALS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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BORING LOG

Boring: B-1 (1 of 1)

Project No: 74X0208
Client: OBG
Project: Deep Run Pump Station
City/State: Spotsylvania County, Virginia

Elevation: 61 ±
Total Depth: 50.0'
Location: See Boring Location Plan

Drilling Method: HSA 2 1/4 ID
Hammer Type: Safety
Date Drilled: 12/30/19
Driller: Martin

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
60.8	0.2	2 inches of asphalt				
60.5	0.5	4 inches of gravel	5-7-8	1.0		
		FILL: medium-dense to loose, yellowish brown, clayey fine SAND - moist		2.5	15	
			3-4-4	3.5		
		(SC)		5.0	8	
55.5	5.5	**ALLUVIAL:** stiff to very hard, reddish brown and dark gray, fat CLAY - moist	3-4-6	6.0		
				7.5	10	
		(CH)	4-5-9	8.5		Subsurface water was measured at 7.8 feet after 24 hours
				10.0	14	
			8-12-15	13.5		Subsurface water level was not able to be determined after auger removal due to the thickness of mud in the borehole
				15.0	27	
			13-21-36	18.5		
				20.0	57	
39.0	22.0	medium-dense to very dense, gray, clayey fine to medium SAND - moist	13-14-16	23.5		
		(SC)		25.0	30	
	▽		8-13-21	28.5		Subsurface water was encountered at 28.5 feet
				30.0	34	
			11-16-24	33.5		
				35.0	40	Cave-in depth 35.8 feet
			16-26-40	38.5		
				40.0	66	
19.0	42.0	very hard, dark olive brown, fat CLAY - moist	16-34-50/6	43.5		
		(CH)		45.0	100+	
14.0	47.0	very dense, gray, silty fine to medium SAND - moist	23-44-50/4	48.5		
11.0	50.0	(SM)		50.0	100+	
		Boring terminated at 50 feet. Boring backfilled and capped upon completion.				

BORING_LOG 74X0208.GPJ F&R.GDT 1/30/20

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON
Engineering Stability Since 1881

BORING LOG

Boring: B-2 (1 of 1)

Project No: 74X0208
Client: OBG
Project: Deep Run Pump Station
City/State: Spotsylvania County, Virginia

Elevation: 60 ±
Total Depth: 50.0'
Location: See Boring Location Plan

Drilling Method: HSA 2 1/4 ID
Hammer Type: Safety
Date Drilled: 12/31/19
Driller: Martin

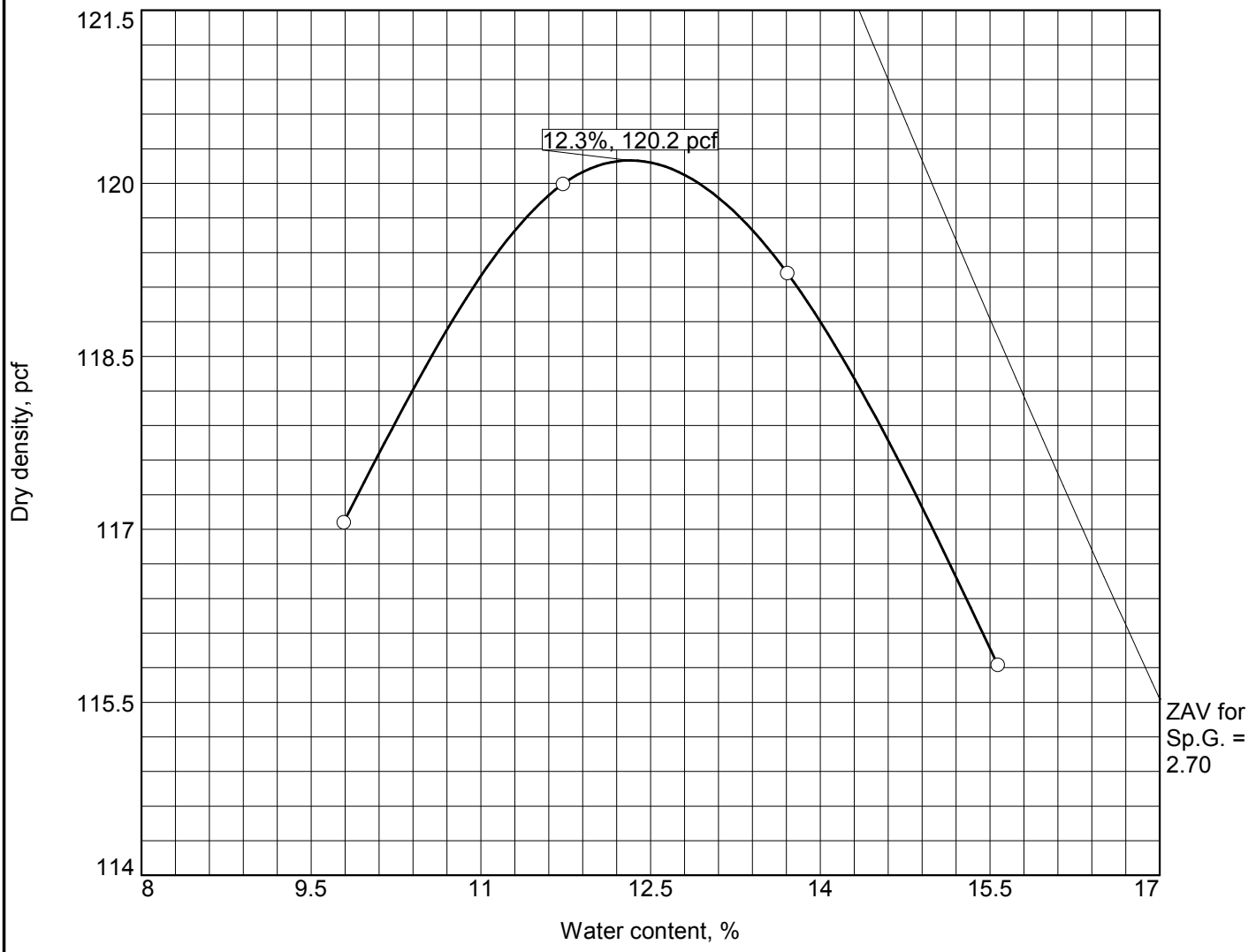
Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
59.8	0.2	2 inches of asphalt				
59.3	0.7	6 inches of gravel	7-7-7	1.0		
				2.5	14	
57.0	3.0	**FILL:** medium-dense, yellowish brown, clayey fine SAND - moist (SC)	5-5-4	3.5		
				5.0	9	
54.5	5.5	stiff, yellowish brown and gray, sandy lean CLAY - moist (CL)	2-3-3	6.0		
				7.5	6	
			2-2-9	8.5		
		ALLUVIAL: firm to stiff, yellowish brown and dark gray, sandy fat CLAY - moist (CH)		10.0	11	Subsurface water was measured at 10.0 feet after 24 hours
48.0	12.0	very stiff to very hard, reddish brown, fat CLAY - moist (CH)	6-10-13	13.5		
				15.0	23	
			18-32-45	18.5		Subsurface water level was measured at 18.0 feet after auger removal
				20.0	77	
38.0	22.0	dense to very dense, gray, silty fine SAND - moist (SM)	23-20-19	23.5		Subsurface water was encountered at 23.5 feet
				25.0	39	
			19-28-34	28.5		
				30.0	62	
28.0	32.0	very dense, gray, silty fine to medium SAND - moist (SM)	11-22-37	33.5		
				35.0	59	Cave-in depth 35.2 feet
			14-32-50/5	38.5		
				40.0	100+	
18.0	42.0	very hard, dark gray and dark olive brown, fat CLAY - moist (CH)	26-50/6	43.5		
				45.0	100+	
13.0	47.0	very dense, dark gray, silty fine SAND - moist (SM)	17-29-45	48.5		
10.0	50.0	Boring terminated at 50 feet. Boring backfilled and capped upon completion.		50.0	74	

BORING_LOG 74X0208.GPJ F&R.GDT 1/30/20

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

APPENDIX III

MOISTURE-DENSITY RELATIONSHIP For Curve No. 134682



Test specification: ASTM D 698-12 Method A Standard
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
0	SC	A-6	12.9	--	36	18	20.2	41.3

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 120.2 pcf	112.4 pcf	Strong brown clayey SAND with gravel, contains mica
Optimum moisture = 12.3 %	14.9 %	

Project No. 74X-0208 **Client:** OBG, Part of Ramboll
Project: Deep Run Pump Station
Date: 1-28-20
○ **Source of Sample:** Borings **Sample Number:** 134682

Remarks:
Date Received: 1-13-2020
Location: B-1, 0'-3'

FROEHLING & ROBERTSON, INC.

Figure

Sp. gr. for ZAV is an assumed value.

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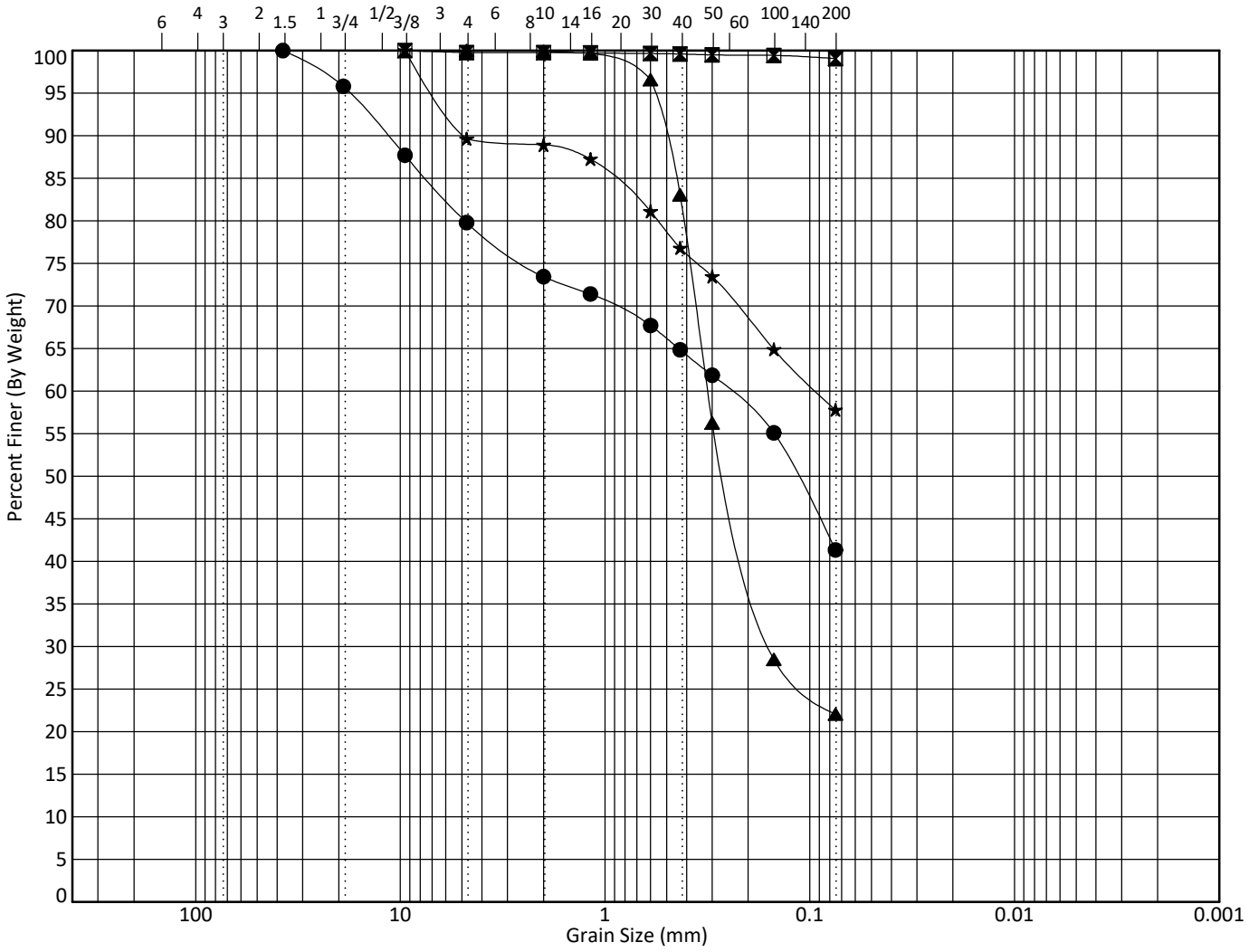
Engineering Stability Since 1881

GRAIN SIZE DISTRIBUTION

Project No: 74X0208
Client: OBG Part of Ramboll
Project: Deep Run Pump Station
City/State: Spotsylvania County, Virginia



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.		Depth	Classification	LL	PL	PI	Cc	Cu
●	B-1	at	0.0	CLAYEY SAND with GRAVEL (SC)	36	18	18		
⊠	B-1	at	8.5	FAT CLAY (CH)	68	31	37		
▲	B-1	at	28.5	CLAYEY SAND (SC)	34	22	12		
★	B-2	at	8.5	SANDY FAT CLAY (CH)	67	23	44		
		at							

	Boring No.		Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	at	0.0	37.5	0.248			20.2	38.5	41.3	
⊠	B-1	at	8.5	9.5				0.2	0.7	99.1	
▲	B-1	at	28.5	4.75	0.315	0.156		0.0	77.9	22.1	
★	B-2	at	8.5	9.5	0.093			10.4	31.8	57.8	
		at									

US_GRAIN_SIZE 74X0208.GPJ F&R.GDT 1/30/20

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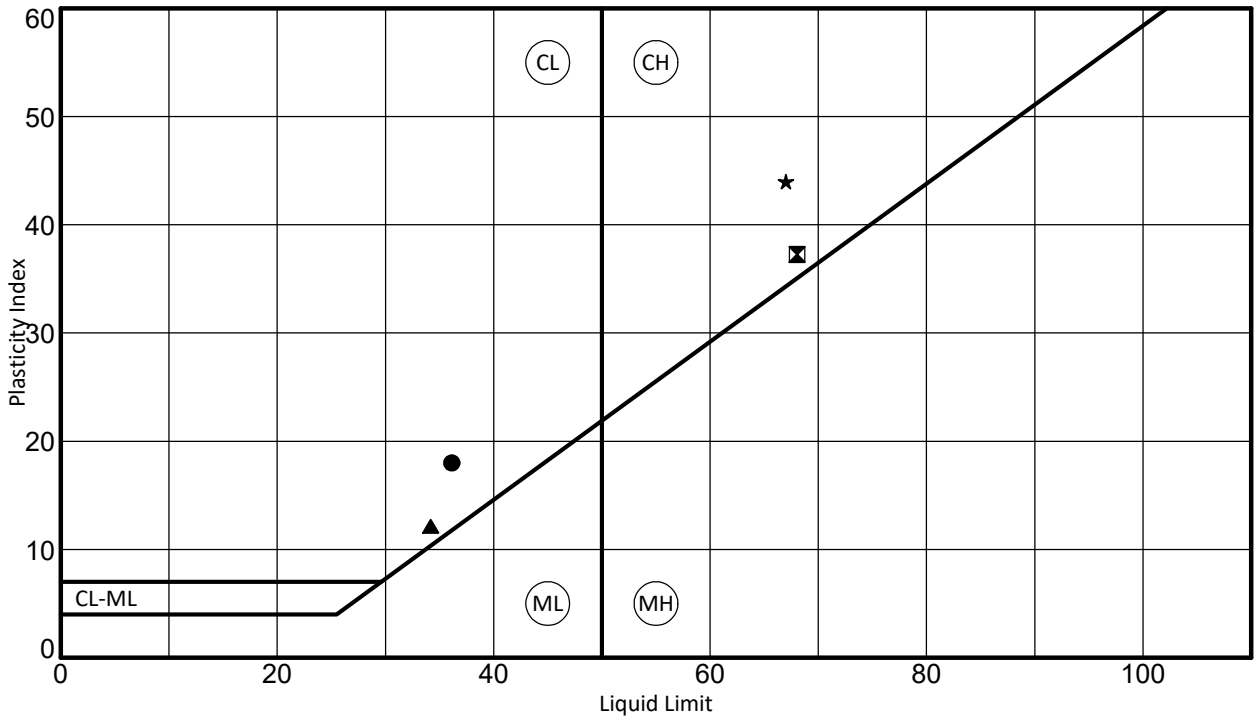
Engineering Stability Since 1881

ATTERBERG LIMITS

Sheet: 1 of 1

Project No: 74X0208
Client: OBG Part of Ramboll
Project: Deep Run Pump Station
City/State: Spotsylvania County, Virginia



Boring No.		Depth	LL	PL	PI	Fines	Classification	% Natural Water Content
● B-1	at	0.0	36	18	18	41.3	CLAYEY SAND with GRAVEL (SC)	12.9
⊠ B-1	at	8.5	68	31	37	99.1	FAT CLAY (CH)	31.6
▲ B-1	at	28.5	34	22	12	22.1	CLAYEY SAND (SC)	24.8
★ B-2	at	8.5	67	23	44	57.8	SANDY FAT CLAY (CH)	39.9

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Microbac Laboratories, Inc. - Baltimore

CERTIFICATE OF ANALYSIS

20A0550

Froehling & Robertson, Inc. - Richmond

Christy L. Shaw
3015 Dumbarton Road
Richmond, VA 23228

Project Name: Deep Run Pump Station

Project / PO Number: 74X0208
Received: 01/07/2020
Reported: 01/30/2020

Analytical Testing Parameters

Client Sample ID: B-1
Sample Matrix: Solid
Lab Sample ID: 20A0550-01
Collected By: Customer
Collection Date: 01/06/2020 12:00

Analyses Subcontracted to: Microbac Laboratories Inc., - Marietta, OH

Diesel Range Organics - GC/FID	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 8015D								
Diesel Range Organics (DRO)	<14800		14800	ug/kg dry		01/13/20 0923	01/17/20 0511	ARJ
Surrogate: o-Terphenyl	75.9	Limit: 43-136		% Rec		01/13/20 0923	01/17/20 0511	ARJ
Surrogate: Octacosane	65.0	Limit: 25-162		% Rec		01/13/20 0923	01/17/20 0511	ARJ

Gasoline Range Organics - GC/FID	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 8015D								
Gasoline Range Organics (GRO)	<140		140	ug/kg dry			01/14/20 1954	ZTL
Surrogate: Chlorobenzene	73.4	Limit: 64-148		% Rec			01/14/20 1954	ZTL

General Parameters	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: ASTM D2216-10								
Percent Solids	68.4		1.00	% (by wt.)		01/14/20 1159	01/15/20 0610	CB

Polychlorinated Biphenyls - GC/ECD	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 8082A								
Aroclor-1016 (PCB-1016)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Aroclor-1221 (PCB-1221)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Aroclor-1232 (PCB-1232)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Aroclor-1242 (PCB-1242)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Aroclor-1248 (PCB-1248)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Aroclor-1254 (PCB-1254)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Aroclor-1260 (PCB-1260)	<0.0257		0.0257	mg/kg dry		01/13/20 0931	01/15/20 1441	ECL
Surrogate: 2,4,5,6-Tetrachloro-m-xylene	97.7	Limit: 26-138		% Rec		01/13/20 0931	01/15/20 1441	ECL
Surrogate: Decachlorobiphenyl (BZ-209)	86.7	Limit: 20-125		% Rec		01/13/20 0931	01/15/20 1441	ECL

TCLP Metals - AA	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 7470A								
Mercury	<0.00200		0.00200	mg/L		01/13/20 0923	01/14/20 1011	TMM

CERTIFICATE OF ANALYSIS

20A0550

Client Sample ID:	B-1		
Sample Matrix:	Solid	**Collected By:**	Customer
Lab Sample ID:	20A0550-01	**Collection Date:**	01/06/2020 12:00

TCLP Metals - ICP	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 6010B								
Arsenic	<0.200	5.00	0.200	mg/L		01/13/20 1202	01/13/20 1533	KEL
Barium	0.240	100	0.100	mg/L		01/13/20 1202	01/13/20 1533	KEL
Cadmium	<0.0200	1.00	0.0200	mg/L		01/13/20 1202	01/13/20 1533	KEL
Chromium	<0.0500	5.00	0.0500	mg/L		01/13/20 1202	01/13/20 1533	KEL
Lead	<0.200	5.00	0.200	mg/L		01/13/20 1202	01/13/20 1533	KEL
Selenium	<0.350	1.00	0.350	mg/L		01/13/20 1202	01/13/20 1533	KEL
Silver	<0.100	5.00	0.100	mg/L		01/13/20 1202	01/13/20 1533	KEL

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CERTIFICATE OF ANALYSIS

20A0550

Client Sample ID:	B-2		
Sample Matrix:	Solid	**Collected By:**	Customer
Lab Sample ID:	20A0550-02	**Collection Date:**	01/06/2020 12:00

Analyses Subcontracted to: Microbac Laboratories Inc., - Marietta, OH

Diesel Range Organics - GC/FID	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 8015D								
Diesel Range Organics (DRO)	<14800		14800	ug/kg dry		01/17/20 1130	01/17/20 1710	ARJ
Surrogate: o-Terphenyl	50.8	Limit: 43-136		% Rec		01/17/20 1130	01/17/20 1710	ARJ
Surrogate: Octacosane	48.9	Limit: 25-162		% Rec		01/17/20 1130	01/17/20 1710	ARJ

Gasoline Range Organics - GC/FID	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 8015D								
Gasoline Range Organics (GRO)	<143		143	ug/kg dry			01/14/20 2203	ZTL
Surrogate: Chlorobenzene	69.7	Limit: 64-148		% Rec			01/14/20 2203	ZTL

General Parameters	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: ASTM D2216-10								
Percent Solids	67.0		1.00	% (by wt.)		01/14/20 1159	01/15/20 0610	CB

Polychlorinated Biphenyls - GC/ECD	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 8082A								
Aroclor-1016 (PCB-1016)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Aroclor-1221 (PCB-1221)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Aroclor-1232 (PCB-1232)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Aroclor-1242 (PCB-1242)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Aroclor-1248 (PCB-1248)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Aroclor-1254 (PCB-1254)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Aroclor-1260 (PCB-1260)	<0.0260		0.0260	mg/kg dry		01/13/20 0931	01/15/20 1459	ECL
Surrogate: 2,4,5,6-Tetrachloro-m-xylene	77.6	Limit: 26-138		% Rec		01/13/20 0931	01/15/20 1459	ECL
Surrogate: Decachlorobiphenyl (BZ-209)	72.6	Limit: 20-125		% Rec		01/13/20 0931	01/15/20 1459	ECL

TCLP Metals - AA	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 7470A								
Mercury	<0.00200		0.00200	mg/L		01/13/20 0923	01/14/20 1013	TMM

TCLP Metals - ICP	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Method: EPA 6010B								
Arsenic	<0.200	5.00	0.200	mg/L		01/13/20 1202	01/13/20 1537	KEL
Barium	0.318	100	0.100	mg/L		01/13/20 1202	01/13/20 1537	KEL
Cadmium	<0.0200	1.00	0.0200	mg/L		01/13/20 1202	01/13/20 1537	KEL
Chromium	<0.0500	5.00	0.0500	mg/L		01/13/20 1202	01/13/20 1537	KEL

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CERTIFICATE OF ANALYSIS

20A0550

Client Sample ID:	B-2		
Sample Matrix:	Solid	**Collected By:**	Customer
Lab Sample ID:	20A0550-02	**Collection Date:**	01/06/2020 12:00

TCLP Metals - ICP	Result	Limit(s)	RL	Units	Note	Prepared	Analyzed	Analyst
Lead	<0.200	5.00	0.200	mg/L		01/13/20 1202	01/13/20 1537	KEL
Selenium	<0.350	1.00	0.350	mg/L		01/13/20 1202	01/13/20 1537	KEL
Silver	<0.100	5.00	0.100	mg/L		01/13/20 1202	01/13/20 1537	KEL

*Results in **bold** have exceeded a limit defined for this project. Limits are provided for reference but as regulatory limits change frequently, Microbac Laboratories, Inc. advises the recipient of this report to confirm such limits and units of concentration with the appropriate Federal, state or local authorities before acting on the data.*

Definitions

% (by wt.):	Percent by Weight
mg/L:	Milligrams per Liter
RL:	Reporting Limit

Report Comments

The data and information on this, and other accompanying documents, represents only the sample(s) analyzed. This report is incomplete unless all pages indicated in the footnote are present and an authorized signature is included.

Reviewed and Approved By:

Evelyn Shinas

Evelyn Shinas
Customer Relationship Coordinator
Reported: 01/30/2020 10:03

APPENDIX IV

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
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ATTACHMENT C

SPOTSYLVANIA COUNTY, VIRGINIA

FMC WWTP DECOMMISSIONING AND FMC PUMP STATION

PRELIMINARY ENGINEERING REPORT

REQUEST FOR PROPOSAL (RFP #20-24-TV)

May 2020

FMC WWTP DECOMMISSIONING AND FMC PUMP STATION

Preliminary Engineering Report - Amendment

May 2020

OBG
Part of Ramboll

FMC WWTP DECOMMISSIONING AND FMC PUMP STATION – PER AMENDMENT

TO:	Julia Monat	**CC:**	Ben Loveday, Scott Powell – County
FROM:	Trey Wilkins, Matt Wimmer		Bill Meinert – OBG (Ramboll)
RE:	Spotsylvania County FMC Improvements – 1.7 MGD Flow Amendment		
FILE:	67353		
DATE:	May 13, 2020		

TABLE OF CONTENTS

FMC WWTP Decommissioning and FMC Pump Station i
Section 1 - Overview 4
1.1 Background 4
1.2 Purpose 4
Section 2 - FMC Decommissioning 4
Section 3 – FMC Pump Station 4
3.1 Design Flows and System Curve Development 4
3.1.1 Design Flows 4
3.1.1.1 Design Flows – Amended 4
3.1.2 System Curve Development 4
3.2 Force Main Design and Alignment 6
3.2.1 Force Main Alignment 6
3.2.2 Traffic Impacts and Road Crossings 7
3.3 Site Conditions 7
3.4 Gravity Sewer 7
3.5 Wet Well 8
3.6 Pumps 8
3.6.1 Smith & Loveless Suction Lift Pumps 8
3.6.2 Gorman-Rupp Suction Lift Pumps 9
3.6.3 Mechanical Layout 10
3.7 Site/Control Building 11
Section 4 – Pump Station – Structural and Architectural Design 11
Section 5 – Pump Station – Electrical Design 11
5.1 Electrical Basis of Design 11
5.2 Power Distribution Summary 11
5.2.1 Electrical Distribution 11
5.2.2 Standby Power System 12
5.2.3 Variable Frequency Drives 12
5.2.4 Transient Voltage Surge Suppression Equipment 12

5.2.5 Disconnect Switches 12
5.2.6 Electric Motors 12
5.2.7 Lighting 13
5.2.8 Telecommunications 13
5.2.9 Fire Alarm System 13
Section 6 – Pump Station – Instrumentation and Controls Design 13
Section 7 – Pump Station – Mechanical Design 13
7.1 Basis of Design 13
7.2 Virginia SCAT Guidelines 13
7.3 Constructability 13
Section 8 – Preliminary Construction Cost Estimate 13
8.1 Summary 13
Section 9 – Conclusion and Recommendations 14
9.1 Summary 14

LIST OF TABLES

Table 3.1: Existing IPPS Average Daily Flow and Peak Daily Flow ..... *Refer to the FMC PS PER Dated June 2018*
Table 3.2: Projected Buildout Flow to the FMC PS ..... *Refer to the FMC PS PER Dated June 2018*
Table 3.3: Projected Force Main Velocities **7**
Table 3.4: Projected Cost for FM Alternatives **7**
Table 4.1: Pump Station – Building Code Analysis ..... *Refer to the FMC PS PER Dated June 2018*
Table 4.2: Design Basis – Live Loads ..... *Refer to the FMC PS PER Dated June 2018*
Table 4.3: Design Basis – Snow Loads ..... *Refer to the FMC PS PER Dated June 2018*
Table 4.4: Design Basis – Wind Loads ..... *Refer to the FMC PS PER Dated June 2018*
Table 4.5: Design Basis – Seismic Loads ..... *Refer to the FMC PS PER Dated June 2018*
Table 4.6: Design Basis – Concrete & Masonry ..... *Refer to the FMC PS PER Dated June 2018*
Table 8.1: Summary – FMC PS and FM Cost Estimate **14**

LIST OF FIGURES

Figure 3.1: Wet Well Profile **5**
Figure 3.2: FMC PS System Curve **6**
Figure 3.3: Smith & Loveless System and Pump Curve **9**
Figure 3.4: Gorman-Rupp System and Pump Curve **10**

LIST OF APPENDICES

Appendix A: Process Mechanical Literature

Appendix B: *Refer to the FMC PS PER Dated June 2018*

Appendix C: Pump Station Preliminary Plans

Appendix D: Probable Cost Breakdown

Appendix E: *Refer to the FMC PS PER Dated June 2018*

SECTION 1 - OVERVIEW

In January 2020, OBG was authorized to amend the FMC WWTP Decommissioning and FMC Pump Station Preliminary Engineering Report (FMC PS PER) dated June 2018. This report is to serve as the amendment and provides a planning-level analysis to increase the new FMC PS and its proposed and existing force main (FM) capacity to 1.7 MGD peak. Sections of the report that have not changed since the FMC PS PER are noted throughout this amendment.

1.1 BACKGROUND

Refer to the FMC PS PER, dated June 2018, for project background.

1.2 PURPOSE

Refer to the FMC PS PER, dated June 2018, for project purpose.

SECTION 2 - FMC DECOMMISSIONING

Refer to the FMC PS PER, dated June 2018, for FMC Decommissioning Plan.

SECTION 3 – FMC PUMP STATION

3.1 DESIGN FLOWS AND SYSTEM CURVE DEVELOPMENT

3.1.1 Design Flows

Refer to the FMC PS PER, dated June 2018, for Design Flows.

3.1.1.1 Design Flows – Amended

In early 2020, the County requested that OBG revise the design flows of the FMC PS to account for additional flows from a to-be-constructed private development within the Bowman Industrial Park and/or other residential, commercial, or industrial growth tributary to the northeast (versus southwest to Deep Run). The basis of design given by the County was a peak instantaneous design flow of 1.7 MGD (1,180 GPM). For the purposes of this study, a peaking factor of 3.0 was assumed, equating to an average daily flow (ADF) of 0.57 MGD (393.5 GPM).

3.1.2 System Curve Development

The first step in sizing the pump station is to establish its system curve. System curves are developed as a means for estimating the TDH of a pumping and conveyance system at various flow rates, and ultimately for selection and sizing of pumps and force main. The curves illustrate the relationship between the flow and head loss through the pump station and force main, and are largely influenced by:

- Static head conditions
- Force main pipe diameter
- Force main pipe material

Static head is the water surface elevation difference between the suction and discharge points; the static head has little variance across the range of pump operating conditions. Regarding pipe diameter, as the diameter decreases, the head loss experienced throughout the force main's system increases. Conversely, as the diameter increases, head loss will decrease. The Hazen-Williams Roughness C-value represents the pipe's interior integrity as it relates to friction losses through the pipeline. C-values differ amongst the various pipe materials, with plastic pipes generally having a higher C-value (and thusly less friction loss) than metallic pipes. For instance, PVC pipe is generally considered to have a C-value in the range of 130-150, depending on its interior condition; while the C-value for ductile iron pipe generally ranges between 120-140, depending on its interior condition.

Spotsylvania County's Water and Sewer Design and Construction Standards Manual dictates that ductile iron pipe shall be used for sanitary sewer force mains, and a C-value of 120 shall be assigned to the force main for the purposes of developing the corresponding system curve. Along with the estimated C-values, the force main and pump station layout was evaluated to obtain a more accurate total dynamic head (TDH) calculation. Based on the preliminary pump station and force main layout, actual losses from bends joints, entrances, exits, and other minor losses have been incorporated into the revised system curves.

As shown in the figure below, the expected invert inflow elevation into the wet well is 40 ft. Due to the invert inflow elevation, the elevation of the wet well floor will be 32 ft. and the "pump off" elevation will be 35 ft. The force main alignment reaches a maximum elevation of approximately 69 ft., resulting in a maximum design static head of approximately 34 ft.

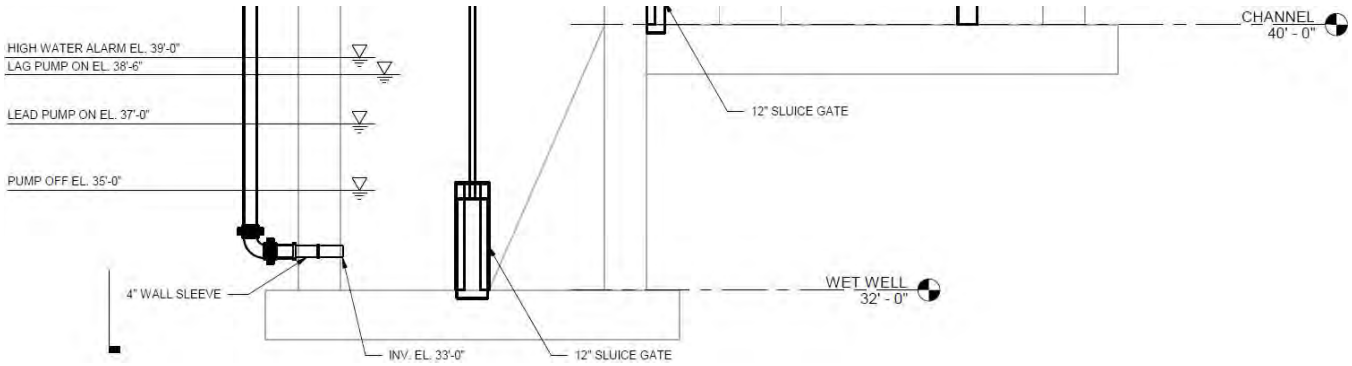

Figure 3.1: Wet Well Profile

The system curves for the proposed pump station were calculated to determine the TDH loss occurring from the proposed wet well location to the discharge point. A new 8" FM [a change from the originally-proposed 6"-diameter FM for existing Bowman Industrial Park flows tributary to FMC] will extend approximately 1,400 feet and connect to the existing 2,800 feet of 12" FM that currently flows from the DRPS to the FMC WWTP. Deep Run will no longer connect to FMC, conveying all its flows to MWWTP. To utilize the remaining life of the existing force main and as a capital cost saving measure, flow will be reversed within the existing 12" FM and flow to the connection with the proposed 36" County-City Force Main that connects the DRPS to the MWWTP headworks. [Note: Depending on construction timing/sequencing with construction of other conveyance capital projects, FMC flows may need to be connected to the existing 16" Deep Run Force Main (for conveyance to MWWTP). Also, the combined FM size was adjusted from 30" to 36"-diameter to accommodate additional City flow, and it resulted in reduced TDH conditions on all three pump stations at combined peak flow rates.]

Because flows from FMC PS will discharge into a force main that's receiving flow from two other pump stations (City IPS, Deep Run PS), a wide range of operating head conditions are expected. To account for the varied head conditions, system curves were developed for the following scenarios:

- "Low Flow Scenario" - FMC PS, with City IPS and DRPS not (temporarily) pumping
- "Average Flow Scenario" - FMC PS, with City IPS and DRPS pumping also at average
- "Peak Flow Scenario" - FMC PS, with City IPS and DRPS also pumping at peak (worst-case TDH condition).

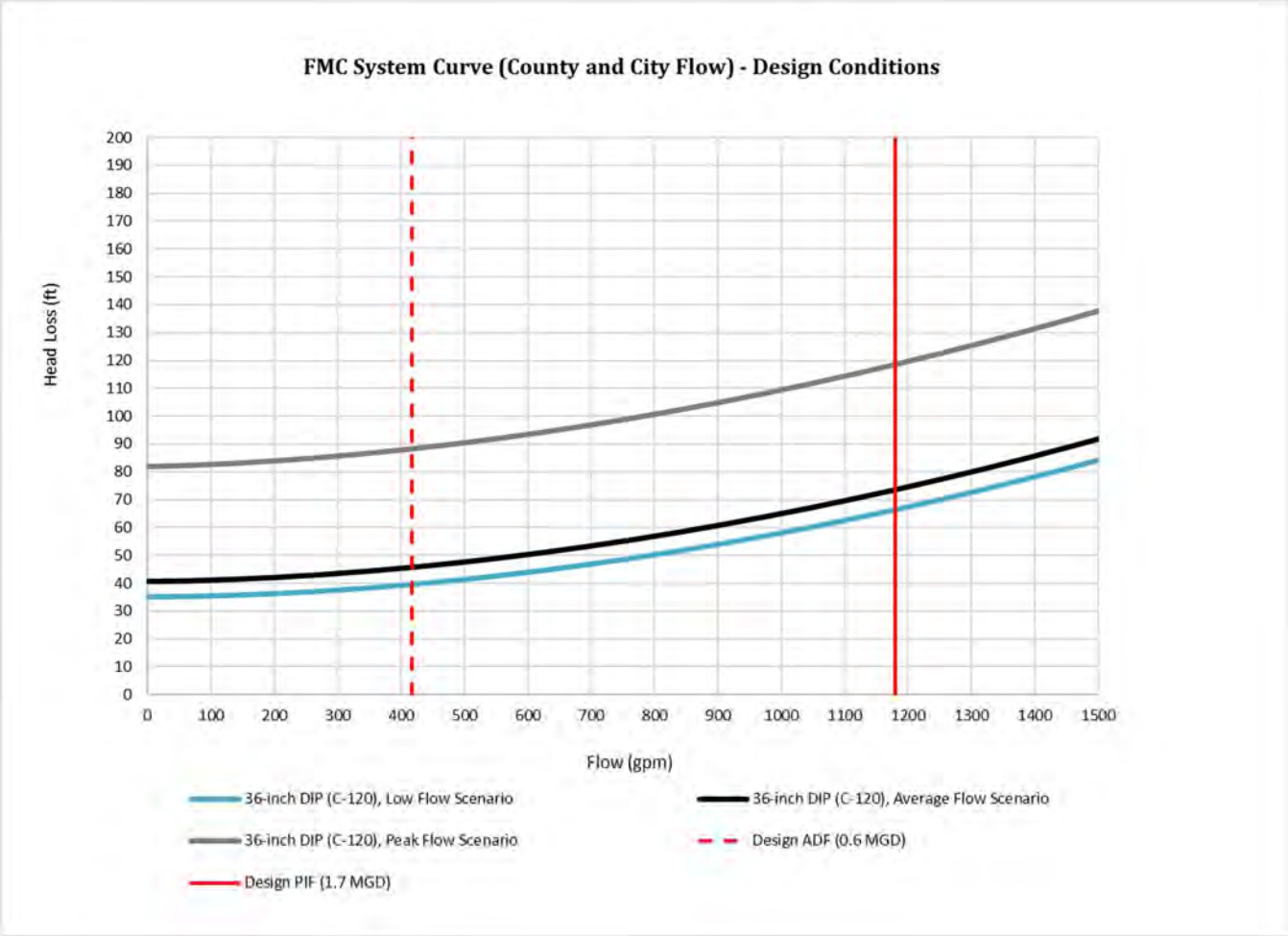

Figure 3.2: FMC PS System Curve

Based on the system curves in the Figure above, the maximum TDH within the proposed FMC force main is approximately 120 ft. at 1175 GPM (1.7-MGD peak) and assumes that all three pump stations are simultaneously conveying peak flows to MWWTP. The other two system curves establish the change in pump discharge conditions that would be accommodated through VFD speed adjustment and/or discharge pressure regulation.

3.2 FORCE MAIN DESIGN AND ALIGNMENT

3.2.1 Force Main Alignment

Two alternatives were developed to analyze the potential force main size and route between the proposed FMC PS and the connection to the Deep Run FM located near Route 17. These alternatives included:

Alternative 1:

A new 8" FM is routed South from the new FMC PS, along Capital Ln for approximately 1,400 feet. Near the entrance to the FMC WWTP, the FM is connected to the existing approximately 2,800 feet of 12" FM that currently sends flow from DRPS to the FMC WWTP. Flow is reversed within this FM and continues to its connection point, a three force main manifold, with the proposed 36" County-City Force Main.

Alternative 2:

A new 8" FM is routed West from the new FMC PS, along Bourbon St and then South along Main St for approximately 2,500 feet until it reaches the railroad track spur located along Main St. The FM routing would then parallel the existing 12" FM back to the connection point, a three force main manifold, with the proposed 36" County-City Force Main.

The table below shows a comparison of the two alternatives reviewed and compares the pipe length, flow and velocity of the various segments.

Table 3.3: Projected Force Main Velocities

Pipe Diameter	Pipe Length (ft)	Flow (gpm)	Velocity (ft/s)
Alternative 1			
8" (new)	1,400	1,180	7.5
12" (existing)	2,800	1,180	3.3
36" (new)	14.860	19,240	5.7
Alternative 2			
8" (new)	4,000	1,180	7.5
36" (new)	14,860	19,240	5.7

Per the SCAT Regulations, the force main's velocity should be between the minimum and maximum allowable velocities of 2.0 fps and 8.0 fps, respectively. When operating the force main at velocities less than 2.0 fps, solids can collect in the bottom of the pipe; when velocities exceed 8.0 fps, the force main's interior can potentially be damaged due to solids' scouring. As shown above, Alternative 1 includes a pipe diameter with velocities within the acceptable range at the design flow.

It is believed that the existing 12" FM located between the FMC WWTP and the Deep Run FM is in serviceable condition and would not need to be replaced as part of this project. Although operating at lower velocities may cause some additional maintenance concerns, there is additional complexity involved in trying to route a new 8" FM the entire length between the FMC PS and the Deep Run FM. Existing railroad tracks would make construction costlier and the approximately three times longer length would be significantly more expensive.

Table 3.4: Projected Cost for FM Alternatives

	Total Cost
Alternative 1	**$420,000**
Alternative 2	**$1,125,000**

For the FMC Force Main, Alternative 1 is recommended because of the lower construction cost associated with building the pipeline.

3.2.2 Traffic Impacts and Road Crossings

Refer to the FMC PS PER, dated June 2018, for Traffic Impacts and Road Crossings.

3.3 SITE CONDITIONS

Refer to the FMC PS PER, dated June 2018, for Site Conditions.

3.4 GRAVITY SEWER

A new gravity sewer will be installed to route flow from the influent of the existing IPPS, west of the existing structure and into the south side of the proposed FMC PS. It is proposed that influent will flow from a new manhole installed overtop the existing gravity sewer, through a 12-inch PVC pipe, and enter a new headworks structure.

The headworks will be a 12' x 12' below-grade concrete structure. The headworks will contain an in-channel hydraulic grinder; a Muffin Monster, Model 30005-0032 is proposed. The grinder is rated for 2,100 GPM with 2-inch shafts, a single drive, and will include a 5-horsepower hydraulic power unit. The channel grinder and respective concrete channel will have the capability of handling a maximum flow of 2,100 GPM without over flowing the channel. The grinder's frame will allow for the grinder to be removed and replaced with a 2" bar screen (in the event of high flows and to allow for grinder maintenance). Once through the grinder, the influent channel will split into two 12" channels. Each channel will terminate with a manual 12" x 12" sluice gate to be used for isolation of the wet well. The influent will flow through the sluice gates into the proposed wet well.

Note: In lieu of a dedicated headworks chamber upstream of the wet well, a grinder can be installed within an upstream manhole (on a guiderail system) and influent can flow directly from the gravity sewer into the wet well.

3.5 WET WELL

Refer to the FMC PS PER, dated June 2018, for Wet Well details.

3.6 PUMPS

For the FMC PS, suction-lift and vacuum-primed centrifugal pumps were considered. The IPPS is currently equipped with Gorman-Rupp suction-lift pumps; these pumps have been in operation since the station's original construction with minimal issues, and the County has shown a preference for this type of pump (e.g., suction-lift and/or vacuum-primed centrifugal pumps) in other stations that it operates. The use of suction-lift/vacuum-primed pumps will also avoid the need for building a dry well, reducing overall cost for the station. For the purposes of this report, two manufacturers were considered: 1) Smith & Loveless and 2) Gorman-Rupp. Consideration of additional "Or Equals" may be investigated during later design, if requested by the County.

3.6.1 Smith & Loveless Suction Lift Pumps

Smith & Loveless (S&L) pumps were selected for consideration based on the County's familiarity with and preference for the manufacturer. The system curve was provided to the manufacturer's local representative, noting that the max design point was 1175 GPM at a TDH of approximately 120 feet. The following pumping system was recommended:

- Three (3) Model 6D3B pumps, installed in parallel
  - Each pump will be equipped with a 11.5" impeller, 40 hp motor and a variable frequency drive (VFD).

A single S&L pump is not able to handle the entire range of anticipated flows for the station. Specifically, a single pump is adequate to meet average day demands and the initial peak demands before full buildout of the proposed development, but a second pump is necessary to meet full buildout peak demands. The third pump would act as a backup to either of the first two pumps to comply with SCAT Regulations and provide complete redundancy in the station. The proposed VFDs would be equipped with limiting controls to not overload the motors and limit the flows to 1175 GPM, in conjunction with an electromagnetic flowmeter. Should future development of the FMC site result in influent flows that exceed those projected for the FMC PS (see Section 3.1), larger impellers and larger motors are available for retrofitting the pumps to accommodate an increase in flow.

For the pumps noted above there is a NPSHr requirement of 20 feet. Pump manufacturer's literature is provided in Appendix A. If the floor of the Control Building were placed at grade, there would not be sufficient NPSHa to meet the needs of the S&L pumps. To achieve sufficient net positive suction head, the floor of the building (and thereby the pumps) would need to be recessed approximately 5 feet.

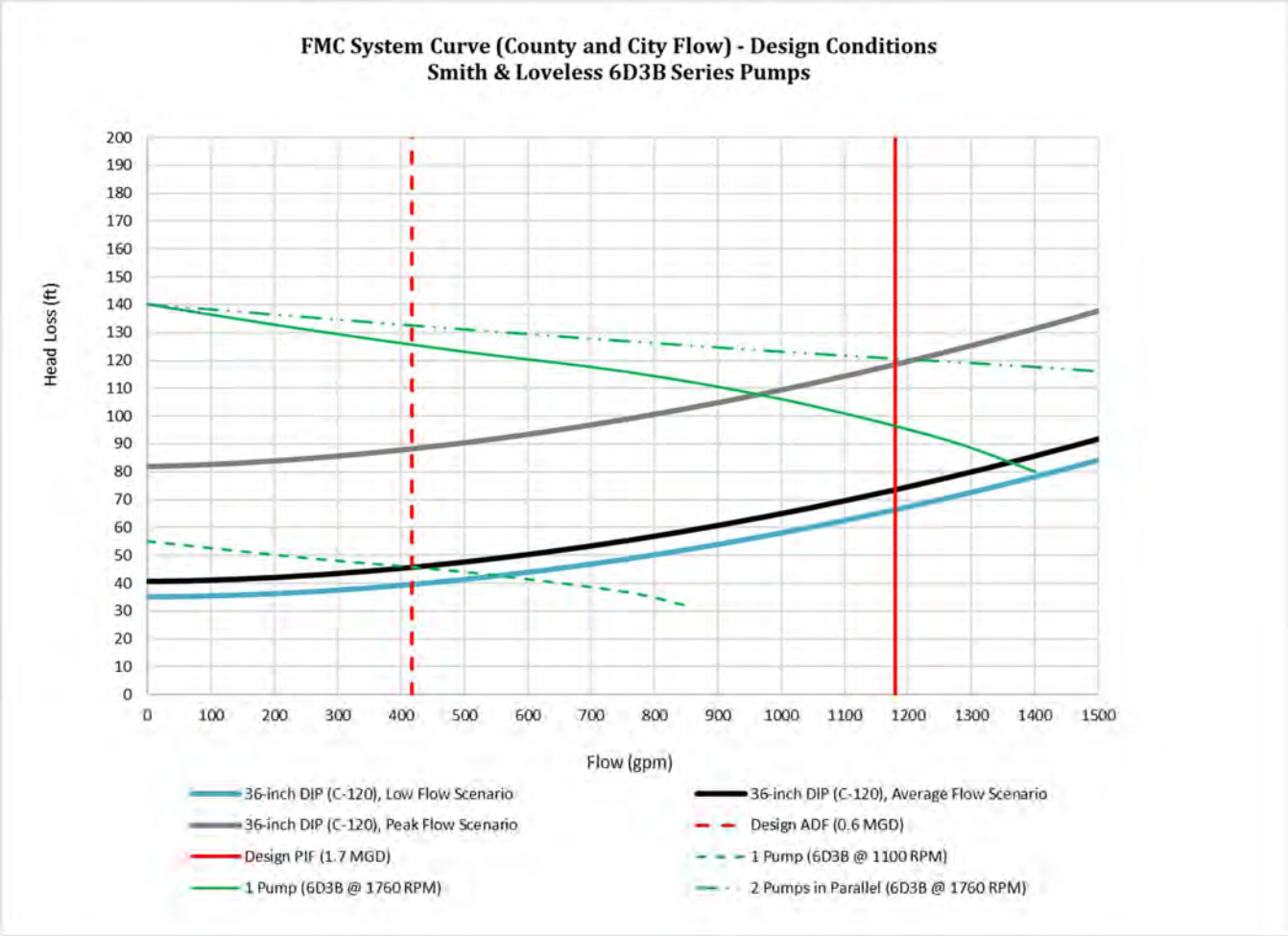

Figure 3.3: Smith & Loveless System and Pump Curve

3.6.2 Gorman-Rupp Suction Lift Pumps

In addition to Smith & Loveless, the County also has Gorman-Rupp pumps installed within their collection and conveyance system, including at the existing IPPS. Based on the system curve, Gorman-Rupp's local representative recommended the following pumping system arrangement:

- Two (2) Model V6AB pumps, installed as lead/standby
  - Each pump will be equipped with a 12.38" inch impeller, 75 hp motor and a VFD.

Each pump will be capable of handling the entire range of anticipated flows for the station with the proposed VFDs allowing the pumps to operate between approximately 410-1175 GPM. The second pump will serve as a backup to comply with SCAT Regulations and provide complete redundancy in the station. Should future development of the FMC site result in influent flows that exceed those projected for the FMC PS (see Section 3.1), larger motors (up to 100 hp) are available for retrofitting the pumps in order to accommodate an increase in flow up to approximately 1420 gpm at a TDH of 140 feet.

For the pumps noted above there is a NPSHr of 12.6 feet. Setting the floor of the Controls Buildings at grade equate to a NPSHa of 15.7 feet which is adequate for the Gorman-Rupp pumps. Pump manufacturer's literature is provided in Appendix A.

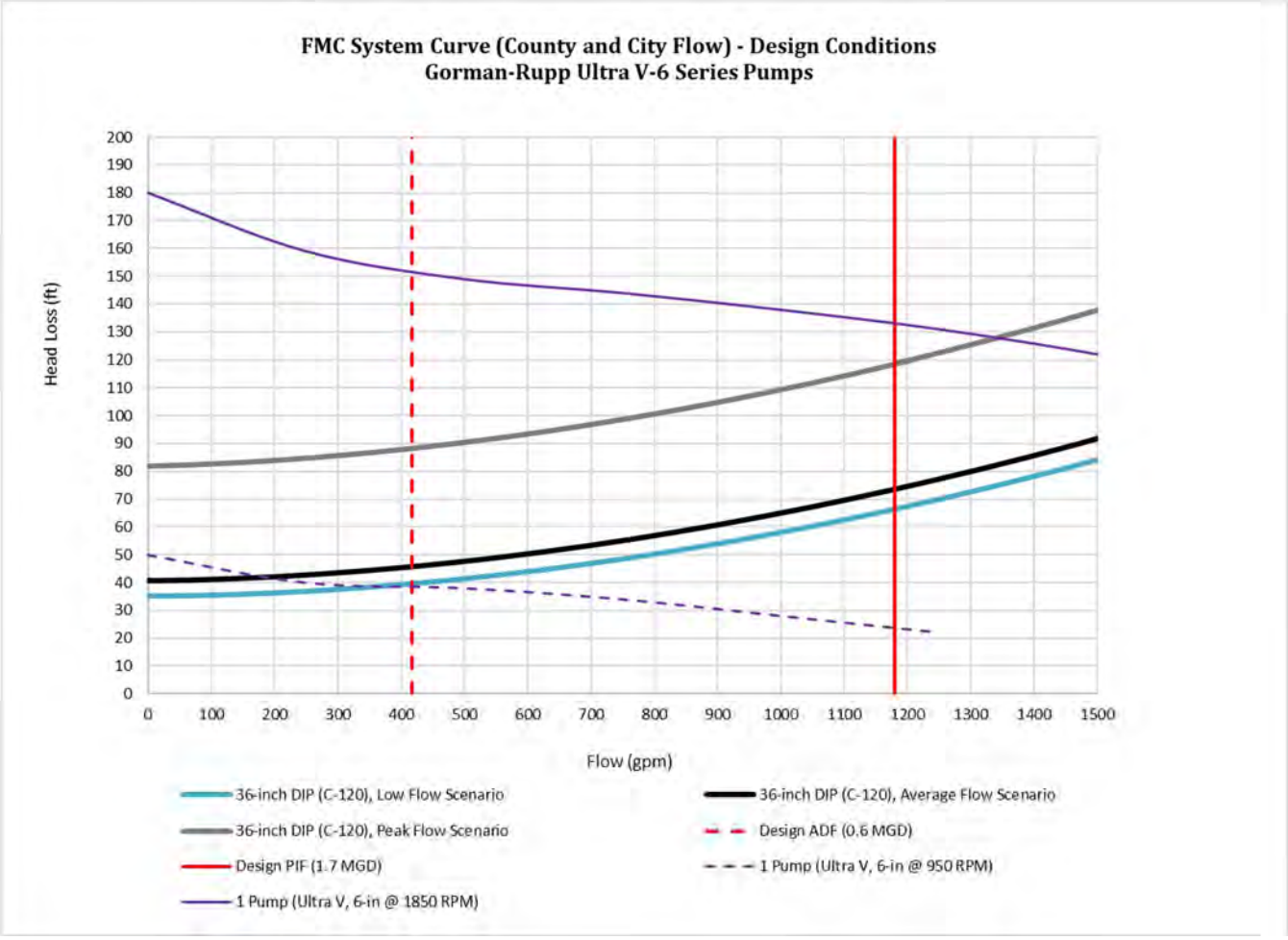

Figure 3.4: Gorman-Rupp System and Pump Curve

3.6.3 Mechanical Layout

The proposed pump layout will provide accessibility for pump maintenance, space for electrical panels, flow meter, and room for the pumps to be installed and removed. For the Smith and Loveless pump option, three pumps will be required, while for the Gorman-Rupp option only two pumps will be required. In either configuration, the pumps are oriented such that each pump's suction intake is on the north side of the wet well. The pumps will be spaced such that adequate spacing is provided between the concrete pads to allow for periodic maintenance of the pumps and so that each pump is drawing from a different wet well chamber. The pumps discharge will connect into a common header within the control building. There will be a flow meter located downstream of the last pump connection to the main header. The pump station building is proposed to have the flow meter located inside the building to save space and material costs. From the header pipe and flow meter, the discharge will enter a new 8-inch force main, exit the pump station building, and proceed along the proposed alignment.

Reference Appendix C for Pump Station Preliminary Plans. Note: Mechanical/Pump Layout drawings are based on the Gorman-Rupp pumping system. Pump selection to be finalized during later design and Pump Station Plans will be updated accordingly.

3.7 SITE/CONTROL BUILDING

For the Gorman-Rupp system, the pump station control building will be a 20' x 15' above-grade concrete structure sitting on a concrete slab; the Smith & Loveless pumping system requires a slightly larger footprint of 20'x20', due to the 5-foot floor recess and to provide adequate space for at-grade installation of the electrical panels within the control building.

The Smith and Loveless pumps will require a recessed floor with an approximate finished floor elevation of 45.0 feet (i.e., 5 feet below grade). The Gorman-Rupp pumps will allow for the finished floor to be set at 50.0 feet. The control building will house the proposed pumps, as well as all electrical equipment and HVAC. The building will be located just north of the wet well. The building will be accessible through a double door located on the west side of the building. This door will also be used for equipment removal.

The proposed PS site will also include a backup diesel generator, sitting on a concrete slab to the north of the control building. The diesel generator will be a 475-kW unit with a 800-gallon sub base fuel tank. To the east of control building will be an odor control unit, also located on a concrete slab. The odor control unit will be an ECS Environmental Solutions activated carbon V1-TM Series odor control system with a design flow rate of 350 cfm.

The County currently sends truckloads of sewer collection waste material to be dumped at an onsite container located directly in front of the existing IPPS. Material dumped in the container drains into the wet well of the pump station. Once the container is full it is transported to a landfill for dumping. There is no plan to change the current process for dumping waste material at the site. A new manhole will be provided to allow the County to continue to drain the container into the influent gravity sewer of the proposed FMC PS.

Drawings for the proposed site can be found in Appendix C.

SECTION 4 – PUMP STATION – STRUCTURAL AND ARCHITECTURAL DESIGN

Refer to the FMC PS PER, dated June 2018, for the Structural and Architectural Design.

SECTION 5 – PUMP STATION – ELECTRICAL DESIGN

5.1 ELECTRICAL BASIS OF DESIGN

Refer to the FMC PS PER, dated June 2018, for the Electrical Basis of Design.

5.2 POWER DISTRIBUTION SUMMARY

The scope of the Electrical work for the proposed pump station is as follows:

5.2.1 ELECTRICAL DISTRIBUTION

The Electrical Utility for this location is Dominion Power. It is anticipated that the Utility will provide an overhead primary Electrical Service to the building.

The building will be fed via two 4" direct buried PVC Schedule 80 conduits, with pull strings, from the utility primary riser pole to the location of the utility pad mounted transformer located adjacent to the building. It is anticipated that the transformer will be a 750kVA unit, with a 480/277-volt, 3 phase secondary voltage.

Within the building, provide an 800-amp, 480/277 volt rated service entrance rated main fused switch with 600-amp fuses, and an auxiliary metering section (for location of the utility CTs). The utility meter socket will be located on the exterior of the building. The main switch section will feed the normal side of the building's automatic transfer switch.

The load side of the automatic transfer switch will feed an 800-amp, 480/277 volt rated distribution switchboard to feed the pump station equipment, including the pumps.

A 45-kVA dry type transformer to step voltage down to 208/120 volts will be provided for convenience and lighting loads.

Based on preliminary Electrical load estimates, the proposed pump station's peak operating Electrical load would be approximately 460 kVA at 480/277 volts, 3-phase. This includes a 25% spare capacity to accommodate future Electrical loads. This dictates that the building be provided with a 600-amp Electrical service at 480/277 volts.

5.2.2 STANDBY POWER SYSTEM

The FMC PS is designated as a Reliability Class I facility, which is required to be provided with two separate and independent sources of power. Each power source will be capable of maintaining continuous pumping operation at peak design flow during power failures, flooding, or equipment malfunctions. The second source of power will have sufficient capacity to operate all components vital to the pump station's operations during peak wastewater flow conditions, together with critical lighting and ventilation equipment.

The second source of power for the proposed pump station will be provided by an on-site, standby generator system. Depending on the ultimate sizing and selection of the pumps, calculations have verified that up to a 475 kW, 480/277-volt diesel generator will be required. The unit will be located exterior to the building, at grade, within a Level 2 Sound Attenuated Enclosure. The unit will be provided with a minimum 800-gallon sub base, dual wall (rupture basin with leak detection) fuel tank. This will provide a minimum of 24 hours of operation at full load. The generator will be provided with a critical grade silencer to mitigate the noise while operational. The unit will be provided with an output circuit breaker for connection to a portable load bank to be used for load testing.

The main service entrance switch (normal power) and the generator (standby power) will each feed an 800-amp rated, three-pole automatic transfer switch. This unit will be provided with a time clock to exercise the generator to meet NFPA 110 requirements for periodic testing. The automatic transfer switch will be located within the proposed pump station.

Note: The SCAT Regulations allow for the provision of a dedicated diesel pump set in lieu of a standby generator system, and it is understood that the County prefers to equip their stations with diesel pump sets, where applicable and cost effective. For the FMC PS, a Godwin CD150S pump is capable of conveying up to 1.7 MGD at 118' TDH; to accommodate the pump's suction lift requirements, the pump station floor would need to be recessed approximately 2 feet (similar to the S&L pumping system). It is recommended that the desired standby power system be evaluated and finalized during later design.

5.2.3 VARIABLE FREQUENCY DRIVES

Refer to the FMC PS PER, dated June 2018, for the Variable Frequency Drives.

5.2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION EQUIPMENT

Refer to the FMC PS PER, dated June 2018, for the Transient Voltage Surge Suppression Equipment.

5.2.5 DISCONNECT SWITCHES

Refer to the FMC PS PER, dated June 2018, for the Introduction to Instrumentation and Controls Design.

5.2.6 ELECTRIC MOTORS

Refer to the FMC PS PER, dated June 2018, for the Introduction to Instrumentation and Controls Design.

5.2.7 LIGHTING

Refer to the FMC PS PER, dated June 2018, for Lighting details.

5.2.8 TELECOMMUNICATIONS

Refer to the FMC PS PER, dated June 2018, for Telecommunications details.

5.2.9 FIRE ALARM SYSTEM

Refer to the FMC PS PER, dated June 2018, for Fire Alarm System Details.

SECTION 6 – PUMP STATION – INSTRUMENTATION AND CONTROLS DESIGN

Refer to the FMC PS PER, dated June 2018, for the Introduction to Instrumentation and Controls Design.

SECTION 7 – PUMP STATION – MECHANICAL DESIGN

7.1 BASIS OF DESIGN

Refer to the FMC PS PER, dated June 2018, for the Mechanical Basis of Design.

7.2 VIRGINIA SCAT GUIDELINES

Refer to the FMC PS PER, dated June 2018, for the Virginia SCAT Guidelines related to Mechanical Design.

7.3 CONSTRUCTABILITY

The HVAC, plumbing, and fire protection systems will be designed as unitary systems without central plants.

SECTION 8 – PRELIMINARY CONSTRUCTION COST ESTIMATE

8.1 SUMMARY

Preliminary construction costs have been estimated for the FMC Pump Station and Force Main based on:

- Gorman-Rupp pump layout/configuration [Note: Smith & Loveless alternative is anticipated to be the more costly than Gorman-Rupp, due to the recessed floor and additional building footprint needed to accommodate at-grade electrical equipment.]
- Available material costs, and
- Available bid tabulation data for similar projects completed in Central Virginia.

The following is a summary of the estimated construction costs for the FMC Pump Station (using the Gorman-Rupp suction lift pump option) and Force Main (reference the Appendix for a complete cost breakdowns):

Table 8.1: Summary – FMC PS and FM Cost Estimate

Item	Cost*
Subtotal – Influent Sewer and Pump Station	$1,875,000
Subtotal – Force Main	$322,500
Subtotal – FMC WWTP Decommissioning	$305,000
Subtotal – Project	$2,502,500
Contingency (30%)	$751,000
Capital Construction Cost – 2020 Dollars	**$3,253,500**
Source: O'Brien & Gere	

*An additional estimate was undertaken to determine the required cost of operating the FMC WWTP for the next 5 years. Based on discussions with the County and the various memos compiled to date, it was determined that an additional $3-4M (contingency) would be required. This is largely broken down into the following major upgrades:

- #3 Generator - $650,000
- #1 Generator - $800,000
- Motor Control Centers – 4 at $187,500 ($750,000 total)
- PTU Building - $250,000
- Lagoon Liners – 3 at $110,000 ($330,000 total)
- Digester Mixers – 2 at $75,000 ($150,000 total)

[Note that these costs were converted from 2018 to 2020 dollars, based on an assumed 10% annual cost increase.]

SECTION 9 – CONCLUSION AND RECOMMENDATIONS

9.1 SUMMARY

The following is a listing of conclusions and recommendations for the FMC PS and FM Project:

- With the proposed decommissioning of the FMC WWTP, all influent flows will be directed elsewhere in the County. A project is currently proposed for the Hazel Run PS to convey County and City flow to the MIS and MWWTP and bypass the City WWTP. As part of the decommissioning project, the Deep Run PS will be modified to convey all flow to the Massaponax gravity sewer system (refer to Deep Run PS & FM PER that assesses two alternatives – maintaining gravity sewer or conveying by force main all the way to MWWTP). A new pump station is proposed in the vicinity of the existing FMC WWTP to receive existing gravity flows in the Industrial Park area, as well as future economic growth at the treatment plant site.
- In early 2020, the County requested that OBG revise the design flows of the FMC PS to account for additional flows. The basis of design given by the County was a peak instantaneous design flow of 1.7 MGD (1,175 GPM). Assuming a peaking factor of 3.0, that equates to an average day design flow of 0.57 MGD (393.5 GPM). Based on these projections, the pump station is recommended to convey a peak design flow of 1,175 GPM at approximately 120' TDH.
  - Installation of a VFD on each pump is recommended, such that the pump (or pumping system) is able to operate between approximately 410-1175 GPM.
- The proposed pump station should be located adjacent to and behind the existing IPPS. A decommissioned control building and set of flash mix tanks from the original treatment plant construction is located in this general area and will need to be demolished before construction can begin.

- The new pump station will require a new gravity approach sewer and headworks structure.
  - Flow will be redirected from an existing manhole just upstream from the existing IPPS using a 12-inch PVC sewer to the influent of the proposed pump station. Additional collector sewer may be required if growth tributary to the proposed FMC PS is not along this 12-inch PVC sewer.
  - A new, channel grinder should be incorporated into the proposed headworks structure (or upstream manhole, if headworks is eliminated) to alleviate concerns with pump ragging and clogging.
- Suction-lift and vacuum-primed centrifugal pumps are both feasible for this particular application, due to the County's past experience with these pumps and the expected site/civil cost savings associated with utilizing a suction-lift/vacuum-primed pump instead of a flooded suction pump. Due to NPSH issues at the higher operation conditions, the suction-lift (i.e., Gorman-Rupp) pumps may be more advantageous for this particular application, but it is understood that the County prefers Smith & Loveless pumps, from an operations and maintenance standpoint. Therefore, both pumping systems are recommended for this application and it is recommended that the design basis be finalized during later design.
- Approximately 1,400 LF of 8" diameter force main is recommended, extending from the proposed pump station to the existing 12" diameter Deep Run FM currently serving the FMC WWTP. Flow will be reversed in the existing 12" FM and connected to the proposed 36" County-City Force Main. A new 12" check valve will be installed on the existing 12" FM upstream of the proposed connection between the 12" FM and the 36" FM.
- Ductile iron pipe shall be the selected pipe material for the force main's pipe material, in accordance with the County's Water and Sewer Design and Construction Standards Manual.
  - Combination air valves shall be installed at every intermediate high point along the section of new 8" FM.

Appendix A – Process Mechanical Literature

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30K MUFFIN MONSTER®
In-line/Open Channel Grinders

Troublesome solids are now easier than ever to reduce with the 30K Muffin Monster dual-shafted grinder. Its slow speed, high-torque design shreds tough solids that typically cause sewer problems. With over 35,000 installations, the proven capabilities of the Muffin Monster is legendary in providing solutions for the ever more stringent operational needs arriving throughout the industry.

The 30K Muffin Monster sewage grinder is designed to protect pumps and other equipment by grinding down the toughest wastewater solids. Applications include lift stations, sludge lines, septage receiving stations, headworks screenings reduction, and more.

The 30K Muffin Monster is available as in-line and open channel configurations. In-line 30K Muffin Monsters are available for 4, 6, 8, 10 or 12 inch pipeline sizes. Open channel 30K Muffin Monsters are available with 8, 12, 18, 24, 32, 40, 50 or 60 inch cutter stacks.

Features

Dual Shafted Grinder

- Slow-speed, high torque grinder handle rags, rocks, wood, wipes, clothing, plastics and other debris.
- Capable of grinding a wider variety of solids than single shafted machines, macerators, or chopper pumps.

Compact and Efficient Design

- Adapts to pipelines or channels with little or no modification.
- In-line 30K Muffin Monster incorporates an easy to remove cutter cartridge.

Automated Monitoring and Controls

- Auto load sensing and reversals reduce interrupts and optimize the grinder's performance.

Benefits

Equipment Protection

- Protect pumps and other critical equipment from costly clogs and damage from tough solids.

Efficient Treatment Operations

- Grinding separates organic from inorganic materials in the waste stream.
- Organics stay in treatment process and screenings are cleaner.

Lower Operating Cost

- Clear pipes and pumps means shorter pump run cycles and lower electrical costs.

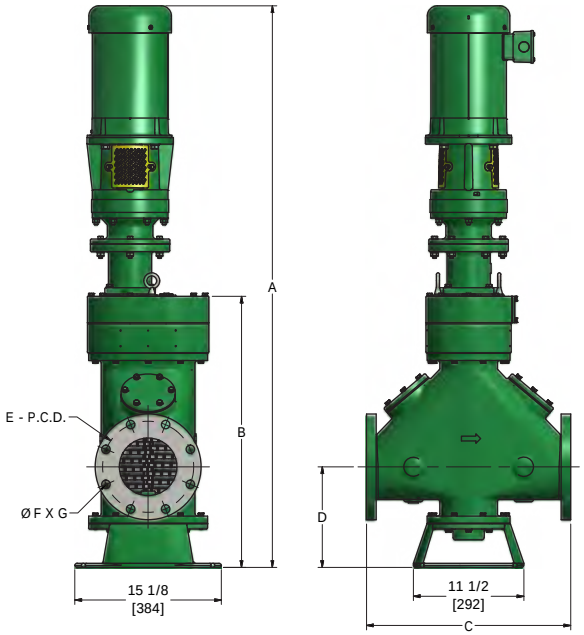
30K series Muffin Monster®

Materials of Construction

Housings: Ductile iron
Cutters: Hardened alloy steel standard
Shafts: Hardened alloy steel
Mechanical Seals: Tungsten carbide faces

Specifications

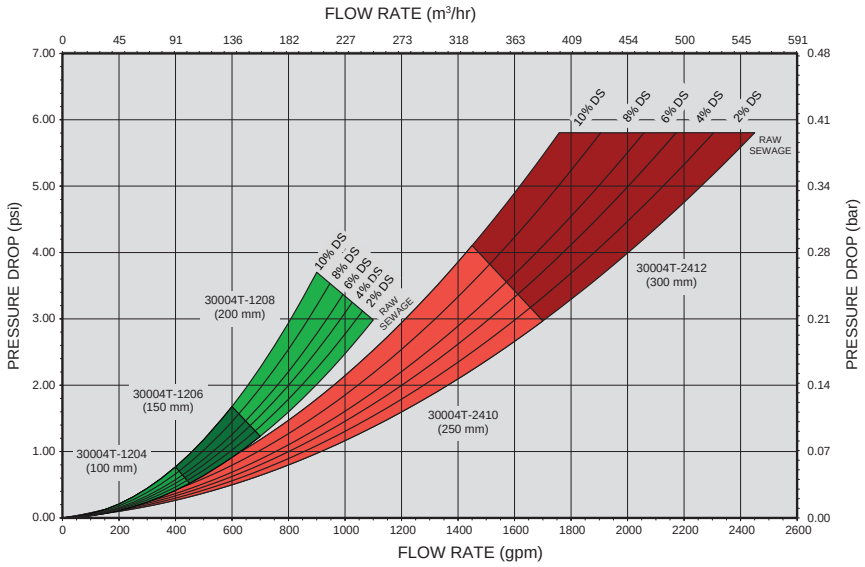
2" (50 mm) hex shafts;
3 HP (2.2 kW) TEFC motor; 29:1 reducer standard
Cutter Size: 4-3/4" (120 mm) diameter cutters
Seal Max Working Pressure: 90 PSI (6 bar) standard



OPTIONS AVAILABLE

	In-Line	Open Channel
7, 11, 13 Tooth Cutters	■	■
17 Tooth Wipes Ready® Cutter	■	■
Monster Metal™ 11 Tooth Cutter	■	■
Severe Duty Seals	■	■
Custom Mounting Frames		■
SS & NEMA 7 Controller Enclosures	■	■
Alternate Voltage & HP Motors	■	■
Explosion Proof Motors	■	■
Immersible Motors	■	■
Hydraulic Power Pack	■	■
Extended Motor Shafts up to 15' (4570mm)	■	■
ANSI, JIS, JWA, BS & AS Flanges	■	
Severe Duty Seals	■	■

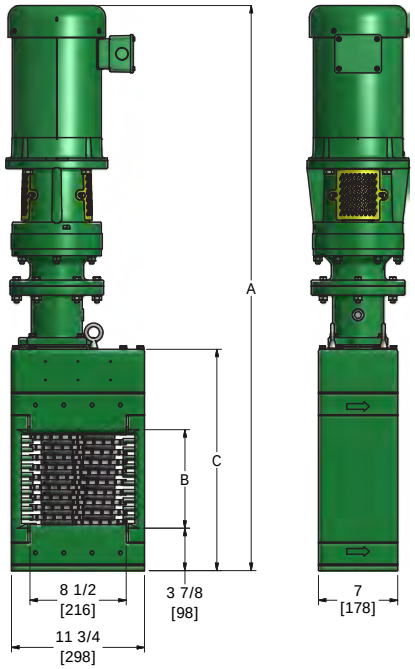
MODEL 30004T



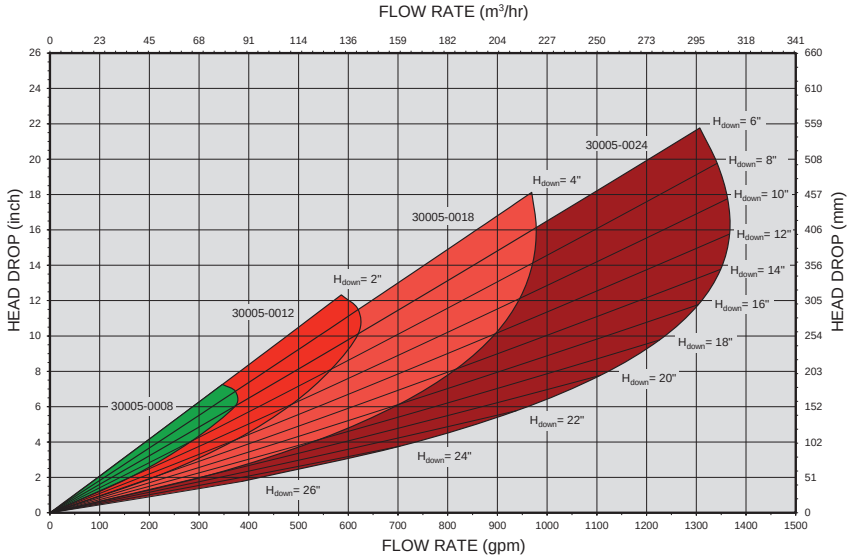
IN-LINE Model	Flow Rate - gpm (m^3/hr)	Pipeline Size - inches (mm)	Pressure Drop - psi (bar)	Standard Dimensions - inches (mm)				Flange Dimensions - inches (mm)			Approximate Net Weight - lbs (kg)
				A	B	C	D	E	F	G	
30004T-1204	450 (102)	4 (100)	0.52 (0.04)	58-1/4 (1480)	28-1/4 (718)	19-1/4 (489)	9-3/8 (238)	7-1/2 (191)	3/4 (19)	8	562 (255)
30004T-1206	700 (159)	6 (150)	1.23 (0.08)	58-1/4 (1480)	28-1/4 (718)	21-1/4 (540)	10-3/8 (264)	9-1/2 (241)	7/8 (22)	8	559 (254)
30004T-1208	1100 (250)	8 (200)	3.00 (0.21)	58-1/4 (1480)	28-1/4 (718)	23-1/4 (591)	11-1/4 (238)	11-3/4 (286)	7/8 (22)	8	568 (258)
30004T-2410	1700 (386)	10 (250)	2.97 (0.20)	69-3/4 (1772)	39-3/4 (1010)	27-1/4 (692)	12-5/16 (313)	14-1/4 (362)	1 (25)	12	789 (358)
30004T-2412	2450 (556)	12 (300)	5.80 (0.40)	69-3/4 (1772)	39-3/4 (1010)	31-1/4 (794)	13-1/4 (337)	17 (431)	1 (25)	12	809 (367)

In-Line unit typically installed prior to suction side of pump. • Consult factory for analysis of application.
• Drive dimensions are a maximum based on a unit with a 3 HP (2.2 kW) drive.

30K series Muffin Monster®



MODEL 30005



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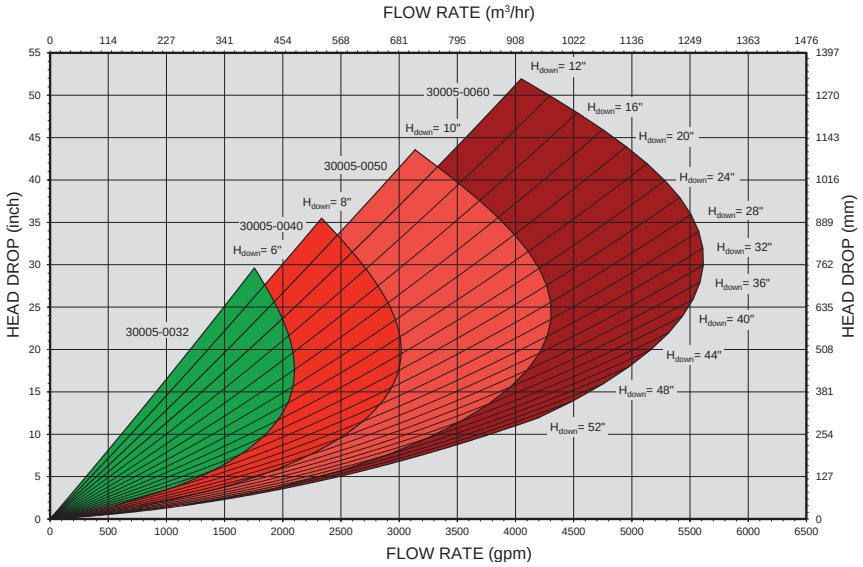


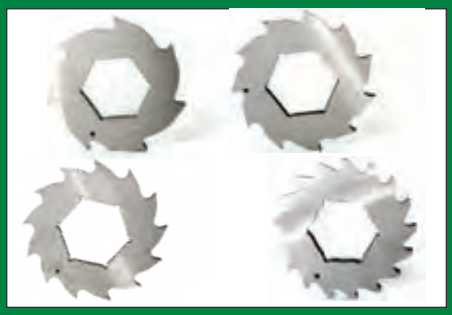
OPEN CHANNEL Model	Flow Rate - gpm (m³/hr)	Head Drop - inches (mm)	Standard Dimensions - inches (mm)			Approximate Net Weight - lbs (kg)
			A	B	C	
30005-0008	370 (84)	7 (178)	49-1/2 (1257)	8 (203)	19-1/2 (495)	370 (168)
30005-0012	620 (141)	11-1/2 (290)	53-5/8 (1362)	12 (305)	23-5/8 (600)	410 (186)
30005-0018	980 (223)	16 (405)	59-1/2 (1511)	18 (457)	29-1/2 (749)	465 (211)
30005-0024	1370 (311)	16 (405)	65-1/4 (1657)	24 (610)	35-1/4 (895)	520 (236)
30005-0032	2100 (477)	17-1/2 (445)	73 (1854)	32 (813)	43 (1092)	580 (263)
30005-0040	3020 (686)	19-1/2 (495)	81 (2057)	40 (1016)	51 (1295)	650 (295)
30005-0050	4310 (979)	23-1/2 (595)	90-7/8 (2308)	50 (1270)	61 (1549)	740 (336)
30005-0060	5620 (1277)	30 (760)	101-3/8 (2575)	60 (1524)	71-3/8 (1813)	845 (383)

* Flow based on optimum channel conditions. • Consult factory for analysis of application.

• Drive dimensions are a maximum based on a unit with a 182T motor frame.• Extended drive shafts are available on request.

Santa Ana, CA. USA | **800.331.2277** | **jwce.com** | **jwce@jwce.com**

JWC Environmental®
A Sulzer Brand



7-Tooth: Pump Stations or Prisons
11-Tooth: Wastewater, Sludge or Scum
13-Tooth: Heat-exchanger or Centrifuge Protection
17-Tooth: Rags and Stringy Materials

Cutters

- 7, 11, 13, 17 and 23 tooth options.
- 17-Tooth Serrated Wipes Ready Cutter option.
- Special Cutter designs for unique needs.
- Optional stainless steel cutters.

Custom Wall Frame

Custom Wall & Channel Frames

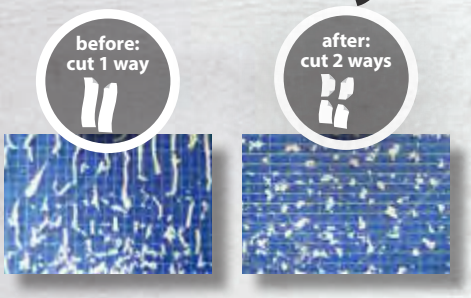
- Frames customized to adapt grinder to fit installation
- Guide rails for easy installation and maintenance
- Stainless steel construction

Extended Motor Shaft

Extended Motor Shaft

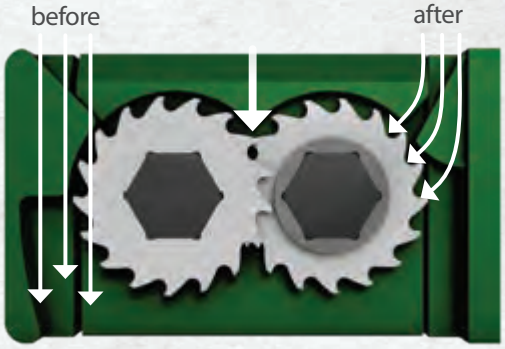
- Places motor above highest water level. Available in 1' (305 mm) increments. Maximum: 15' (4570 mm).

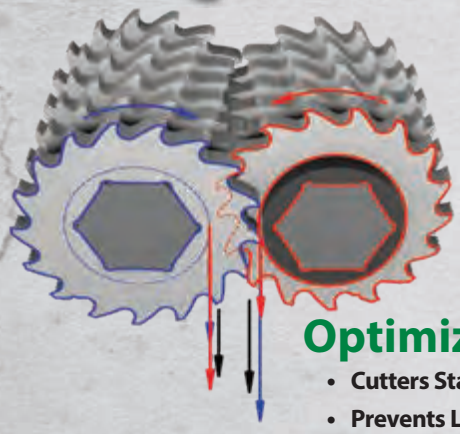
wipes ready® technology



Wipes Ready Cutters*

- **Cut wipes in 2 directions**
- **Smaller particle size**
- **No reweaving**





Optimized Cut Control*

- **Cutters Stay Clean**
- **Prevents Long Strips**

Patented DELTA P Side Rails

- **Drives Debris into Cutters**
- **Prevents Build Up**
- **Enhances High Flow**

* Patent Pending

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V1-TM

The V1-TM is a low cost, simple odor control system that utilizes activated carbon – sometimes in conjunction with a secondary polishing media to remove odor.

- Simple and easy to install and operate
- High efficiencies of H_2S and organic odor removal
- Perfect for applications between 50 and 1500 CFM
- High quality FRP construction manufactured to exceed industry standards

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V1-TM

SIMPLE, EASY, COST EFFECTIVE SOLUTION UP TO 3000 CFM

FEATURES	BENEFIT
Low Cost	V1-TM systems can economically treat up to 1500 cfm. Capital costs are reduced because of unit simplicity.
No Chemicals	Uses carbon media to treat odor compounds, no chemicals or additives are required.
High-Quality Construction	Manufactured using high-quality FRP components. Full 100-mil corrosion barriers on all surfaces exposed to the corrosive environment
Industry Standard Design Basis	Systems are sized to keep bed velocities between 50 and 60 f/m. Standard contact time for all V1 units is 3 seconds.
High Quality Media	The ECS V1 is available with a wide variety of media including Calgon Minotaur, one of only two A-Grade carbons with a .3 H_2S capacity and Calgon Centaur, a water regenerable carbon with ultimate H_2S capacity of .69
High Reliability	ECS carbon units require no acclimation time and can operate intermittently.
Options Available	V1-TM deep beds are available in a number of options • Custom colors available • Sound attenuation packages (enclosure and silencer) • Single or three phase operation

ECS Offers the Following Complete Line of Odor Control Products

- V1 Single Bed
- V2 Dual-Bed
- VX Radial Flow
- X-Pac Chemical Scrubber
- BioPure Biofilter Media
- FRP Ductwork Systems
- AMCA Certified Dampers
- Grease Filter / Mist Eliminators
- Control Panels
- FRP Fans
- Activated Carbon Media
- FRP Chemical Storage Tanks
- FRP Hoods / Covers
- Sound Enclosures and Silencers
- Field Services

ECS ENVIRONMENTAL SOLUTIONS

ECS is based out of a 100,000 sq/ft manufacturing / design facility located in central Texas. We offer a complete line of odor control equipment and services including carbon adsorbers, wet scrubbers, biofilters with the unique capability to manufacture and supply system components.

P.O. BOX 127 / 2201 TAYLORS VALLEY RD / BELTON,TX 76513
P. 254.933.2270 / F. 254.933.2212

WWW.ECS-ENV.COM

KOHLER®

Model: 400REOZJB

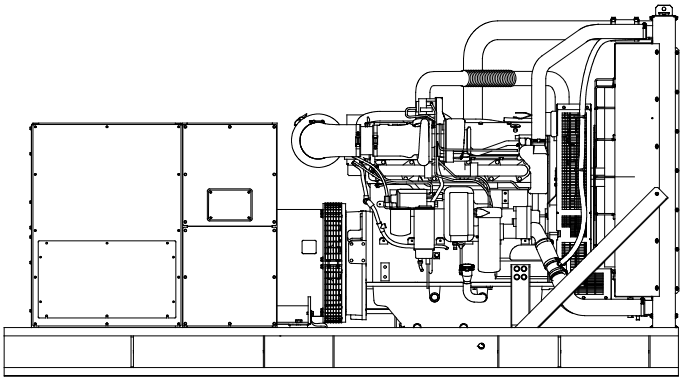
208- 600 V **Diesel**

ISO 9001 KOHLER® NATIONALLY REGISTERED

Tier 3 EPA-Certified for Stationary Emergency Applications

Ratings Range

		60 Hz
Standby:	**kW**	315- 410
	kVA	394- 513



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz emergency generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A one-year limited warranty covers all generator set systems and components. Two- and five-year extended limited warranties are also available.
- Alternator features:
  - The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
  - The brushless, rotating-field alternator has broadrange reconnectability.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 3.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).
  - Integral vibration isolation eliminates the need for under-unit vibration spring isolators.
  - An electronic, isochronous governor delivers precise frequency regulation.
  - Mount up to four circuit breakers to allow circuit protection of selected priority loads.

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
4M4021	120/208	3	60	400/500	1388	380/475	1318
	127/220	3	60	410/513	1345	390/488	1279
	139/240	3	60	410/513	1233	400/500	1203
	220/380	3	60	315/394	598	315/394	598
	240/416	3	60	400/500	694	380/475	659
	277/480	3	60	410/513	616	405/506	609
5M4027	120/208	3	60	410/513	1423	410/513	1423
	127/220	3	60	410/513	1345	410/513	1345
	139/240	3	60	410/513	1233	410/513	1233
	220/380	3	60	405/506	769	405/506	769
	240/416	3	60	410/513	711	410/513	711
	277/480	3	60	410/513	616	410/513	616
5M4028	120/208	3	60	410/513	1423	410/513	1423
	127/220	3	60	410/513	1345	410/513	1345
	139/240	3	60	410/513	1233	410/513	1233
	220/380	3	60	410/513	779	410/513	779
	240/416	3	60	410/513	711	410/513	711
	277/480	3	60	410/513	616	410/513	616
4M4266	347/600	3	60	410/513	493	400/500	481
5M4272	347/600	3	60	410/513	493	410/513	493

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Alternator Specifications

Specifications		Alternator
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet, Pilot Exciter
Leads: quantity, type		12, Reconnectable
		4, 600 V
Voltage regulator		Solid State, Volts/Hz
Insulation:		NEMA MG1
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1, Sealed
Coupling		Flexible Disc
Amortisseur windings		Full
Rotor balancing		125%
Voltage regulation, no-load to full-load		Controller Dependent
One-step load acceptance		100% of Rating
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	4M4021 (12 lead)	1725
480 V	5M4027 (12 lead)	1550
480 V	5M4028 (12 lead)	1800
600 V	4M4266 (4 lead)	1300
600 V	5M4272 (4 lead)	1750

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.
- Brushless alternator with brushless pilot exciter for excellent load response.

Application Data

Engine

Engine Specifications	
Engine manufacturer	John Deere
Engine model	6135HFG84
Engine type	4-Cycle, Turbocharged, Charge Air-Cooled
Cylinder arrangement	6, Inline
Displacement, L (cu. in.)	13.5 (824)
Bore and stroke, mm (in.)	132 x 165 (5.2 x 6.5)
Compression ratio	16.0:1
Piston speed, m/min. (ft./min.)	594 (1950)
Main bearings: quantity, type	7, Replaceable Insert
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	460 (617)
Crankshaft material	Forged Steel
Valve material	
Intake/Exhaust	Nickel-Chromium Head Chromium-Silicone Stem
Governor: type, make/model	JDEC Electronic L15
Frequency regulation, no-load to full-load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Exhaust

Exhaust System	
Exhaust manifold type	Dry
Exhaust flow at rated kW, m^3/min. (cfm)	74 (2606)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	527 (981)
Maximum allowable back pressure, kPa (in. Hg)	Min. 4 (1.2) Max. 7.5 (2.2)
Engine exhaust outlet size, mm (in.)	See ADV drawing

Engine Electrical

Engine Electrical System	
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	60
Starter motor rated voltage (DC)	24
Battery, recommended cold cranking amps (CCA):	
Qty., CCA rating each	Two, 950
Battery voltage (DC)	12

Fuel

Fuel System	
Fuel supply line, min. ID, mm (in.)	13 (0.50)
Fuel return line, min. ID, mm (in.)	10 (0.38)
Max. lift, fuel pump: type, m (ft.)	Electronic 2.1 (6.8)
Max. fuel flow, Lph (gph)	191.3 (50.5)
Max. return line restriction, kPa (in. Hg)	35 (10.3)
Fuel prime pump	Electronic
Fuel filter	
Secondary	2 Microns @ 98% Efficiency
Primary	10 Microns
Water Separator	Yes
Recommended fuel	#2 Diesel

Lubrication

Lubricating System	
Type	Full Pressure
Oil pan capacity, L (qt.) §	40.0 (42.3)
Oil pan capacity with filter, L (qt.) §	42.0 (44.4)
Oil filter: quantity, type §	1, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Application Data

Cooling

Radiator System	
Ambient temperature, °C (°F)*	50 (122)
Engine jacket water capacity, L (gal.)	18 (4.8)
Radiator system capacity, including engine, L (gal.)	67.2 (17.8)
Engine jacket water flow, Lpm (gpm)	400 (106)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	208 (11839)
Heat rejected to air charge cooler at rated kW, dry exhaust, kW (Btu/min.)	94 (5350)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	965 (38)
Fan, kWm (HP)	18 (24)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

* Enclosure with internal silencer reduces ambient temperature capability by 5°C (9°F).

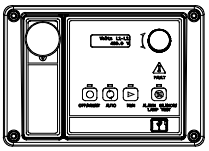
Operation Requirements

Air Requirements	
Radiator-cooled cooling air, m^3/min. (scfm)†	651 (23000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (cfm)†	297 (10500)
Combustion air, m^3/min. (cfm)	28 (996)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	43 (2448)
Alternator, kW (Btu/min.)	40 (2277)

† Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

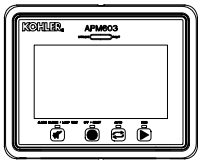
Fuel Consumption	
Diesel, Lph (gph) at % load	**Standby Rating**
100%	116.9 (30.9)
75%	90.9 (24.0)
50%	63.8 (16.8)
25%	34.2 (9.0)

Controllers



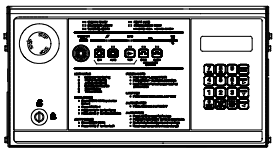
APM402 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.
- Digital display and menu control provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or serial configuration
- Controller supports Modbus® protocol
- Integrated hybrid voltage regulator with ±0.5% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-161 for additional controller features and accessories.



APM603 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.
- Graphic display with touch screen and menu control provides easy local data access
- Measurements are selectable in metric or English units
- Paralleling capability with first-on logic, synchronizer, kW and kVAR load sharing, and protective relays
  Note: Parallel with other APM603 controllers only
- Generator management to turn paralleled generators off and on as required by load demand
- Load management to connect and disconnect loads as required
- Controller supports Modbus® RTU, Modbus® TCP, SNMP and BACNet®
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- UL-listed overcurrent protective device
- NFPA 110 Level 1 capability

Refer to G6-162 for additional controller features and accessories.



Decision-Maker® 6000 Paralleling Controller
Provides advanced control, system monitoring, and system diagnostics with remote monitoring capabilities for paralleling multiple generator sets.
- Paralleling capability with first-on logic, synchronizer, kW and kVAR load sharing, and protective relays
  Note: Parallel with other Decision-Maker® 6000 controllers only
- Digital display and keypad provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or modem configuration
- Controller supports Modbus® protocol
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-107 for additional controller features and accessories.

KOHLER

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Standard Features

- Alternator Protection
- Battery Rack and Cables
- Customer Connection (standard with Decision-Maker® 6000 controller only)
- Local Emergency Stop Switch
- Oil Drain Extension
- Operation and Installation Literature

Available Options

Circuit Breakers

Type

- ❑ Magnetic Trip
- ❑ Thermal Magnetic Trip
- ❑ Electronic Trip (LI)
- ❑ Electronic Trip with Short Time (LSI)
- ❑ Electronic Trip with Ground Fault (LSIG)

Rating

- ❑ 80%
- ❑ 100%

Operation

- ❑ Manual
- ❑ Electrically Operated (for paralleling)

Circuit Breaker Mounting

- ❑ Generator Mounted
- ❑ Remote Mounted
- ❑ Bus Bar (for remote mounted breakers)

Enclosures for Remote Mounted Circuit Breakers

- ❑ NEMA 1
- ❑ NEMA 3R

Approvals and Listings

- ❑ California OSHPD Pre-Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ Hurricane Rated Enclosure

Enclosed Unit

- ❑ Sound Enclosure Level 1 and Subbase Fuel Tank Packages
- ❑ Sound Enclosure Level 2 and Subbase Fuel Tank Packages
- ❑ Weather Enclosure and Subbase Fuel Tank Packages

Open Unit

- ❑ Exhaust Silencer, Critical (kit: PA-354880)
- ❑ Flexible Exhaust Connector, Stainless Steel

Fuel System

- ❑ Flexible Fuel Lines (Select rubber or stainless steel)

Controller

- ❑ Common Failure Relay (Decision-Maker® 6000 and APM603 controllers only)
- ❑ Dry Contact (isolated alarm) (Decision-Maker® 6000 controller only)
- ❑ Two Input/Five Output Module (APM402 controller only)
- ❑ Four Input/Fifteen Output Module (APM603 controller only)
- ❑ Remote Audiovisual Alarm Panel (Decision-Maker® 6000 controller only)
- ❑ Lockable Emergency Stop Switch
- ❑ Remote Emergency Stop Switch
- ❑ Remote Serial Annunciator Panel
- ❑ Run Relay (standard with APM603, optional with others)
- ❑ Manual Key Switch (APM603 controller only)
- ❑ Manual Speed Adjust (APM402 controller only)

Cooling System

- ❑ Block Heater, 2500 W, 90- 120 V, 1 Ph
- ❑ Block Heater, 2500 W, 190- 208 V, 1 Ph
- ❑ Block Heater, 2500 W, 210- 240 V, 1 Ph
- ❑ Block Heater, 2500 W, 380- 480 V, 1 Ph
  Required for ambient temperatures below 0°C (32°F)
- ❑ Radiator Duct Flange

Electrical System

- ❑ Generator Heater
- ❑ Battery
- ❑ Battery Charger, Equalize/Float Type
- ❑ Battery Heater

Paralleling System

- ❑ Voltage Sensing

Miscellaneous

- ❑ Air Cleaner, Heavy Duty
- ❑ Air Cleaner Restriction Indicator
- ❑ Crankcase Emissions Canister
- ❑ Engine Fluids Added
- ❑ Rated Power Factor Testing

Literature

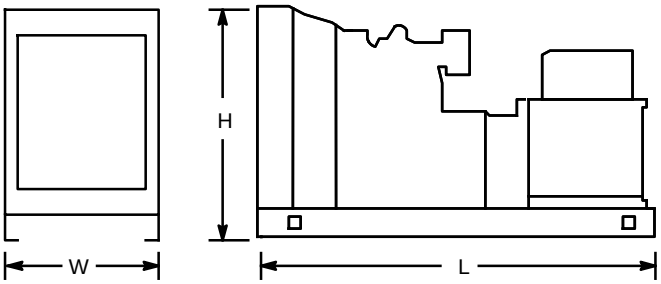
- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Warranty

- ❑ 2-Year Basic Limited Warranty
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty

Dimensions and Weights

Overall Size, L x W x H, max., mm (in.):	3630 x 1425 x 1993 (142.9 x 56.1 x 78.5)
Weight (radiator model), wet, max., kg (lb.):	3883 (8560)



NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

DISTRIBUTED BY:

Pump Data Sheet - Gorman-Rupp SEW 60Hz

Company: Ramboll
Name: Trey Wilkins
Date: 02/07/2020

Pump:

Size:	V6A-B-2	Dimensions:	Suction:	6 in
Type:	V&VS-SERIES		Discharge:	6 in
Synch Speed:	Adjustable			
Dia:	12.38 in			
Curve:	V6A-B-2			
Impeller:	38615-102			

Fluid:

Name:	Water		
SG:	1	Vapor Pressure:	0.256 psi a
Density:	62.4 lb/ft³	Atm Pressure:	14.7 psi a
Viscosity:	1.1 cP		
Temperature:	60 °F		

Search Criteria:

Flow:	1175 US gpm	Near Miss:	---
Head:	119 ft	Static Head:	80 ft

Pump Limits:

Temperature:	---	Sphere Size:	3 in
Wkg Pressure:	---		

Motor:

Consult Gorman-Rupp SEW 60Hz to select a motor for this pump.

Pump Selection Warnings:

None

--- Duty Point ---

Flow:	1175 US gpm
Head:	119 ft
Eff:	65.2%
Power:	54.2 hp
NPSHr:	12.6 ft
Speed:	1766 rpm

--- Design Curve ---

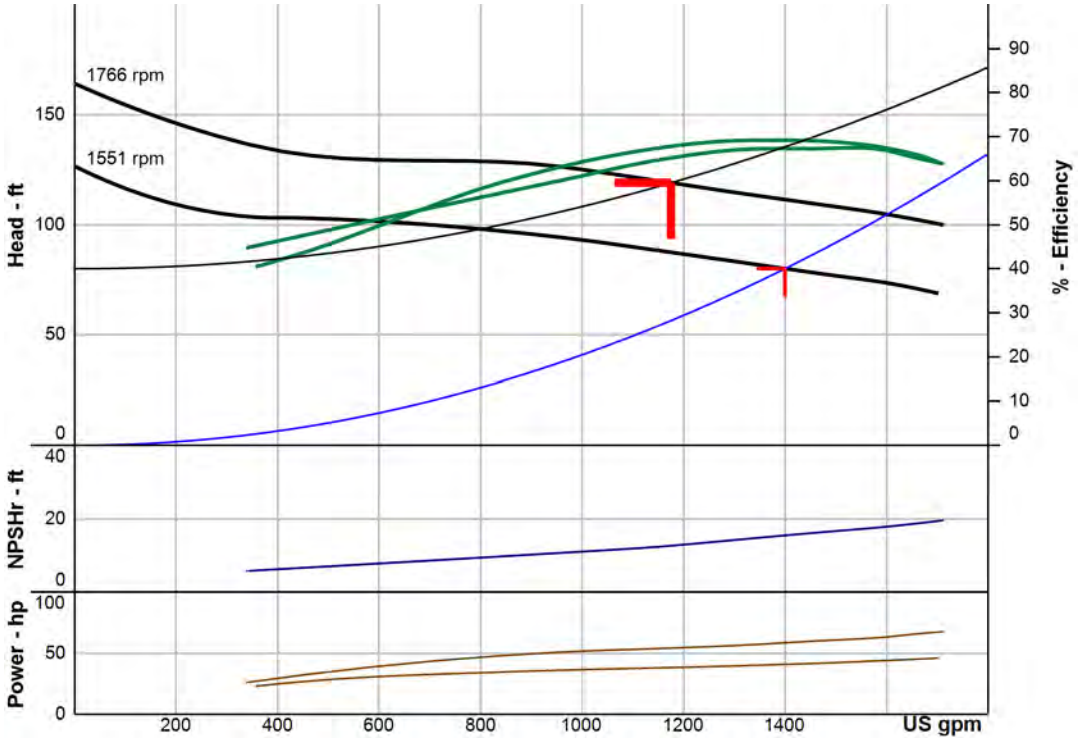
Shutoff Head:	164 ft
Shutoff dP:	71.1 psi
Min Flow:	--- US gpm

BEP: 67.3% @ 1452 US gpm

NOL Power:
67.7 hp @ 1713 US gpm

--- Max Curve ---

Max Power:
88 hp @ 1693 US gpm



This curve is provided for preliminary selection only. Please consult factory before making final pump or motor selections.

Operating Points:

Data Point	Speed	Flow	Head	NPSHr	Efficiency	Power	Min Flow
	rpm	US gpm	ft	ft	%	hp	US gpm
Primary	1766	1175	119	12.6	65.2	54.2	---
1	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---
6	1551	1400	80.1	15.5	69.2	40.9	---

Self Priming Centrifugal Pump

ULTRA V® SERIES

VARIOUS PATENTS APPLY

Model V6A60-B

Size 8” x 6”

5 YEAR WARRANTY ULTRA V SERIES®

PUMP SPECIFICATIONS

Size: 8” x 6” (203 mm x 154 mm).**

Casing: Gray Iron 30.
Maximum Operating Pressure 129 psi (889 kPa).*

Semi-Open Type, Two Vane Impeller: Ductile Iron 65-45-12.
Handles 3” (76,2 mm) Diameter Spherical Solids.

Impeller Shaft: Alloy Steel 4150.

Self-Cleaning Replaceable Wear Plate: Carbon Steel ASTM A36.

Shimless Adjustable Cover Plate: Gray Iron 30.

Externally Removable Flap Valve: Neoprene w/Nylon and Steel Reinforcing.

Suction Flange/Flap Valve Seat: Gray Iron 30.

Bearing Housing: Gray Iron 30.

Seal Plate: Gray Iron 30.

Shaft Sleeve: Alloy Steel 4130.

Radial and Thrust Bearings: Open Double Row Ball.
Bearing and Seal Cavity Lubrication: SAE 30 Non-Detergent Oil.

Gaskets: Buna-N, Compressed Synthetic Fibers, Vegetable Fiber, PTFE, Cork and Rubber.

O-Rings: Buna-N.

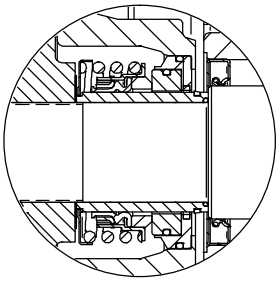
Hardware: Standard Plated Steel.

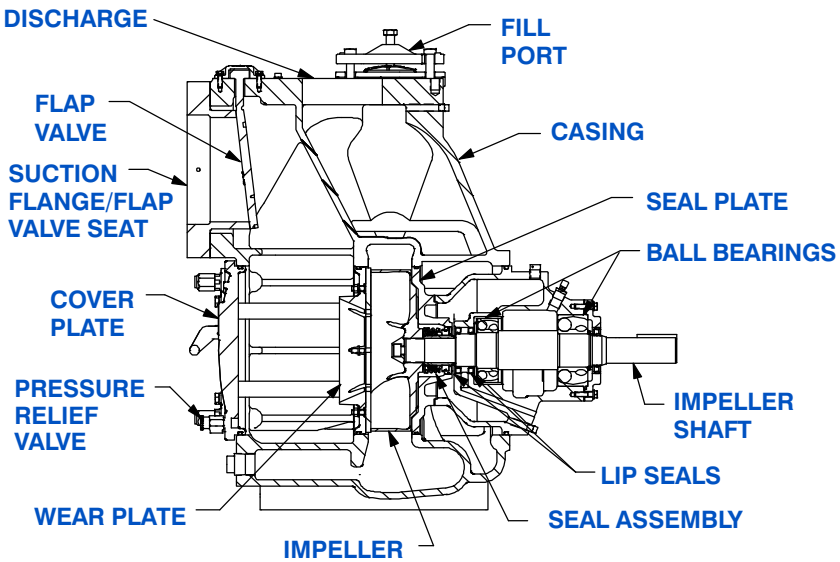
Brass Pressure Relief Valve.

Bearing and Seal Cavity Oil Level Sight Gauges.

Optional Equipment: Automatic Air Release Valve. High Pump Temperature Shutdown Kit. Stainless Steel/G-R Hard Iron Impeller, Seal Plate and Wear Plate. Cartridge Seal w/Stainless Steel Sleeve. 120/240 Volt Casing Heater.

** Optional Gray Iron 30 Flanges Available as Follows (See Price Sheets):
8” and 6” Female NPT Suction/Discharge Flange Kits.
8” and 6” ASA Suction/Discharge Spool Flange Kits.
200 mm and 150 mm DIN 2527 (PN 16) Suction/Discharge Spool Flange Kits.





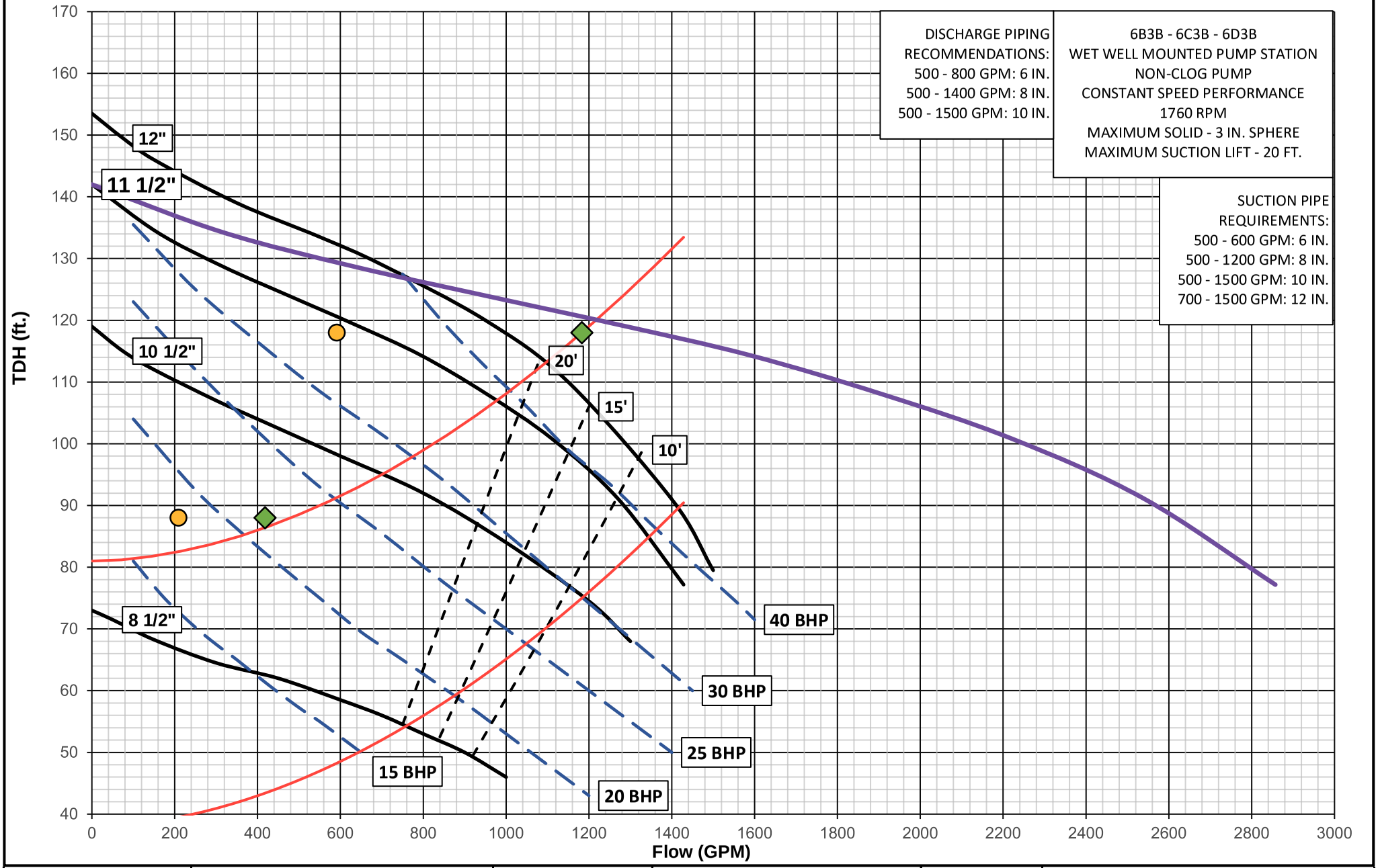
SEAL DETAIL

Cartridge Type, Mechanical, Oil-Lubricated, Double Floating, Self-Aligning. Silicon Carbide Rotating and Stationary Faces. Stainless Steel 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel 18-8 Cage and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).*

*** *Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.***

Pump Curve

Smith & Loveless Inc.



Location:	FMC Pump Station	Design Point:	591.5 GPM @ 118 ft.	Pump Model:	6B3B / 6C3B / 6D3B, 1760 RPM
Project Name:		Impeller Trim:	11 - 1/2 Inches	HP & Efficiency:	See Curve HP & 52.8%

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Appendix B – Flood Plain Information

Refer to the FMC PS PER dated June 2018 for Flood Plain Information

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Appendix C – Pump Station Preliminary Plans

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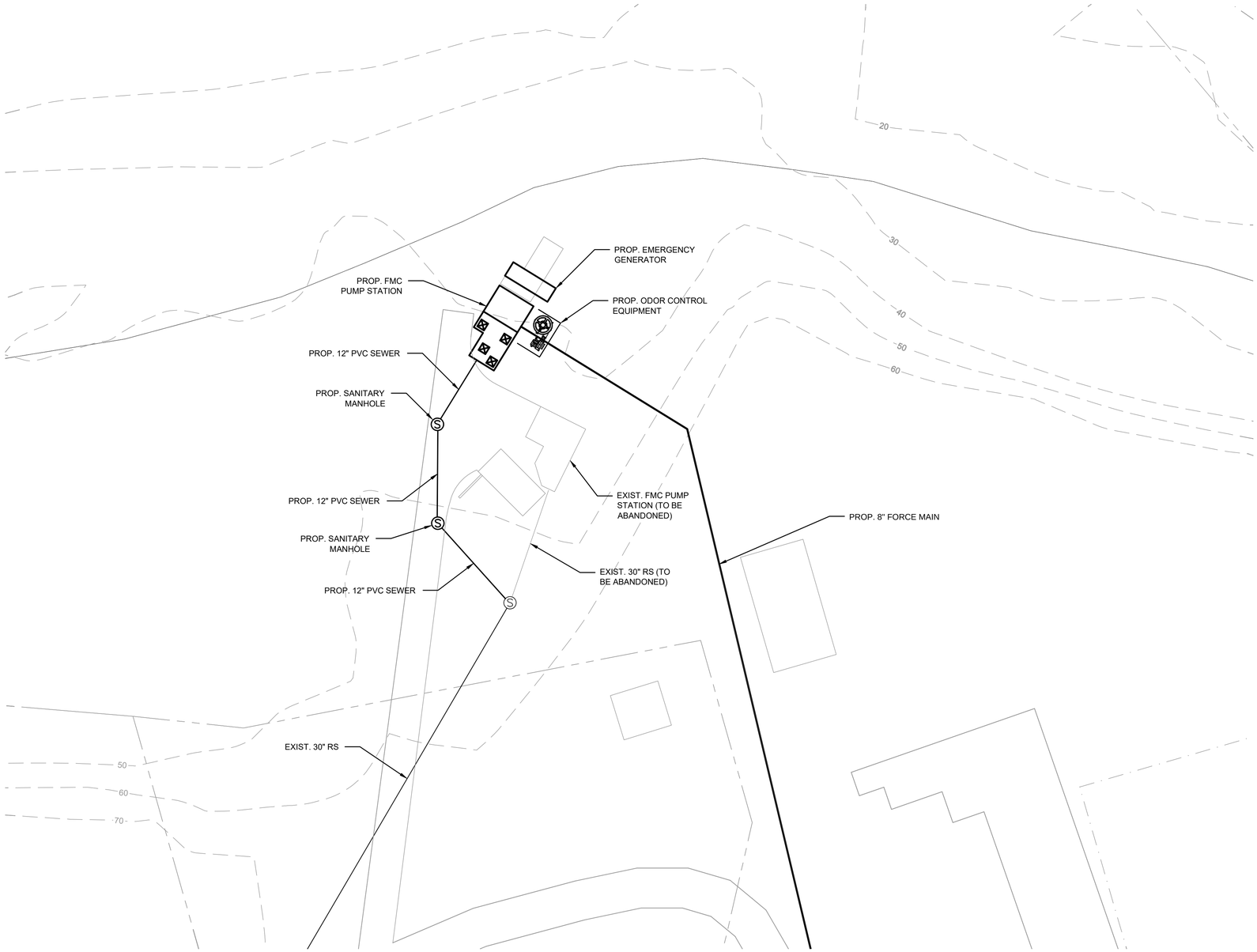

TRUE NORTH

SITE PLAN

1"=30'

1' 0 1'

PRELIMINARY
NOT FOR CONSTRUCTION
DATE PRELIMISSUEDATE

IN CHARGE OF
DESIGNED BY
CHECKED BY
DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC

SPOTSYLVANIA COUNTY DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

CIVIL

PUMP STATION SITE PLAN

FILE NO. 5842.67353

DATE XX/XX/XX

C-001

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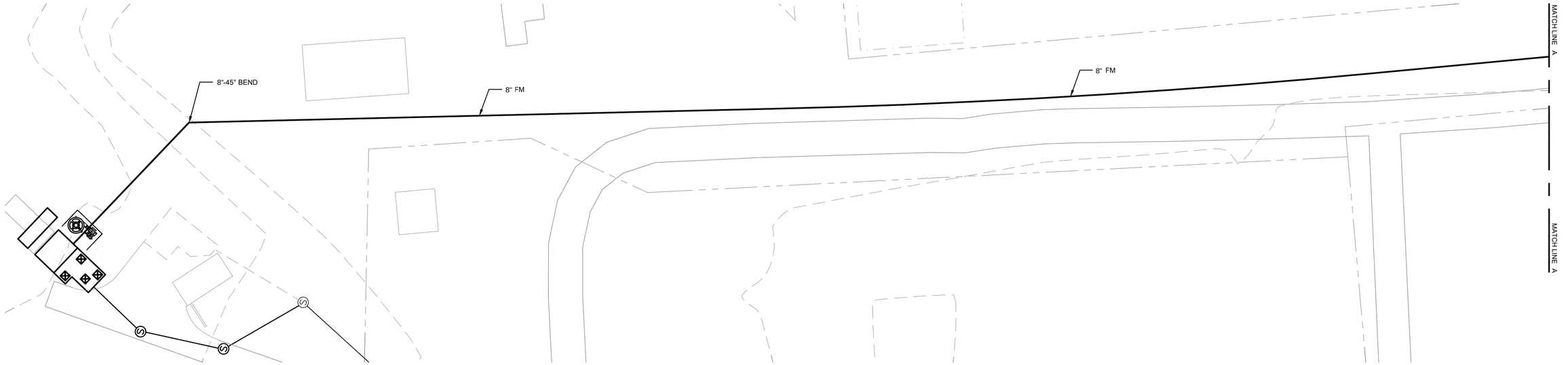
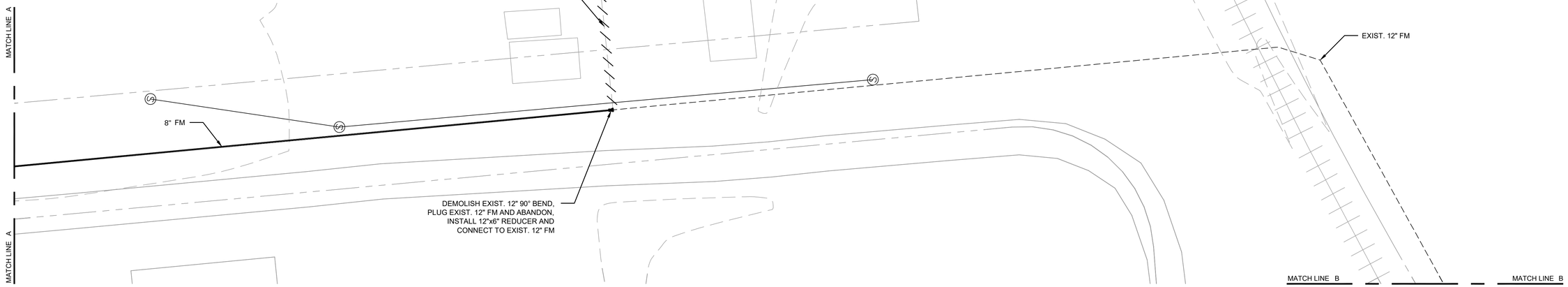


SITE PLAN

1"=30'



SITE PLAN

1"=30'

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CIVIL

PROPOSED FORCE MAIN STA. 0+00 TO STA. X+XX

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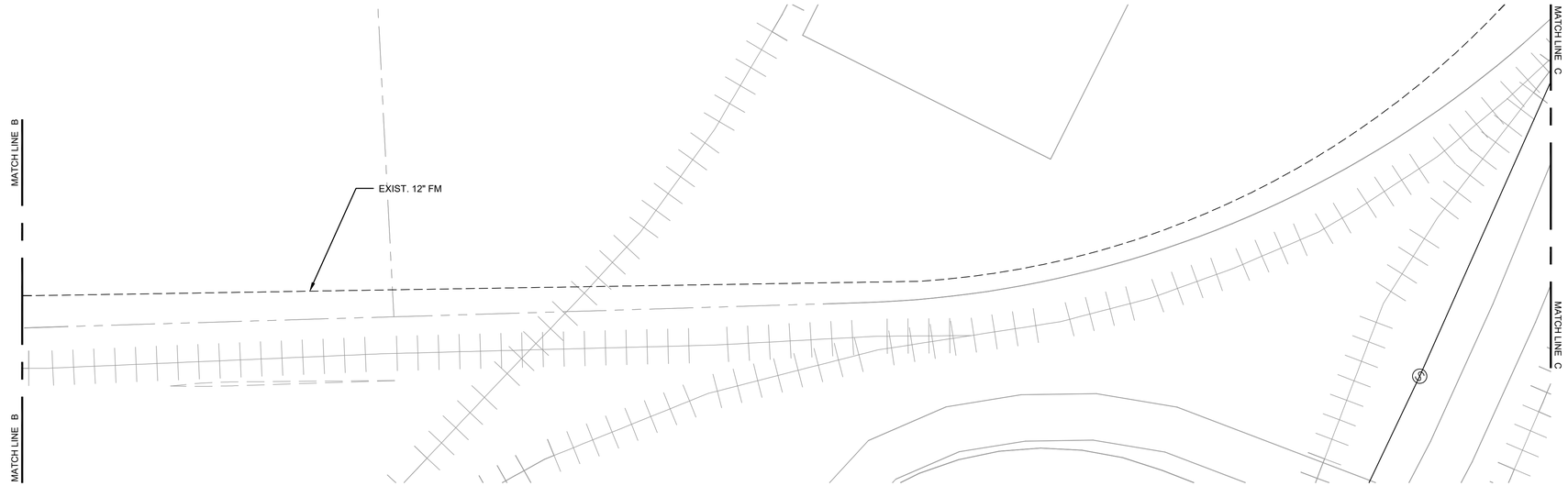

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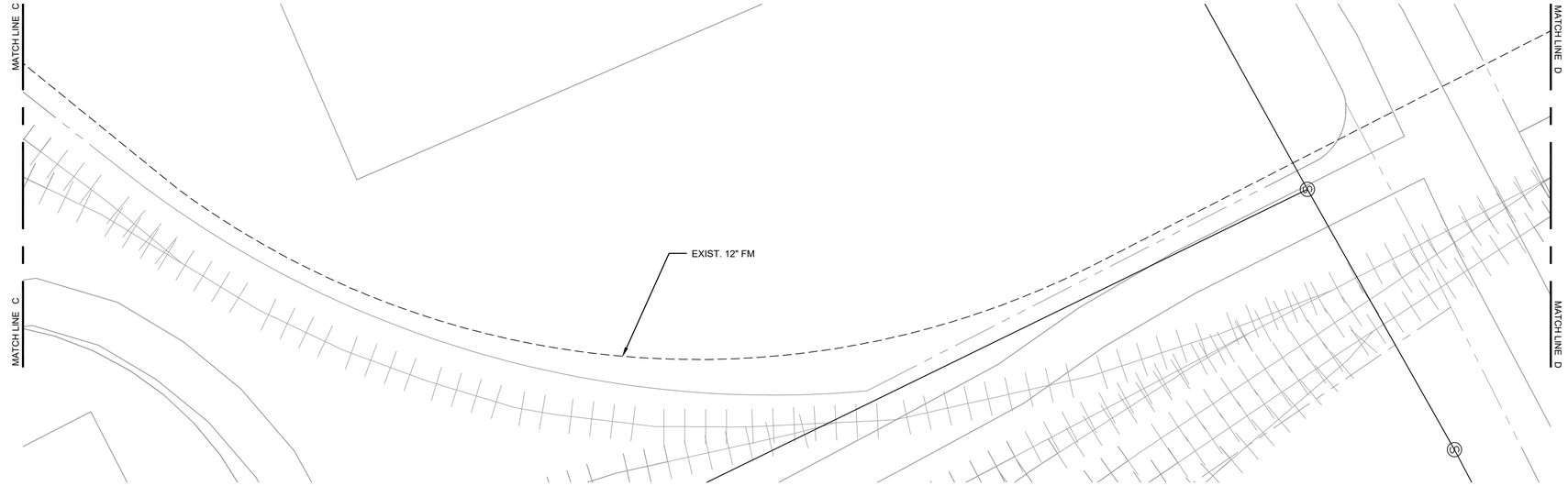

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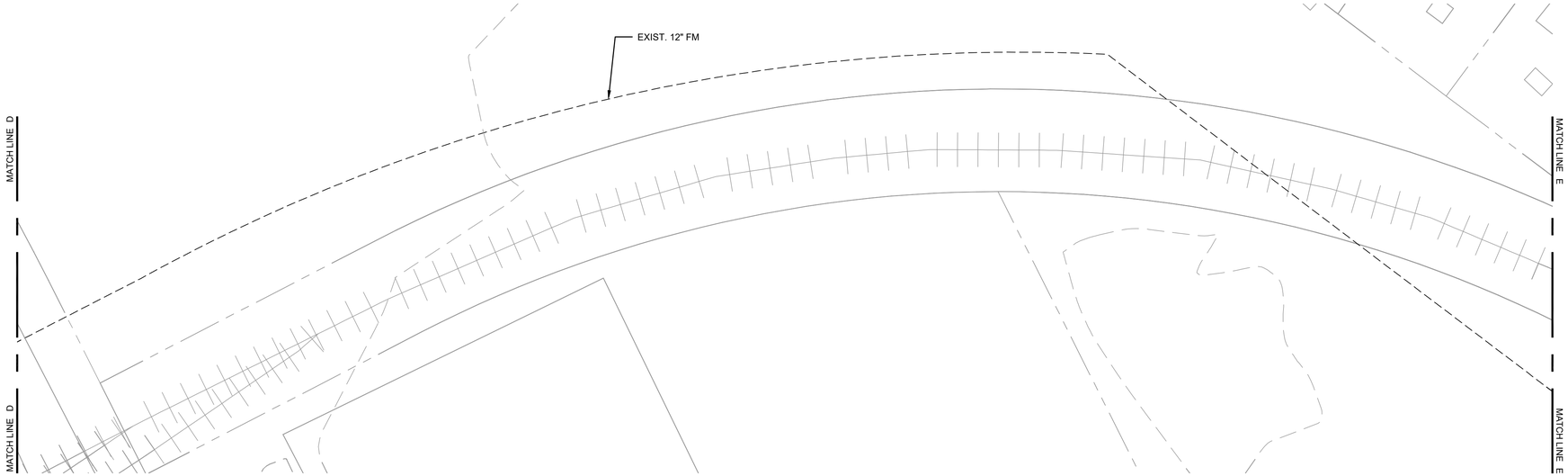

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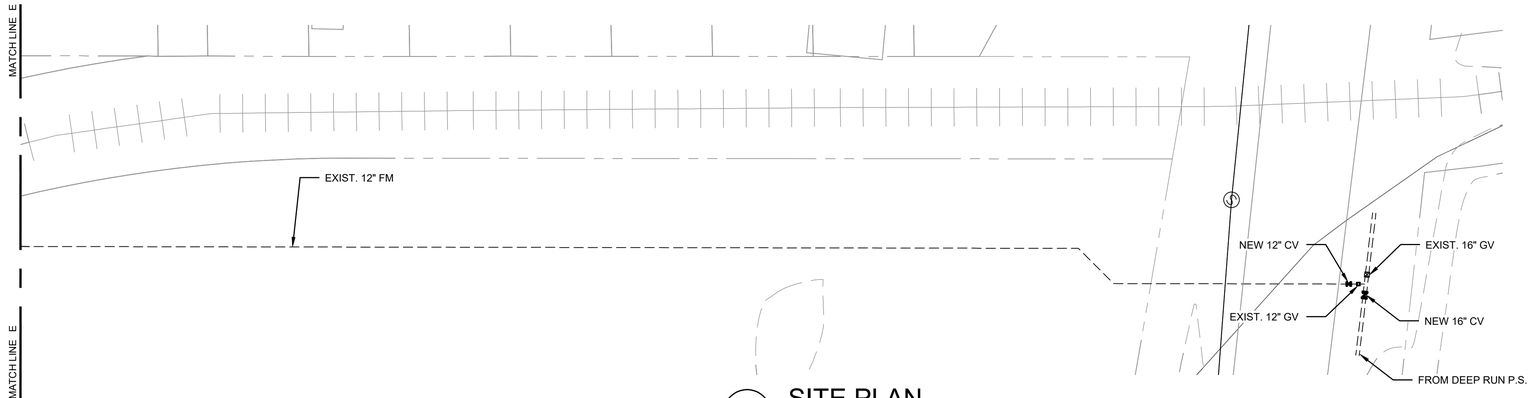

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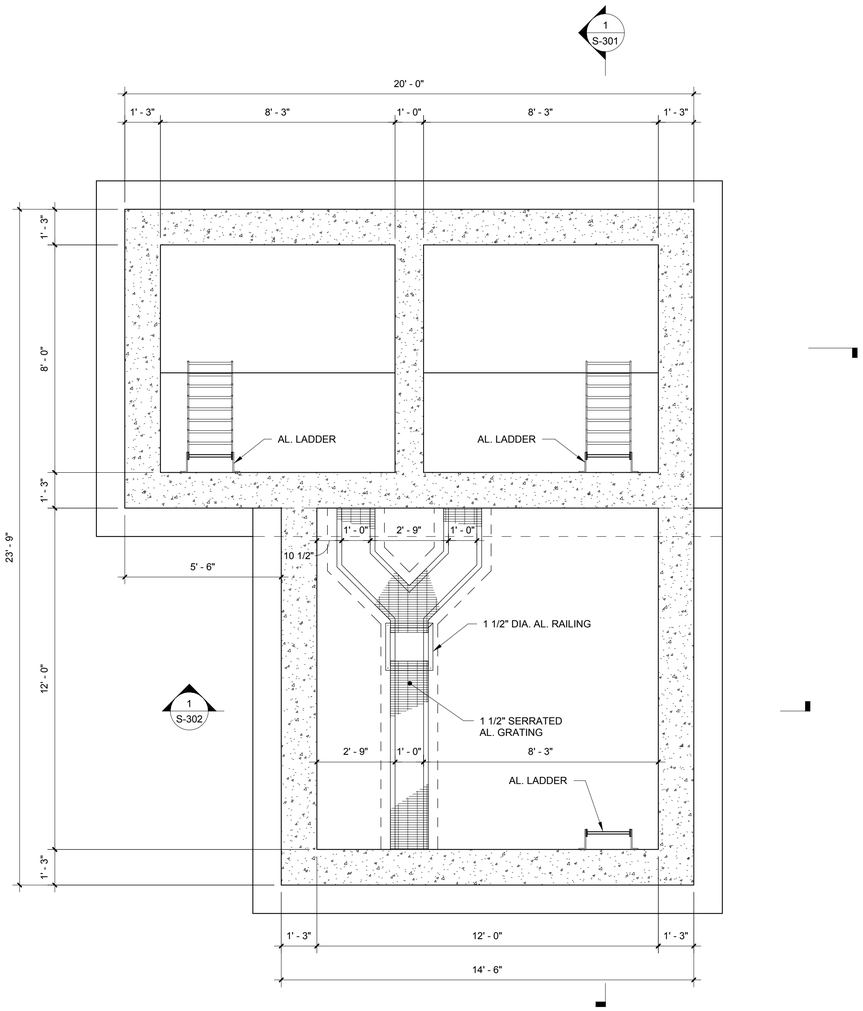

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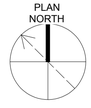

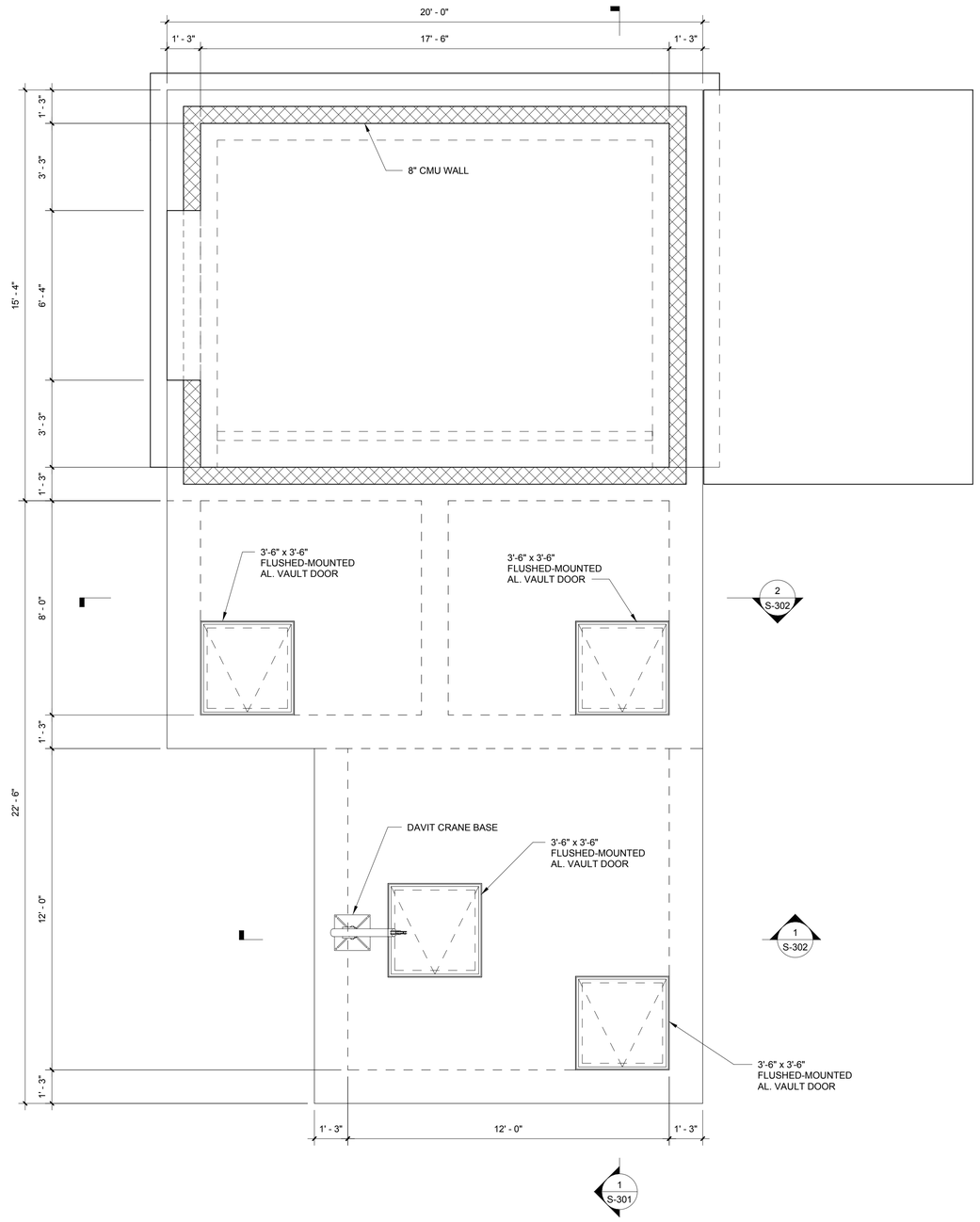

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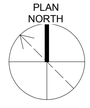

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DRAWN BY	R. EGAN		

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STRUCTURAL

PLANS

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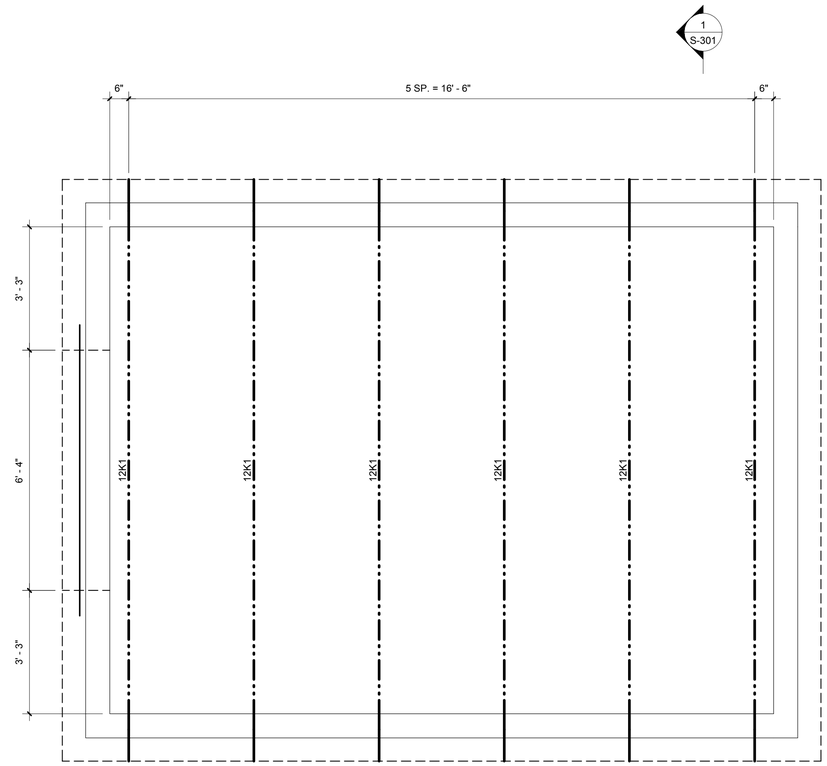

ROOF FRAMING PLAN

1/2" = 1'-0"

2' 1' 0 1' 2'

PLAN NORTH

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FREDERICKSBURG, VIRGINIA

STRUCTURAL

ROOF FRAMING PLAN

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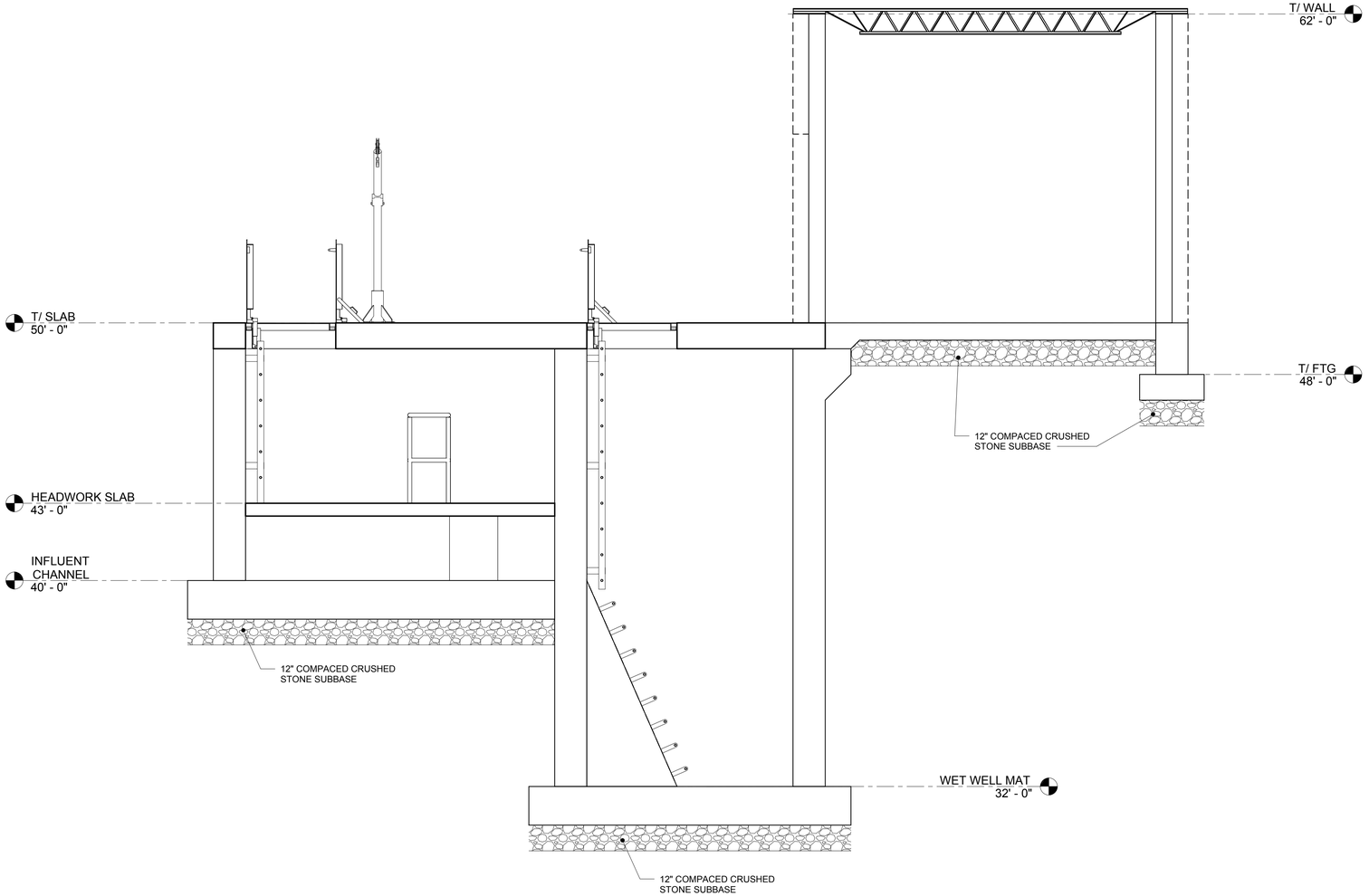

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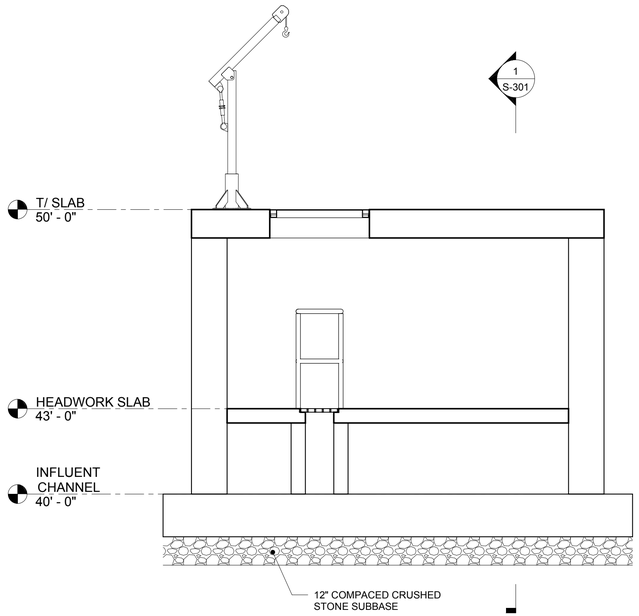

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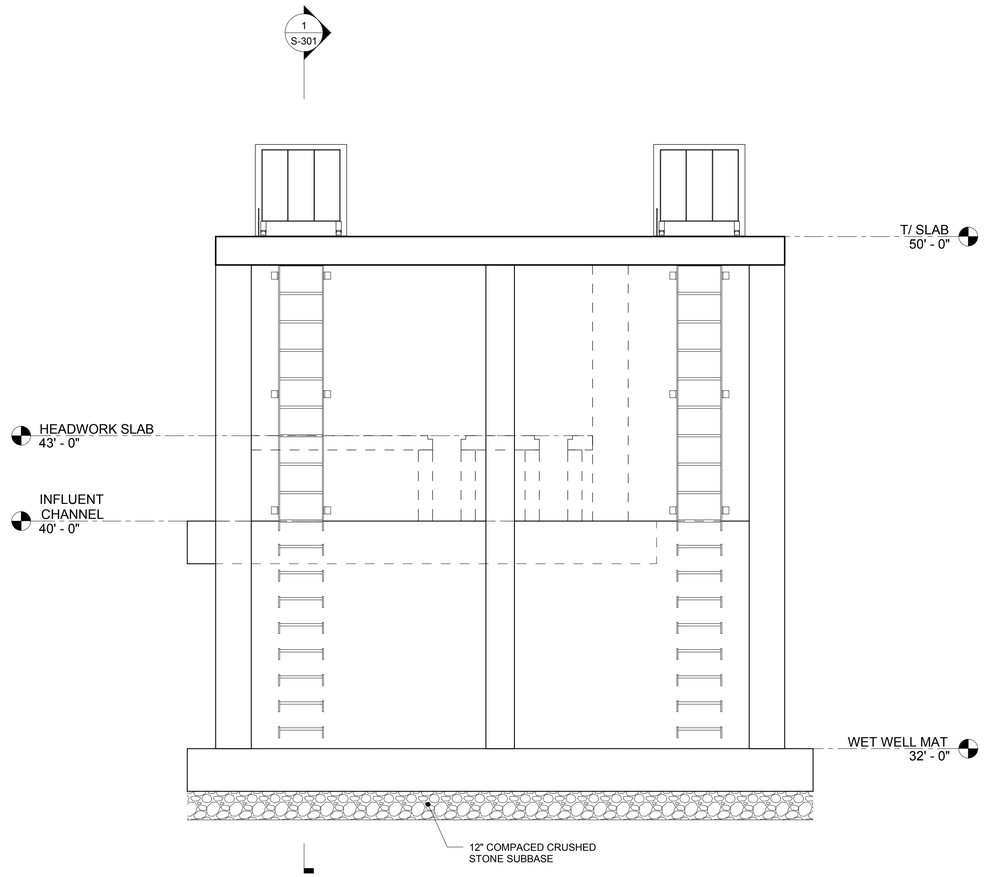

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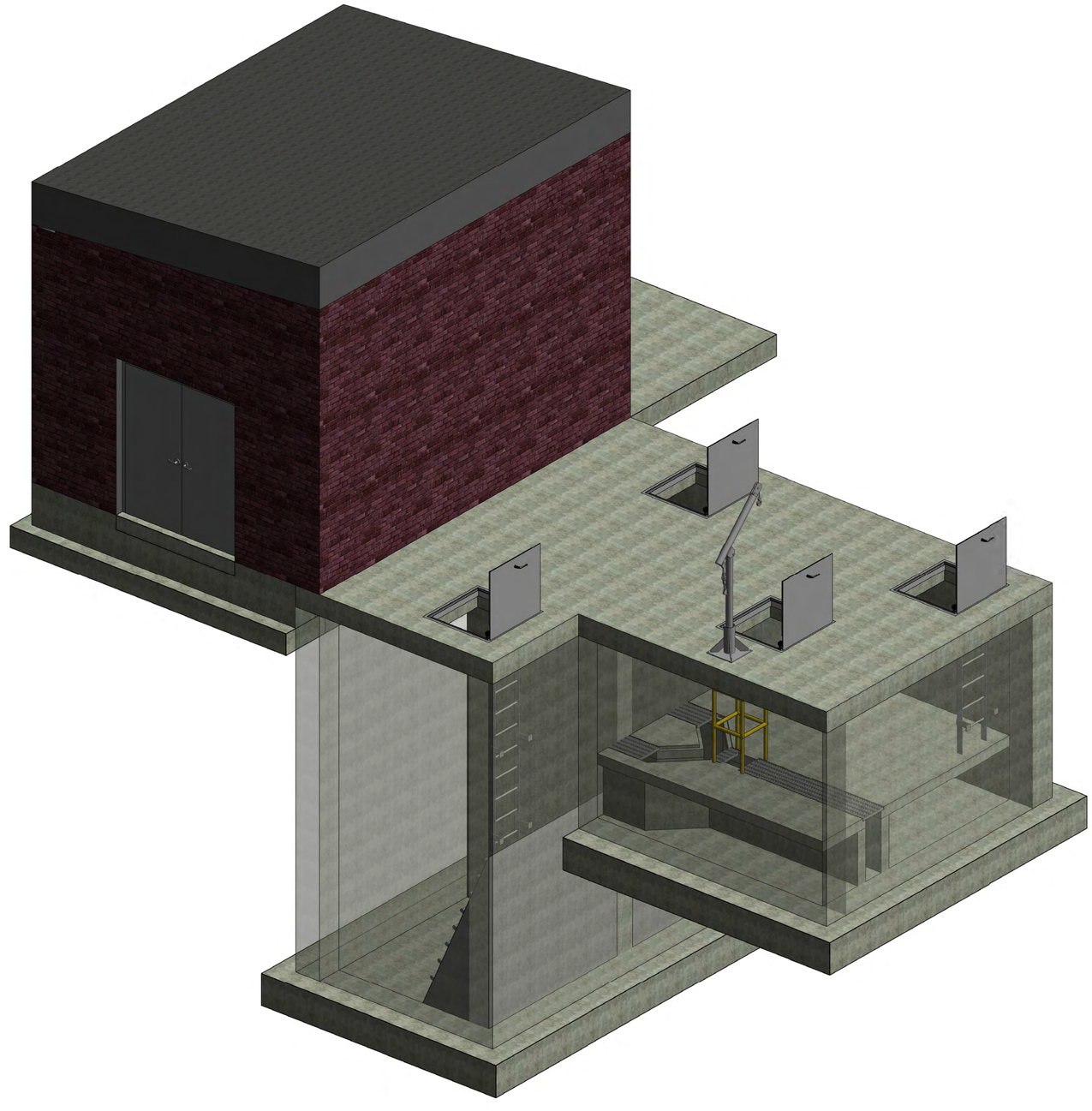

3D VIEW
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STRUCTURAL

3D REPRESENTATIONS

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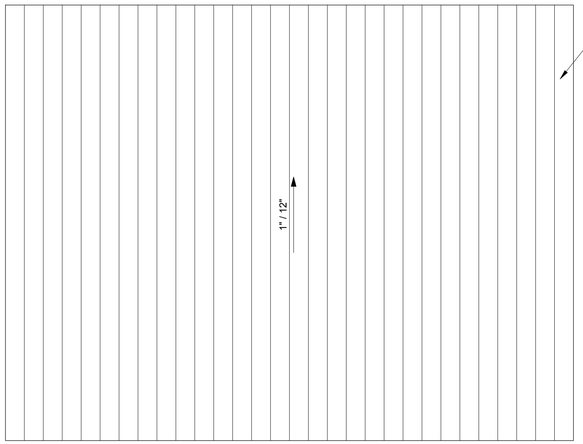

ROOF PLAN

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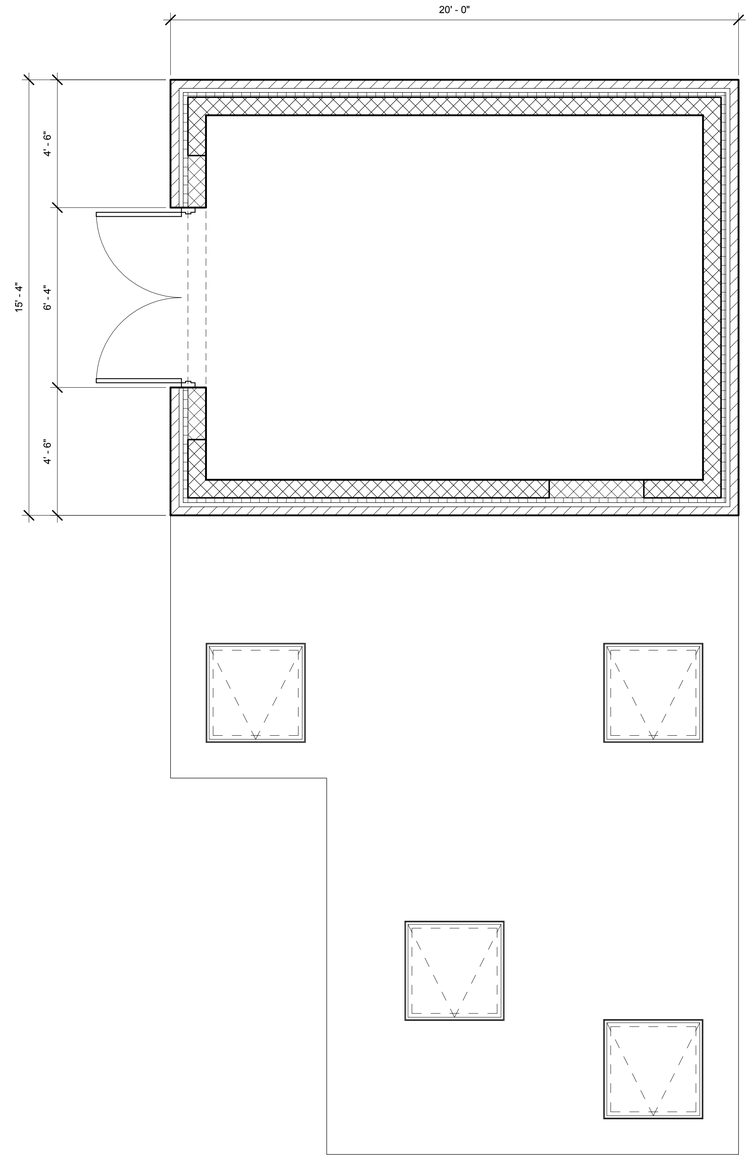

FLOOR PLAN

3/8" = 1'-0"

3' 2' 1' 0 1' 2' 3'

PLAN NORTH

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ARCHITECTURAL

FLOOR PLAN

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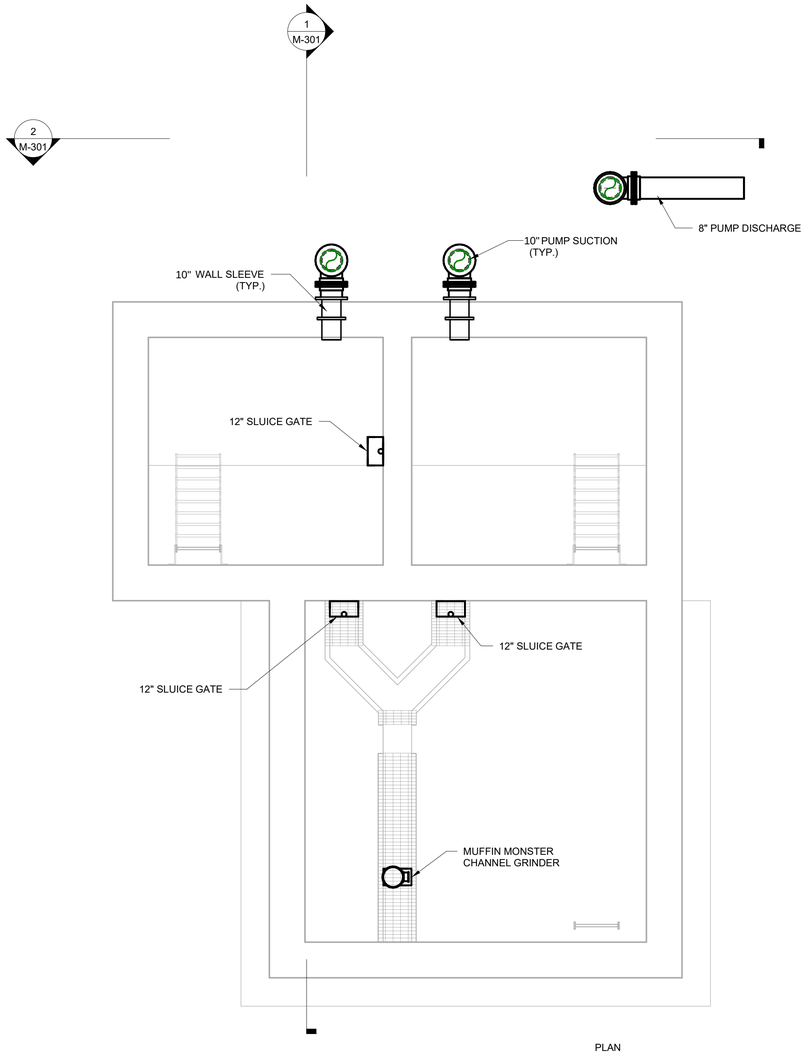

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3/8" = 1'-0"

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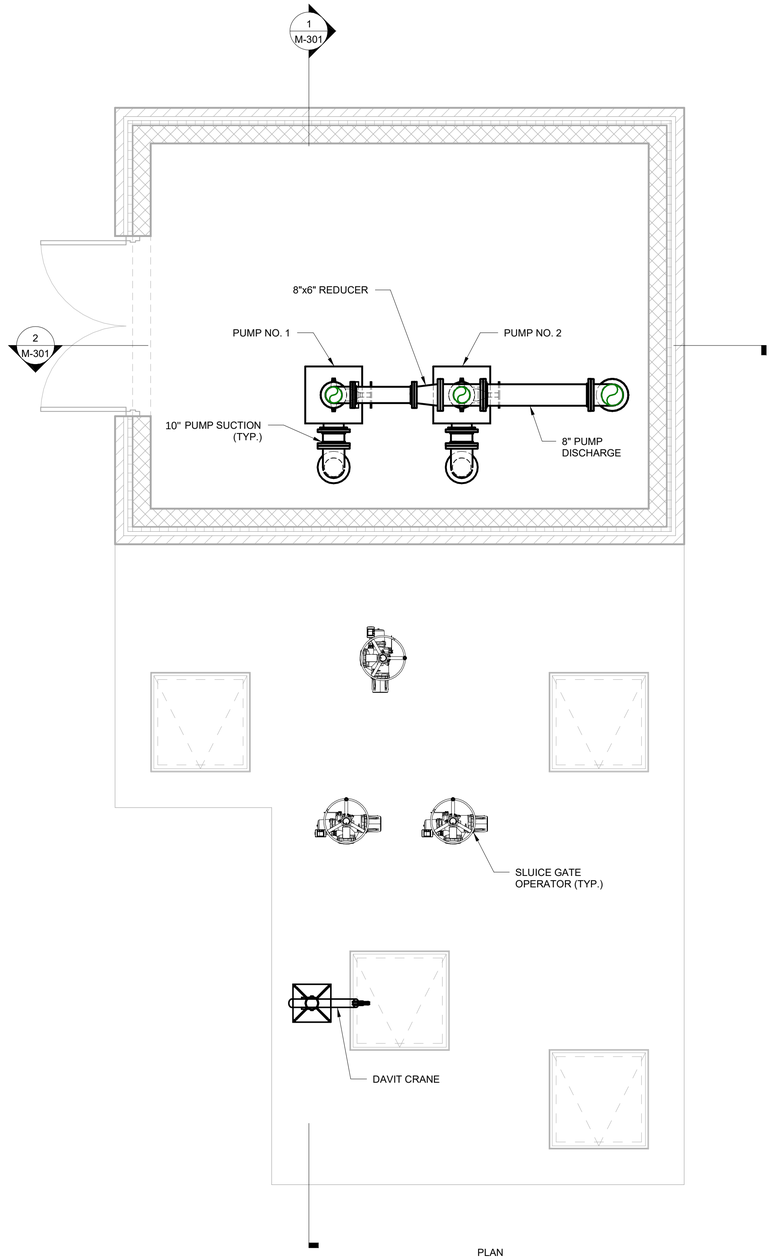

PLAN AT EL. 50'-0"

3/8" = 1'-0"

PLAN NORTH

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MECHANICAL

FLOOR PLANS

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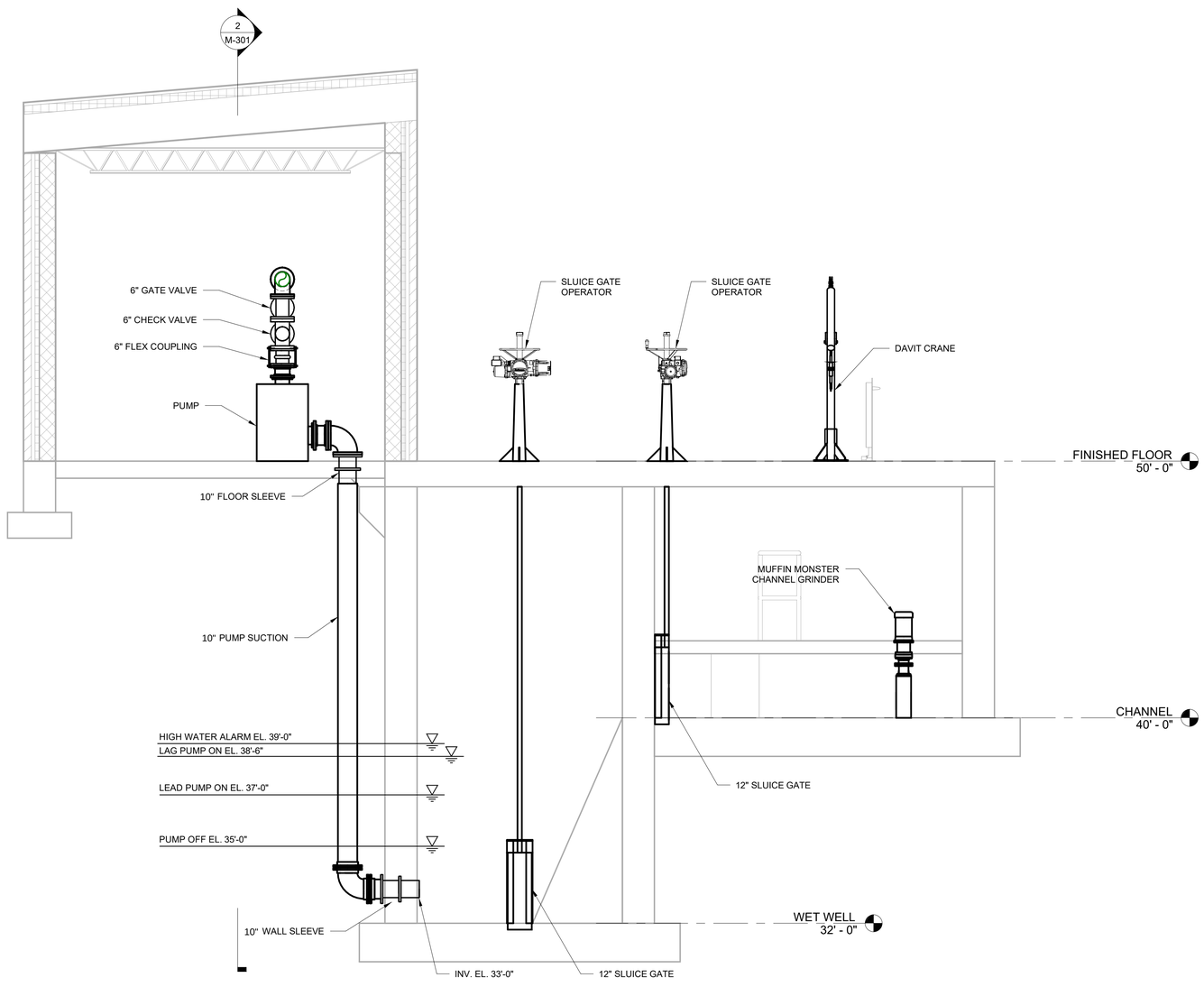

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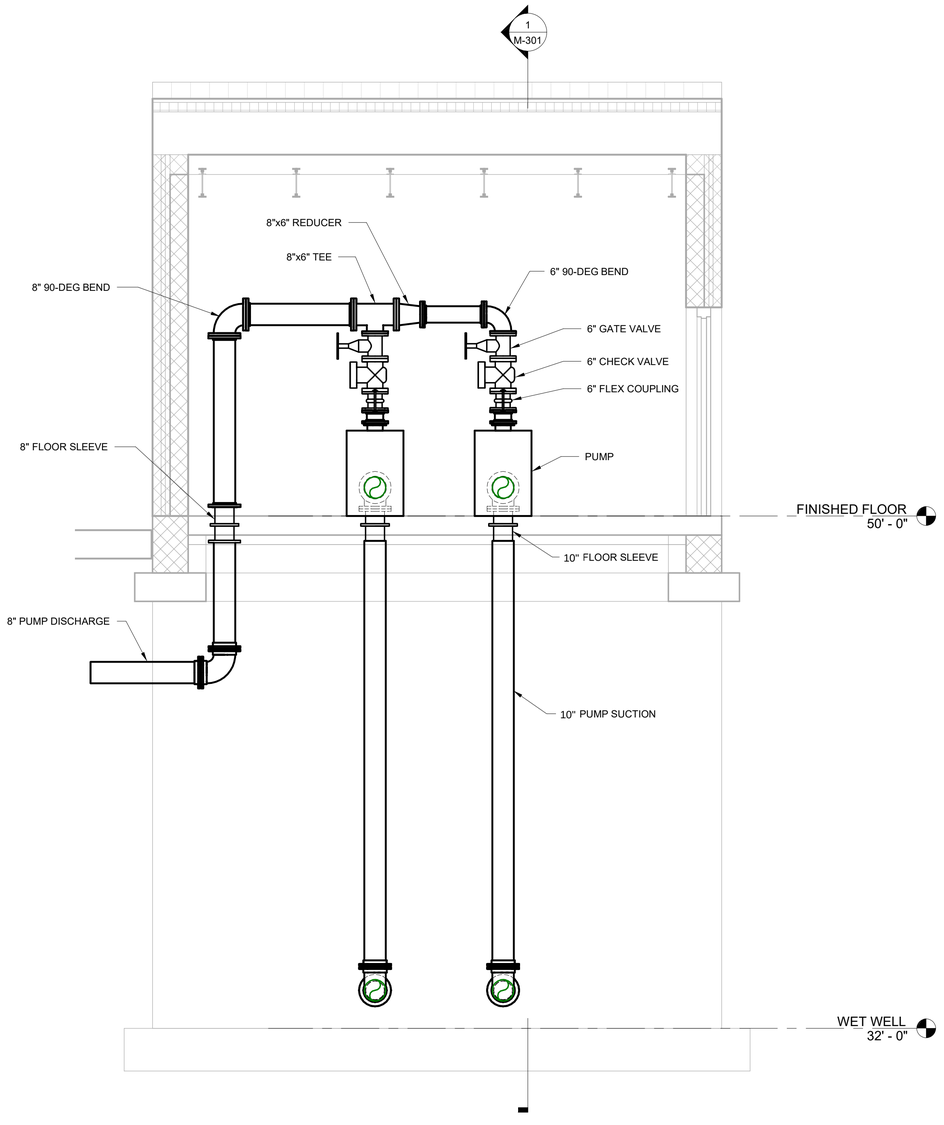

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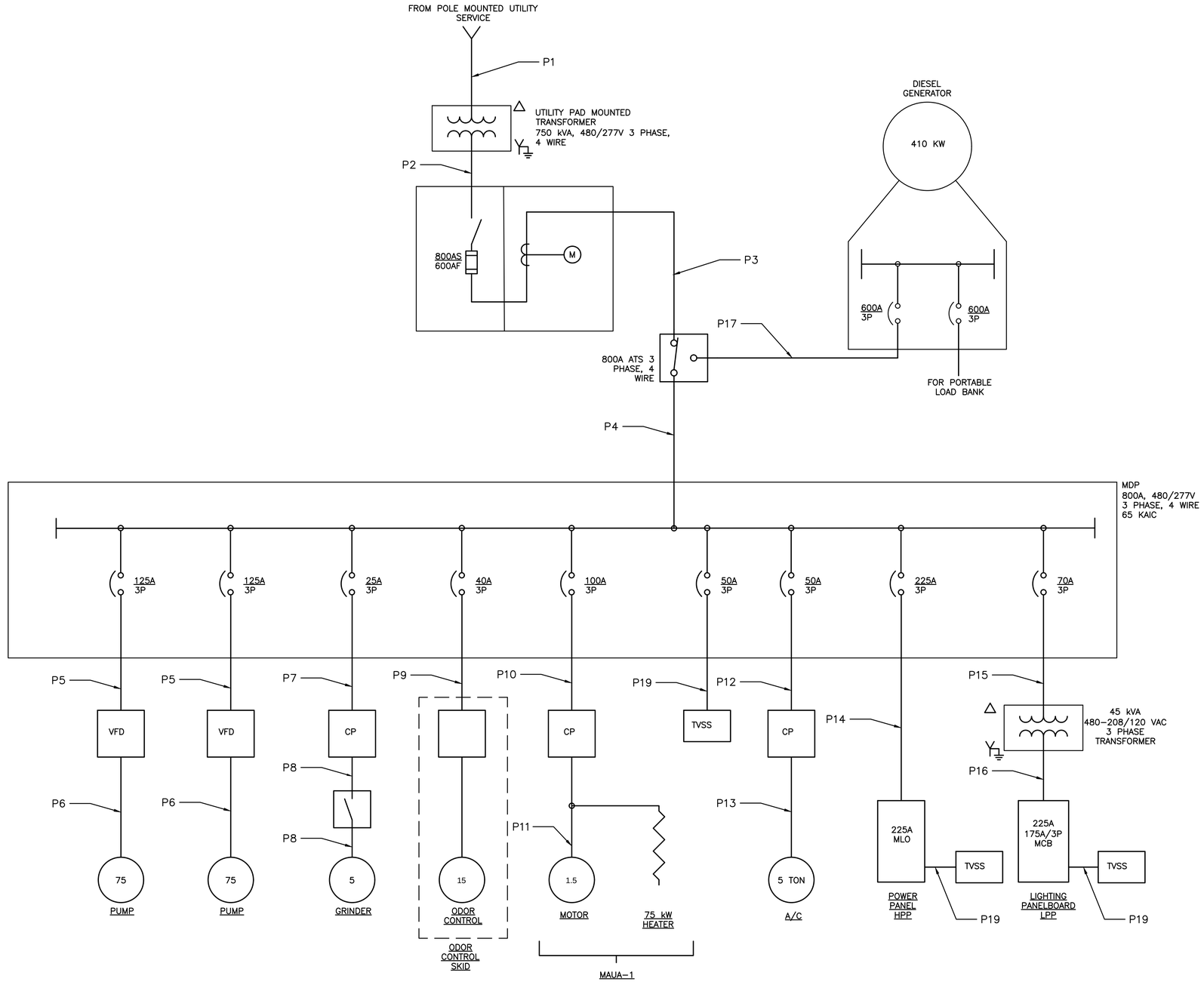

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SYRACUSE, NEW YORK

SPOTSYLVANIA COUNTY
FMC DECOMMISSIONING AND FMC PUMP STATION
PRELIMINARY ENGINEERING REPORT
FREDERICKSBURG, VIRGINIA

ELECTRICAL

ONE-LINE DIAGRAM

FILE NO. 5842.67353-E101

DATE JUNE 11, 2018

E-101

POWER - CONDUCTOR AND CONDUIT SCHEDULE					
DESIGNATION	FROM	TO	CONDUIT SIZE	CONDUCTORS QTY/SIZE	REMARKS
P1	UTILITY RISER POLE	UTILITY 500 KVA PAD MOUNTED TRANSFORMER	2 SETS 4"	UTILITY PROVIDED	PROVIDE NYLON PULL STRING IN EACH CONDUIT
P2	UTILITY 500 KVA PAD MOUNTED TRANSFORMER	MAIN SWITCH MS-1	2 SETS 4"	4# 350MCM, 1 #1G, PER CONDUIT	
P3	MAIN SWITCH MS-1	ATS	2 SETS 4"	4# 350MCM, 1# 1G, PER CONDUIT	-
P4	ATS	SWITCHBOARD MDP	2 SETS 4"	4# 350MCM, 1#1G, PER CONDUIT	
P5	SWITCHBOARD MDP	75 HP PUMP VFD	3/4"	3# 1/0, 1# 6G	
P6	75 HP PUMP VFD	75 HP PUMP	3/4"	3# 1/0, 1# 6G	-
P7	SWITCHBOARD MDP	5 HP GRINDER CONTROLLER	3/4"	3# 12, 1# 12G	-
P8	5 HP GRINDER CONTROLLER	5 HP GRINDER	3/4"	3# 12, 1# 12G	-
P9	SWITCHBOARD MDP	ODOR CONTROL SYSTEM CONTROL PANEL	3/4"	3# 10, 1# 10G	-
P10	SWITCHBOARD MDP	MAHU-1 CONTROL PANEL	2"	3# 1/0, 1# 6G	-
P11	MAHU-1 CONTROL PANEL	MAHU-1 CONTROL	2"	3# 1/0, 1# 6G	-
P12	SWITCHBOARD MDP	AC CONTROL PANEL	3/4"	3# 6, 1# 10G	-
P13	AC CONTROL PANEL	AC UNIT	3/4"	3# 6, 1# 10G	
P14	SWITCHBOARD MDP	PANEL HPP	2-1/2"	4# 4/0, 1# 4G	
P15	SWITCHBOARD MDP	45 KVA TRANSFORMER	1-1/2"	3# 4, 1# 8G	
P16	45 KVA TRANSFORMER	PANEL LPP	2"	4# 2/0, 1# 6G	
P17	GENERATOR	ATS	2 SETS 4"	4# 350MCM, 1#1G, PER CONDUIT	
P18	METERING SECTION OF MAIN SWITCH	METER SOCKET	1"	COORDINATE WITH UTILITY	LOCATE METER SOCKET ON EXTERIOR OF BUILDING
P19	METERING SECTION OF MAIN SWITCH	TVSS EQUIPMENT	1-1/2"	4-#4, 1-#10 GRD	

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CHECKED BY J. DOMANSKI
DRAWN BY J. LAGOY

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SYRACUSE, NEW YORK

SPOTSYLVANIA COUNTY
FMC DECOMMISSIONING AND FMC PUMP STATION
PRELIMINARY ENGINEERING REPORT
FREDERICKSBURG, VIRGINIA

ELECTRICAL

CONDUIT & CONDUCTOR SCHEDULE

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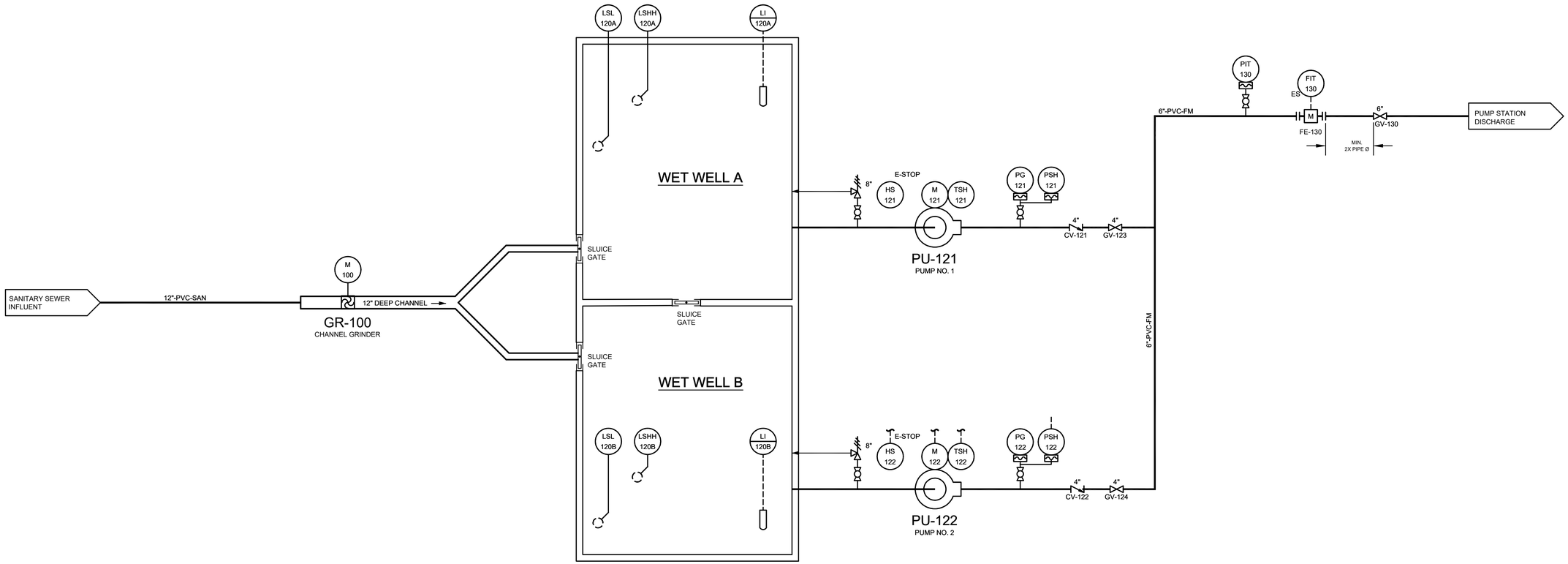
DATE JUNE 11, 2018

E-102



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FMC DECOMMISSIONING & FMC PUMP STATION
PRELIMINARY ENGINEERING REPORT
FREDERICKSBURG, VIRGINIA

INSTRUMENTATION

PFD - PUMPING STATION

FILE NO. 5842.67353
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FIG-1

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Appendix E – Report of Geotechnical Study

Refer to the FMC PS PER dated June 2018 for geotechnical information.

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FMC WWTP DECOMMISSIONING AND FMC PUMP STATION

TO: Doug Crooks
FROM: Isaac Katz, Matt Wimmer, Bill Meinert
RE: Spotsylvania County FMC Improvements
FILE: 67353
DATE: June 21, 2018

CC: Ben Loveday, Chris Edwards, Scott Powell

TABLE OF CONTENTS

FMC WWTP Decommissioning and FMC Pump Station i
Section 1 - Overview 4
1.1 Background 4
1.2 Purpose 4
Section 2 - FMC Decommissioning 5
2.1 Regulatory Requirements 5
2.2 Fate of Structures and Equipment 5
2.3 Site Re-Use Alternatives 5
Section 3 – FMC Pump Station 6
3.1 Design Flows and System Curve Development 6
3.1.1 Design Flows 6
3.1.2 System Curve Development 7
3.2 Force Main Design and Alignment 8
3.2.1 Force Main Alignment 8
3.2.2 Traffic Impacts and Road Crossings 10
3.3 Site Conditions 10
3.3.1 Existing 10
3.3.2 Proposed Location 10
3.3.3 General Site Layout 10
3.4 Gravity Sewer 10
3.5 Wet Well 11
3.6 Pumps 11
3.6.1 Smith & Loveless Suction Lift Pumps 11
3.6.2 Gorman Rupp Suction Lift Pumps 12
3.7 Site/Control Building 13
Section 4 – Pump Station – Structural and Architectural Design 14
4.1 Codes and Standards 14
4.2 Description of Architectural Systems 14
4.3 Description of Structural Systems 15
4.4 Design Criteria 16

4.4.1 Material Properties 17
Section 5 – Pump Station – Electrical Design 18
5.1 Electrical Basis of Design 18
5.1.1 Reliability and Flexibility 18
5.1.2 Safety 18
5.1.3 Codes and Standards 18
5.2 Power Distribution Summary 18
5.2.2 Electrical Distribution 18
5.2.3 Standby Power System 19
5.2.4 Variable Frequency Drives 19
5.2.5 Transient Voltage Surge Suppression Equipment 19
5.2.6 Disconnect Switches 20
5.2.7 Electric Motors 20
5.2.8 Lighting 20
5.2.9 Telecommunications 20
5.2.10 Fire Alarm System 21
Section 6 – Pump Station – Instrumentation and Controls Design 21
6.1 Introduction 21
6.2 Codes and Standards 21
6.3 Basis of Design 21
6.3.1 Process Control 21
6.3.2 Control Panel 21
6.3.3 Redundancy and Reliability 22
6.3.4 Remote Communications 22
6.3.5 Constructability 22
Section 7 – Pump Station – Mechanical Design 22
7.1 Basis of Design 22
7.1.1 HVAC 23
7.1.2 Plumbing 23
7.1.3 Fire Protection 23
7.2 Virginia SCAT Guidelines 23
7.3 Constructability 23
section 8 – Preliminary Construction Cost Estimate 23
8.1 Summary 23
Section 9 – Conclusion and Recommendations 24
9.1 Summary 24

LIST OF TABLES

Table 3.1: Existing IPPS Average Daily Flow and Peak Daily Flow....6
Table 3.2: Projected Buildout Flow to the FMC PS....6
Table 3.3: Projected Force Main Velocities....9
Table 3.4: Projected Cost for FM Alternatives....9
Table 4.1: Pump Station – Building Code Analysis....14
Table 4.2: Design Basis – Live Loads....16
Table 4.3: Design Basis – Snow Loads....16
Table 4.4: Design Basis – Wind Loads....16
Table 4.5: Design Basis – Seismic Loads....16
Table 4.6: Design Basis – Concrete & Masonry....17
Table 8.1: Summary – FMC PS and FM Cost Estimate....24

LIST OF FIGURES

Figure 3.1: Wet Well Profile....7
Figure 3.2: FMC PS System Curve....8
Figure 3.3: Smith & Loveless System and Pump Curve....12
Figure 3.4: Gorman Rupp System and Pump Curve....13

LIST OF APPENDICES

Appendix A: Process Mechanical Literature
Appendix B: Flood Plain Information
Appendix C: Pump Station Preliminary Plans
Appendix D: Probable Cost Breakdown
Appendix E: Report of Geotechnical Study (to be completed)

SECTION 1 - OVERVIEW

1.1 BACKGROUND

In October 2015, O'Brien & Gere (OBG) delivered a series of technical memoranda (Technical Memoranda No. 1 through No.4) to Spotsylvania County (County) and the City of Fredericksburg (City). Collectively, those memos evaluated and modeled the decommissioning of the City WWTP and the County's FMC WWTP; associated conveyance projects to deliver the City and FMC flows to the Massaponax WWTP (MWWTP); and several expansions and upgrade scenarios to the MWWTP (9.4 to 17.9 MGD ratings). These scenarios represented various combinations of potential County and City flows (average, peak) that might be transferred to the MWWTP. In March 2018, a preliminary engineering report (PER) detailing the Hazel Run Pump Station (HRPS) was prepared for the County. The HRPS would serve to divert City and County flows within the Hazel Run Drainage Basin from the City's collection system and Influent Pump Station (and ultimately, the County's FMC WWTP) to the MWWTP. In tandem with the HRPS PER, the upgrades identified in this FMC PER serve as the next step in the County's plan to upgrade end of useful service life equipment throughout the system and to create a more cost-effective treatment and conveyance system for the City and County.

Please refer to the Conveyance & Treatment Alternatives Evaluation – Tech Memos #1 & #2 (dated 10/13/15) and Wastewater Plan Update draft memo (dated 1/26/17), which outlined the various scenarios for the construction of a new PS located at the existing FMC WWTP site. The potential need to decommission the FMC WWTP has been accelerated due to expected reductions in effluent nutrient limits and near-term re-use potential of the FMC site (following decommissioning). The exact timing of FMC decommissioning is uncertain, however. It is anticipated that the WWTP will be offline before the currently-anticipated 2023 VPDES permit expiration date (2018 draft renewal issued by DEQ). Our understanding is that the City-County Service Agreement is under review by both entities.

The FMC WWTP currently receives flow from three sources, including the following:

- Diversion of up to 2 MGD (ADF) from the City IPS (which partially includes County Hazel Run gravity system flow)
- Flows pumped from the Deep Run PS (DRPS) (adjustable by County personnel between the FMC WWTP and the MWWTP)
  - Note: County typically directs all DRPS flows to MWWTP during storm events when peak flow rates are transferred from the City IPS to the FMC WWTP.
- A small amount of collection system flow from the Industrial Park Sewer system that is pumped through the Industrial Park PS (IPPS)

With the potential installation of the Hazel Run PS, County flows would be removed from the City's collection system, and City flows (from the City IPS) to FMC WWTP would be halted. Flows would no longer be split from the DRPS; all flow would be directed towards the MWWTP. A new FMC PS would collect the remaining IPPS gravity flow, as well as any future growth on the existing FMC WWTP site, conveying flow back into the existing Deep Run FM (DRFM) and towards the MWWTP. Following these improvements, the FMC WWTP would be decommissioned. There are no planned provisions for flow equalization at the FMC site.

In October 2017, OBG was retained by the County to provide professional engineering services to advance planning-level analyses to preliminary engineering stage for the construction of a new FMC PS, Force Main, associated appurtenances and the potential decommissioning of the FMC WWTP.

1.2 PURPOSE

The purpose of the FMC WWTP Decommissioning and Related Upgrades project is to advance preliminary engineering design of a new pump station and force main along with preliminary decommissioning plans for the FMC WWTP. The design focuses mainly on civil, mechanical, structural, and electrical components, with the intent

to: 1) provide a comprehensive conveyance solution for parts of the Industrial Park sewer system, 2) facilitate future decommissioning of the FMC WWTP, and 3) allow for conveyance of future flows from potential growth on the existing FMC WWTP site.

Specifically, this Preliminary Engineering Report is comprised of the following components:

- FMC Decommissioning
- FMC Pump Station
  - Design flows
  - System curve development
  - Conceptual design of the pump station's approach sewer, headworks, wet well, control building and associated structural, architectural, electrical, mechanical, and instrumentation and controls design
- Force main design and alignment considerations
- Preliminary construction cost estimate.

SECTION 2 - FMC DECOMMISSIONING

2.1 REGULATORY REQUIREMENTS

The proposed closure of the FMC WWTP will be completed in accordance with the relevant portions of the 2008 VA SCAT Regulation 9 VAC 25-790-120.E.3 and the facility's VPDES Permit No. VA0022853. These regulations stipulate that a facility closure plan shall address the following information at a minimum:

- Residual wastewater and solids treatment, removal and final disposition
- Removal of structures, equipment, piping and appurtenances
- Site grading and erosion and sediment control
- Proposed land use (post-closure) of site.

Note: A standard facility closure plan does not address unique site-specific issues such as potential contamination or proposed site redevelopment.

2.2 FATE OF STRUCTURES AND EQUIPMENT

The County will designate a list of mechanical and electrical equipment that they wish to be saved during the closure of the FMC WWTP. All other equipment will be turned over to the demolition contractor and will be disposed of or removed from the site in accordance with applicable laws and regulations. Residual wastewater will be drained from the site and conveyed via a temporary pump to the collection system leading to the DRPS and eventually the MWWTP. Residual solids will be dewatered at the existing treatment plant site. The sludge will be disposed in accordance with the current sludge management plan and hauled to the County operated centralized sludge composting operation at the Livingston Landfill & Composting Facility.

Once removed from operation, all equipment, structures, tanks and piping that have been in contact with sewage shall be drained or dewatered, and cleaned by spraying/flushing with non-potable water. Once drained and cleaned all facilities and below ground piping will be left in place at the treatment plant. Facilities open to the environment and with the potential to collect rain water will have the bottom slab of the structure partially demolished to allow for water drainage. Open piping will be plugged and left in place. Any demolished materials shall be completely removed from the site and properly disposed of in accordance with applicable laws and regulations.

2.3 SITE RE-USE ALTERNATIVES

The FMC WWTP site spans two County parcels. Combined, these parcels are approximately 70, acres with direct access to the Rappahannock River. Approximately half of this acreage is outside the 100-year flood plain and

would be considered usable land for future development. Discussions with the County have indicated a preference for future commercial or industrial operations on this site. As such, the proposed FMC PS has been sized to accommodate a potential large-scale commercial or industrial operation of certain allowable water consumption and wastewater production levels. Any future construction on the site will require the demolition of the existing treatment plant facilities. It is assumed that the developer or contractor for the future site will be responsible for this work.

SECTION 3 – FMC PUMP STATION

3.1 DESIGN FLOWS AND SYSTEM CURVE DEVELOPMENT

3.1.1 Design Flows

As part of the construction plan for FMC PS, all existing flows pumped to the FMC WWTP will be disconnected, with the remaining gravity flow (from the Industrial Park neighborhood) directed to the proposed PS. To date, no direct flow monitoring study has been completed for the Industrial Park sewer shed. As part of a Spotsylvania County Wastewater Plan Update memo dated (1/26/17), OBG compiled flow data from studies done between 2013-2016 to develop a hierarchy of existing flow conditions in the City and County. Using this study as a basis, flow to the IPPS was isolated, with the purpose of quantifying the average daily flow (ADF) and peak daily flow (PDF) that would potentially be received by the proposed FMC PS. Through discussions with the County, it was also determined that vac-trucks (collecting sewer system sludge) are directed daily to the existing IPPS, where they dump their contents into an on-site roll-off container. This container drains the liquid contents from the sludge directly into the IPPS wet well and contributes to the daily flow at the IPPS. The results are summarized in the Table 3.1 below.

Table 3.1: Existing IPPS Average Daily Flow and Peak Daily Flow

FACILITY	ADF (MGD)	PEAKING FACTOR	PDF (MGD)
FMC WWTP EFFLUENT	2.28	3.1	6.98
City IPS to FMC (w/ Hazel Run)	1.69	3.1	5.29
Deep Run to FMC (w/o Hazel Run)	0.56	3.0	1.67
IPPS (w/ trucked sludge)	**0.04**	**3.0**	**0.12**

Note that the PDF peaking factor is somewhat arbitrary for a small PS, such as IPPS, that received trucked wastes. Truck discharge rate, number of trucks, wet well size, and peak pumping capacity influence the station's requirements.

Future flows to the proposed FMC PS include a portion of the gravity sewer flows from the Industrial Park neighborhood, as well as potential growth on the site currently occupied by the FMC WWTP. After decommissioning, the County is targeting future development of the two parcels that currently make up the treatment plant site. These parcels are a combined 70 acres with approximately half of the site, or 36.5 acres, sitting outside the 100-yr flood plain and therefore available as useable space for development. Utilizing the County zoning guidelines, the following table shows the projected buildout flows for the FMC WWTP parcels that would drain to the proposed FMC PS.

Table 3.2: Projected Buildout Flow to the FMC PS

Parcel	Usable Area (acres)	Floor to Area Ratio (FAR)	Sqft for Development	UC (gal/sqft)	ADF (gpm)	PDF (gpm)
25-A-8	30	1	1,306,800	0.0576	52	157
25-8-8B	6.5	1	285,318	0.0576	11	34
				TOTAL	**63**	**191**

Based on discussions with County staff, a new FMC PS may periodically receive trucked wastes – at startup during transition in flows between County WWTP facilities, or as a backup to a centralized MWWTP receiving such trucked volumes in the future. The proposed FMC PS will provide conveyance capacity for both the existing Industrial Park flows and will be sized to accommodate future projected growth in the area. An average daily flow of 100 gpm with a peak daily flow of 300 gpm will serve as the design basis for the proposed pump station and force main.

3.1.2 System Curve Development

The first step in sizing the pump station is to establish its system curve. System curves are developed as a means for estimating the TDH of a pumping and conveyance system at various flow rates, and ultimately for selection and sizing of pumps and force main. The curves illustrate the relationship between the flow and head loss through the pump station and force main, and are largely influenced by:

- Static head conditions
- Force main pipe diameter
- Force main pipe material

Static head is the water surface elevation difference between the suction and discharge points; the static head has little variance across the range of pump operating conditions. Regarding pipe diameter, as the diameter decreases, the head loss experienced throughout the force main's system increases. Conversely, as the diameter increases, head loss will decrease. The Hazen-Williams Roughness C-value represents the pipe's interior integrity as it relates to friction losses through the pipeline. C-values differ amongst the various pipe materials, with plastic pipes generally having a higher C-value (and thusly less friction loss) than metallic pipes. For instance, PVC pipe is generally considered to have a C-value in the range of 130-150, depending on its interior condition; while the C-value for ductile iron pipe generally ranges between 120-140, depending on its interior condition.

Spotsylvania County's Water and Sewer Design and Construction Standards Manual dictates that ductile iron pipe shall be used for sanitary sewer force mains, and a C-value of 120 shall be assigned to the force main for the purposes of developing the corresponding system curve. Along with the estimated C-values, the force main and pump station layout was evaluated to obtain a more accurate total dynamic head (TDH) calculation. Based on the preliminary pump station and force main layout, actual losses from bends joints, entrances, exits and other minor losses have been incorporated into the revised system curves.

As shown in the figure below, the expected invert inflow elevation into the wet well is 40 ft. Due to the invert inflow elevation, the elevation of the wet well floor will be 32 ft. and the "pump off" elevation will be 35 ft. The force main alignment reaches a maximum elevation of approximately 69 ft., resulting in a maximum design static head of approximately 34 ft.

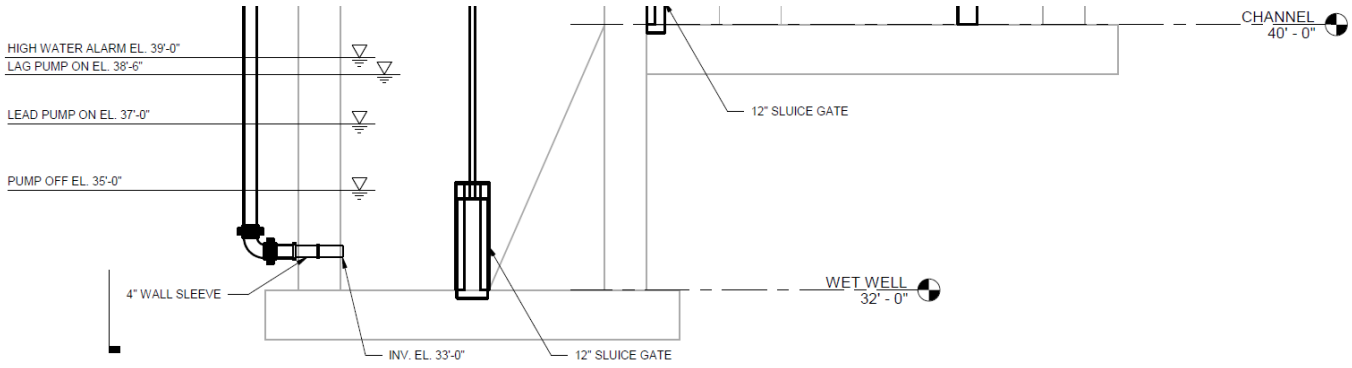


Figure 3.1: Wet Well Profile

The system curves for the proposed pump station were calculated to determine the TDH loss occurring from the proposed wet well location to the discharge point. A new 6" FM will extend approximately 1,400 feet and connect to the existing 2,800 feet of 12" FM that currently flows from the DRPS to the FMC WWTP. To utilize the remaining life of the existing force main and as a capital cost saving measure, flow will be reversed within the existing 12" FM and flow to the connection with the existing approximately 5,700 feet of 16" FM that connects the DRPS to the MWWTP gravity sewer. System curves were developed for the following scenarios:

- FMC PS low level, DRPS in operation
- FMC PS high level, DRPS in operation
- FMC PS high level, DRPS not in operation.

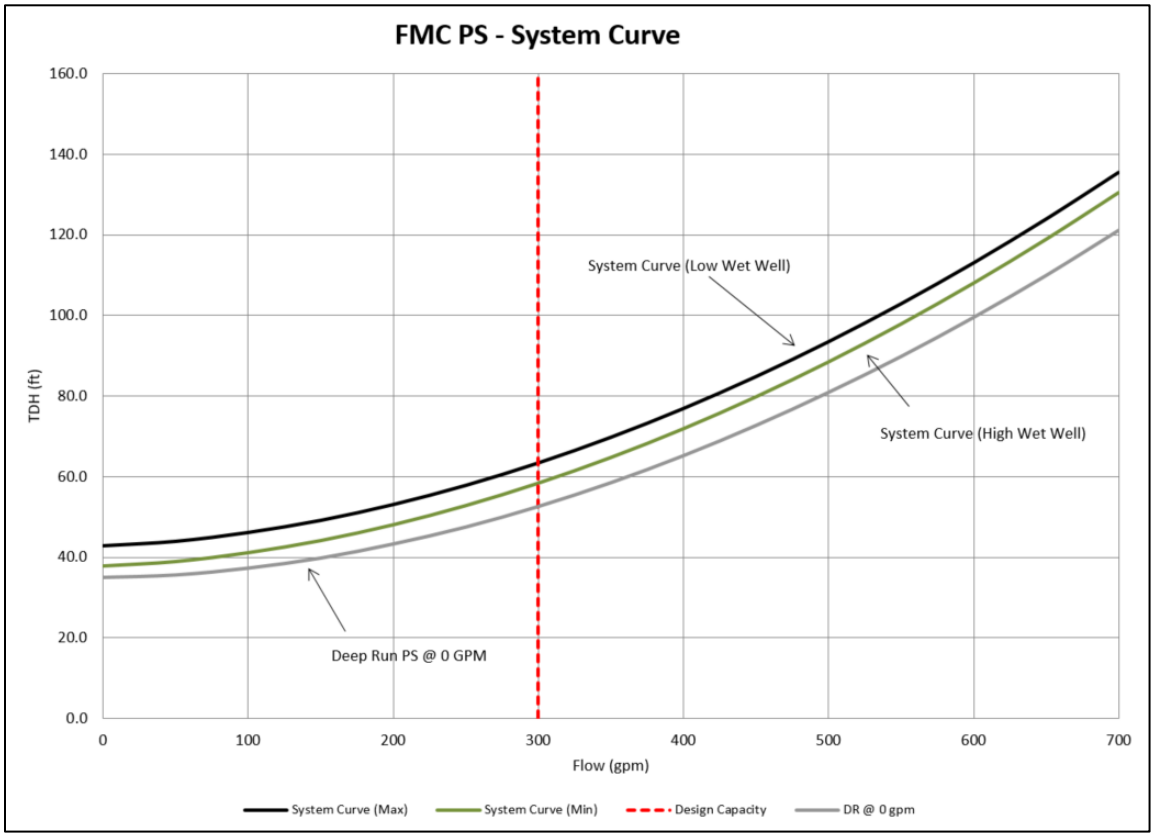


Figure 3.2: FMC PS System Curve

Based on the system curves in the Figure above, the maximum TDH of the proposed force main is 65 ft. at 300 gpm.

3.2 FORCE MAIN DESIGN AND ALIGNMENT

3.2.1 Force Main Alignment

Two alternatives were developed to analyze the potential force main size and route between the proposed FMC PS and the connection to the Deep Run FM located near Route 17. These alternatives included:

Alternative 1:

A new 6" FM is routed South from the new FMC PS, along Capital Ln for approximately 1,400 feet. Near the entrance to the FMC WWTP, the FM is connected to the existing approximately 2,800 feet of 12" FM that currently

sends flow from DRPS to the FMC WWTP. Flow is reversed within this FM and continues to its connection point with the existing 16" FM that currently sends flow from DRPS to the Massaponax gravity sewer system.

Alternative 2:

A new 6" FM is routed West from the new FMC PS, along Bourbon St and then South along Main St for approximately 2,500 feet until it hits the railroad track spur located along Main St. The FM then parallels the existing 12" FM back to the connection point with the existing 16" FM that currently sends flow from DRPS to the Massaponax gravity sewer system.

The table below shows a comparison of the two alternatives reviewed and compares the pipe length, flow and velocity of the various segments.

Table 3.3: Projected Force Main Velocities

Pipe Diameter	Pipe Length (ft)	Flow (gpm)	Velocity (ft/s)
Alternative 1			
6" (new)	1,400	300	3.4
12" (existing)	2,800	300	0.9
16" (existing)	5,700	1,690	2.7
Alternative 2			
6" (new)	4,000	300	3.4
16" (existing)	5,700	1,690	2.7

Per the SCAT Regulations, the force main's velocity should be between the minimum and maximum allowable velocities of 2.0 fps and 8.0 fps, respectively. When operating the force main at velocities less than 2.0 fps, solids can collect in the bottom of the pipe; when velocities exceed 8.0 fps, the force main's interior can potentially be damaged due to solids' scouring. As shown above, Alternative 1 includes a pipe diameter with a velocity below the recommended 2.0 fps at the design flow.

It is believed that the existing 12" FM located between the FMC WWTP and the Deep Run FM is in serviceable condition and would not need to be replaced as part of this project. Although operating at lower velocities may cause some additional maintenance concerns, there is additional complexity involved in trying to route a new 6" FM the entire length between the FMC PS and the Deep Run FM. Existing railroad tracks would make construction costlier and the approximately three times longer length would be significantly more expensive. It was therefore determined that Alternative 2 is a less cost-effective solution for the County.

Table 3.4: Projected Cost for FM Alternatives

	Total Cost
Alternative 1	**$265,000**
Alternative 2	**$813,000**

To address settlement concerns within the force main at velocities less than 2 feet per second, it's recommended that the County flush the force main on a semi-regular basis (e.g. weekly or bi-weekly) to prevent solids from settling in the main and to re-suspend solids that may have previously settled. For long-term maintenance of the force main, pig launching and receiving pits would allow for periodic cleaning of the force main for the remaining life of the existing line.

For the FMC Force Main, Alternative 1 is recommended because of the lower construction cost associated with building the pipeline. It is assumed that the County will address the lower velocities associated with Alternative 1 by flushing the line as described above.

3.2.2 Traffic Impacts and Road Crossings

The proposed force main alignment follows Capital Ln from the proposed pump station site to the proposed connection with the existing 16" Deep Run FM. Understanding that the County prefers that the new force main be installed outside of the Capital Ln pavement limits, roadway and associated traffic impacts will be minimized to the greatest extent possible. The force main will be constructed off the side of the road, in the grass area that is currently part of the FMC WWTP.

The existing 12" Deep Run FM connects to the 16" Deep Run FM at the intersection of an unnamed road and Routes 2 & 17. The FMC PS and the DRPS will be operated independently of each other, both pumping into the same FM but dependent on their own internal wet wells and instrumentation. Because of this, it is proposed that an inline check valve be installed both on the 12" FM and the 16" FM (upstream of the connection) at this location. The 12" check valve will protect the FMC PS from flow being pumped from the DRPS and the 16" check valve will protect the DRPS from flow being pumped from the FMC PS. Both check valves will be installed within 4-foot diameter vaults to allow for periodic maintenance. VDOT coordination (and permitting) will be necessary for the installation of these check valves.

3.3 SITE CONDITIONS

3.3.1 Existing

The existing IPPS was constructed in 1984 during the conversion of FMC to a municipal treatment plant. The IPPS receives influent via a 24" gravity sewer that comes in to the south of the PS. Its sewer shed consists of a small section of the Industrial Park, an economic development area first built in 1985. The majority of the Industrial Park sewer shed drains to the DRPS, either via gravity sewer or through County PS #2.

3.3.2 Proposed Location

The proposed FMC PS will be located North of the existing IPPS, on County-owned property, along Bourbon St and a paper road that leads to the Rappahannock River. The proposed location is currently occupied by a set of abandoned flash mix tanks and a control building. Both were constructed before the municipal plant was put into service and will need to be demolished prior to construction of the FMC PS. The site is partially clear, but clearing will be necessary to accommodate the new PS. Once the new PS is complete and in service, the existing IPPS will be demolished and a paved parking lot constructed in its place to help serve the new PS.

Parts of the proposed site are located within the Special Floodplain District (100-year flood plain), but all proposed construction will be outside this area. A copy of the FEMA Firm Map used to determine the 100-year flood zone has been included in Appendix B.

3.3.3 General Site Layout

The pump station design includes the design of a new pump station control building and wet well structure. The influent will flow through a new approach sewer to the pump station's headworks, which consists of an influent channel and a grinder. Once through the headworks, flow will split through two manual sluice gates and into the wet well. The wet well will be a 20' x 8' concrete structure with a dividing wall and manual sluice gate in the middle. The wet well will include two 3' x 3' metal access hatches with aluminum ladders located outside the control building to allow internal access. Proposed PS configuration layout drawings can be found in Appendix C.

3.4 GRAVITY SEWER

A new gravity sewer will be installed to route flow from the influent of the existing IPPS, west of the existing structure and into the south side of the proposed FMC PS. It is proposed that influent will flow from a new manhole installed overtop the existing gravity sewer, through a 12-inch PVC pipe, and enter a new headworks structure.

The headworks will be a 12' x 12' below-grade concrete structure. The headworks will contain an in-channel grinder; a Muffin Monster, Model 30005-0008 is proposed. The grinder is rated for 370 gpm with 2-inch shafts, a single drive, and will include a 3 horsepower (hp) motor. The channel grinder and respective concrete channel will have the capability of handling a maximum flow of 370 gpm without over flowing the channel. The grinder's

frame will allow for the grinder to be removed and replaced with a 2" bar screen (in the event of high flows and to allow for grinder maintenance). Once through the grinder, the influent channel will split into two 12" channels. Each channel will terminate with a manual 12" x 12" sluice gate to be used for isolation of the wet well. The influent will flow through the sluice gates into the proposed wet well.

3.5 WET WELL

The wet well will include a dividing wall to create two separate chambers, each approximately 8.5' x 8'. The wall will include a manual sluice gate to isolate either side of the wet well for maintenance. The proposed functionality of the pumps and wet well will remain constant. Once in the wet well, the influent depth will rise until it reaches the "lead pump on" elevation, at which point the lead pump will turn on and the wastewater will be drawn through the corresponding pump's suction piping. If the influent's depth in the wet well continues to increase with one pump on, the water surface elevation (WSEL) will reach the "high alarm" elevation and the standby pump will switch on. The influent will then be drawn through two suction pipes and conveyed by both the lead and standby pumps until the WSEL is reduced to the "pump off" elevation. At that elevation, both pumps will turn off and will not turn on again until the influent's WSEL reaches the "lead pump on" elevation. A combination of an ultrasonic level transmitter (primary) and float switches (backup) will be utilized to monitor the level in the wet wells.

3.6 PUMPS

For the FMC PS, suction-lift centrifugal pumps are proposed. The IPPS is currently equipped with Gorman Rupp suction-lift pumps; these pumps have been in operation since the station's original construction with minimal issues, and the County has shown a preference for this type of pump in other stations that it operates. The use of suction-lift pumps will also avoid the need for building a dry well, reducing overall cost for the station. For the purposes of this report, two manufacturers were considered: 1) Smith & Loveless and 2) Gorman Rupp. Consideration of additional "Or Equals" may be investigated during later design, if requested by the County.

3.6.1 Smith & Loveless Suction Lift Pumps

Smith & Loveless (S&L) pumps were selected for consideration based on the County's familiarity with and preference for the manufacturer. The system curve was provided to the manufacturer's local representative, noting that the design point was 300 gpm at a TDH of approximately 65 feet. The following pumping system was recommended:

- Two (2) Model 4B2D pumps, installed as lead/standby
  - Each pump will be equipped with an 8.5" impeller, 10 hp motor and a variable frequency drive (VFD).

Each pump can handle the entire range of anticipated flows for the station, with the proposed VFDs allowing the pumps to operate between approximately 150-350 gpm. The second pump will serve as a backup to comply with SCAT Regulations and provide complete redundancy in the station. Should future development of the FMC site result in influent flows that exceed those projected for the FMC PS (see Section 3.1), larger impellers (up to 10.125") and larger motors (up to 20 hp) are available for retrofitting the pumps to accommodate an increase in flow up to approximately 480 gpm at a TDH of 90 feet.

For the pumps and pumping conditions noted above, the maximum available static suction lift is approximately 20 feet. Pump manufacturer's literature is provided in Appendix A.

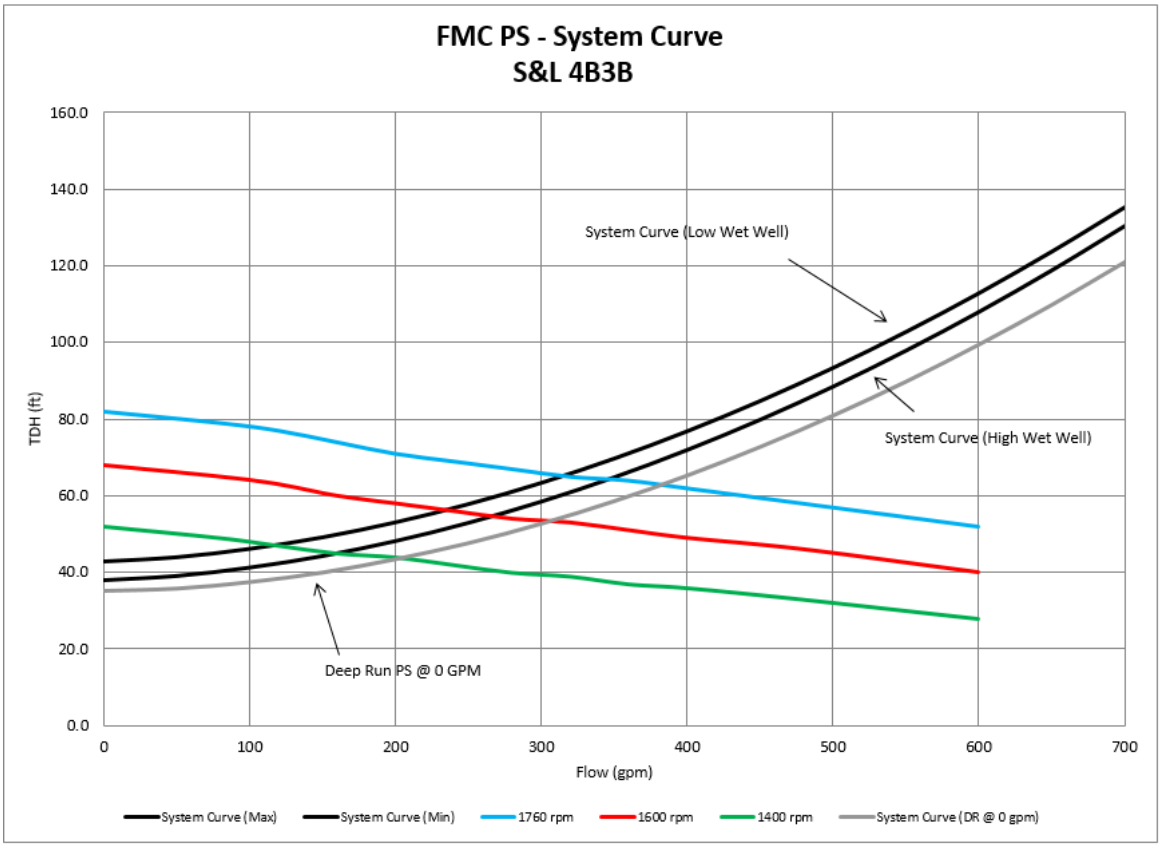


Figure 3.3: Smith & Loveless System and Pump Curve

3.6.2 Gorman Rupp Suction Lift Pumps

In addition to Smith Loveless, the County also has Gorman Rupp pumps installed within their collection and conveyance system, including at the existing IPPS. Based on the system curve, Gorman Rupp's local representative recommended the following pumping system arrangement:

- Two (2) Model GR T4AB4 pumps, installed as lead/standby
  - Each pump will be equipped with a 9.75" inch impeller, 15 hp motor and a VFD.

Each pump will be capable of handling the entire range of anticipated flows for the station with the proposed VFDs allowing the pumps to operate between approximately 120-350 gpm. The second pump will serve as a backup to comply with SCAT Regulations and provide complete redundancy in the station. Should future development of the FMC site result in influent flows that exceed those projected for the FMC PS (see Section 3.1), larger motors (up to 30 hp) are available for retrofitting the pumps in order to accommodate an increase in flow up to approximately 520 gpm at a TDH of 98 feet; the pumps will already be equipped with the largest available impeller.

For the pumps noted above there is a NPSHr of 5.9 feet with a NPSHa of 13.1 feet. Pump manufacturer's literature is provided in Appendix A.

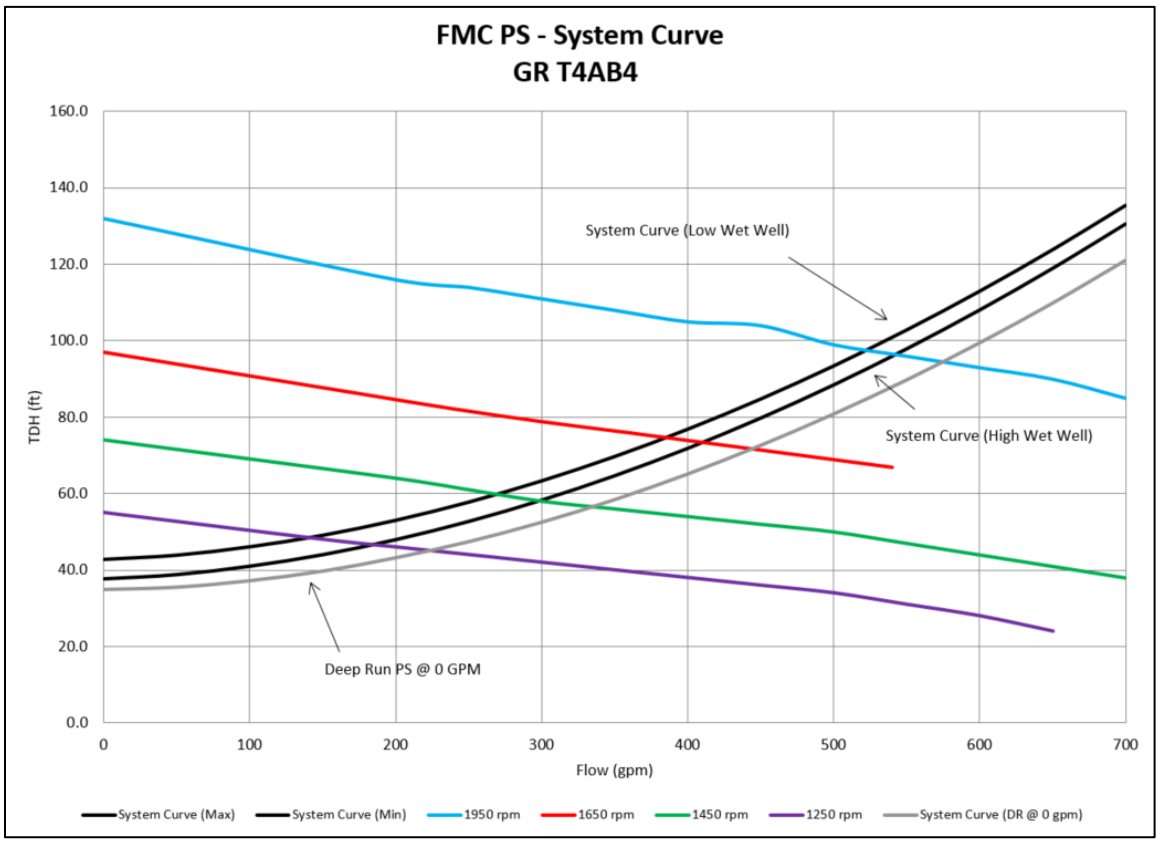


Figure 3.4: Gorman Rupp System and Pump Curve

The proposed layout will provide accessibility for pump maintenance, space for electrical panels, flow meter, and room for the pumps to be installed and removed. For each of the pump options (Smith and Loveless, suction-lift; Gorman Rupp, suction-lift) a total of 2 pumps will be necessary. In either configuration, the pumps are oriented such that each pump's suction intake is on the north side of the wet well. The pumps will be spaced such that adequate spacing is provided between the concrete pads to allow for periodic maintenance of the pumps and so that each pump is drawing from a different wet well chamber. The pumps discharge will connect into a common header within the control building. There will be a flow meter located downstream of the last pump connection to the main header. The pump station building is proposed to have the flow meter located inside the building to save space and material costs. From the header pipe and flow meter, the discharge will enter a new 6-inch force main, exit the pump station building, and proceed along the proposed alignment.

3.7 SITE/CONTROL BUILDING

The pump station control building will be a 20' x 15' above-grade concrete structure sitting on a concrete slab. The control building will house the proposed pumps, as well as all electrical equipment and HVAC. The building will be located just north of the wet well. The building will be accessible through a double door located on the west side of the building. This door will also be used for equipment removal.

The proposed PS site will also include a backup diesel generator, sitting on a concrete slab to the north of the control building. The diesel generator will be a 275-kW unit with a 500-gallon sub base fuel tank. To the east of control building will be an odor control unit, also located on a concrete slab. The odor control unit will be an ECS Environmental Solutions activated carbon V1-TM Series odor control system with a design flow rate of 350 cfm.

The County currently sends truckloads of sewer collection waste material to be dumped at an onsite container located directly in front of the existing IPPS. Material dumped in the container drains into the wet well of the pump

station. Once the container is full it is transported to a landfill for dumping. There is no plan to change the current process for dumping waste material at the site. A new manhole will be provided to allow the County to continue to drain the container into the influent gravity sewer of the proposed FMC PS.

Site drawings for the proposed site can be found in Appendix C.

SECTION 4 – PUMP STATION – STRUCTURAL AND ARCHITECTURAL DESIGN

The following section lists the applicable codes and referenced standards, describes the structural and architectural systems, provides structural design criteria, and identifies anticipated material properties for the design of the proposed FMC PS.

4.1 CODES AND STANDARDS

The structural and architectural design for the project will be in accordance with the following codes, referenced standards and publications:

- Part I of the Virginia Uniform Statewide Building Code (2012) referred to as the Virginia Construction Code (VCC)
  - The 2012 International Building Code (IBC 2012) as incorporated by reference into the VCC.
- American Society of Civil Engineers (ASCE) 7-10, Minimum Design Loads for Buildings and Other Structures
- ACI 318-11, Building Code Requirements for Structural Concrete
- ACI 530-11, Building Code Requirements for Masonry Structures
- ACI 530.1-11, Specification for Masonry Structures
- AISC 360-10, Specification for Structural Steel Buildings
- AWS D1.1, Structural Welding Code
- 2012 Virginia Energy Conservation Code.

4.2 DESCRIPTION OF ARCHITECTURAL SYSTEMS

The project includes a 20'-0" x 15'-4" control building with 12'-0" high eaves. The following table summarizes the key elements of the building code analysis conducted for the construction activities associated with the Spotsylvania County Project.

Table 4.1: Pump Station – Building Code Analysis

Group	Code
Occupancy Classification	Group F-2
Construction Classification	Type IIB – Non-combustible
Fire Protection	Sprinkler – Not Required
Fire Detection	Fire Detection or Heat Detection – Not Required
Emergency Lighting	Emergency Lighting – Required (Section 1008.1)
Means of Egress Exits	One exit required (Section 1006.3.2)
Accessibility	Exempt (Section 1103.2.9)

Exterior Walls:

- The exterior walls will be comprised of 8-inch concrete masonry units, 2-inch continuous rigid insulation, 1 ¾ inch air space, and brick to 12'-0" above finished floor.

Roof:

- The roof system will consist of a Standing Seam Metal roofing system with four inches (R-25) of rigid insulation, on 1 ½ inch metal deck.

Interior Finishes:

- The interior finishes are as follows:
  - Floor: Sealed concrete
  - Walls: CMU – sealed
  - Ceiling: Exposed structure – painted.

Exterior Doors and Frames:

- Hollow Metal
- Overhead Coiling Steel.

Building R-Value Requirements:

- Roofs: R-25ci
- Above grade walls / Mass: R-9.5ci
- Below Grade Walls / R-7.5ci
- Slabs on Grade / Unheated Slab: R-10 for 24" below
- Exterior Doors: Swinging U = 0.70
  - Roll-up R = 4.75.

4.3 DESCRIPTION OF STRUCTURAL SYSTEMS

The pumping station consists of a below-grade portion and a smaller above-grade superstructure. The below-grade portion of the structure consists of three adjacent below-grade chambers housing the headworks, wet well, and dry well. The above-grade portion of the structure will house the electrical equipment, and provide stair access to the dry well operating floor.

The roof of the structure is anticipated to consist of a metal roof system on a structural metal deck. Structural steel beam or steel bar joists will span between load-bearing masonry walls to support the roof. The above-grade walls will consist of reinforced concrete masonry block providing the structural support of the roof and backing for the architectural finished walls. The at-grade and below-grade portions of the structure will consist of cast-in-place concrete foundation mat, walls, and elevated slabs. The electrical equipment will be supported on a platform at grade-level, suspended above the operating floor of the dry well.

Access to the headworks and wet well will be made with at-grade vault doors and aluminum ladders. Each ladder will be equipped with an extendable ladder safety post to assist with safe ladder use. Access to the dry well will be made from a double door with an interior landing, and a set of stairs from the grade level down to the dry well operating floor.

Pump maintenance is expected to be completed by use of a gantry crane. As a design alternate, a small pre-engineered metal building can be used for forming the super-structure of the facility.

Reference Appendix C for related structural design.

4.4 DESIGN CRITERIA

Design live loads are as follows:

Table 4.2: Design Basis – Live Loads

LIVE LOAD CRITERIA	REFERENCE
Floor Live Load = 250 psf	Not explicitly stated in Table 1607.1 (IBC 2012), but rated for supporting electrical equipment (similar to heavy manufacturing or heavy storage)
Wheel loads on at-grade slabs = 32,000-lb axle load (16,000-lbs per wheel)	Section 1607.7 (IBC 2012) & AASHTO
Minimum Uniform Roof Live Load = 20 psf	Table 1607.1 (IBC 2012)
Handrails & Guards Live Loads: 50 lbs/ft linear load and a 200-lb concentrated load	Section 1607.8 (IBC 2012) & Section 4.5.1 (ASCE 7)

Design snow load is defined as follows:

Table 4.3: Design Basis – Snow Loads

SNOW LOAD CRITERIA	REFERENCE
Ground Snow Load, p_g = 25 psf	Figure 7-1 (ASCE 7)
Snow Load Importance Factor, I_S = 1.1	Table 1.5-2 (ASCE 7)
Thermal Factor, C_t = 1.0 (assumes heated building)	Table 7-3 (ASCE 7)
Exposure Factor, C_e = 1.0 (Exposure B)	Table 7-2 (ASCE 7)
Flat Roof Snow Load, $p_f = 0.7\ C_e\ C_t\ I_s\ p_g$ = 19.3 psf	Eq. 7.3-1 (ASCE 7)

Design wind loading is defined as follows:

Table 4.4: Design Basis – Wind Loads

WIND LOAD CRITERIA	REFERENCE
Ultimate 3-second wind gust speed = 120 mph	Figure 26.5-1C (ASCE 7)
Exposure category: B	Table 1.5-2 (ASCE 7)

Design seismic loading is defined as follows:

Table 4.5: Design Basis – Seismic Loads

SEISMIC LOAD CRITERIA	REFERENCE
Site class: D	Assumed, pending geotechnical investigations.
Mapped spectral acceleration at short period, S_S = 0.147	Figure 22-1 (ASCE 7)

Mapped spectral acceleration at 1-sec Period, S_1 = 0.056	Figure 22-2 (ASCE 7)
Site Coefficient, F_a = 1.6	Table 11.4-1 (ASCE 7)
Site Coefficient, F_v = 2.4	Table 11.4-2 (ASCE 7)
Maximum Considered EQ Spectral Response Accel, S_{MS} = 0.236	Eq. 11.4-1 (ASCE 7)
Maximum Considered EQ Spectral Response Accel, S_{M1} = 0.134	Eq. 11.4-2 (ASCE 7)
Design Spectral Response, S_{DS} = 0.157	Eq. 11.4-3 (ASCE 7)
Design Spectral Response, S_{D1} = 0.089	Eq. 11.4-4 (ASCE 7)
Seismic importance factor: I_E = 1.25	Table 1.5-2 (ASCE 7)
Seismic Design Category: B	Section 11.6 (ASCE 7)

Equipment Loads:

Equipment loads supported by the structure will be based on information supplied by the equipment manufacturer. Design will address vibration loads where appropriate, including start-up, operating and shutdown frequencies, and follow the guidelines provided in ACI 351.3 – Foundation for Dynamic Equipment.

4.4.1 MATERIAL PROPERTIES

Table 4.6: Design Basis – Concrete & Masonry

ELEMENT	VALUE
Cast-in-place Concrete:	
Minimum 28-day compressive strength	f'_c = 4,500 psi
Maximum water-cement ratio	0.42
Aggregate	ASTM C33, 1" max.
Slump	4" to 6" (prior to addition of admixtures)
Air entrainment	4.5% to 7.5%
Steel reinforcement	ASTM A615, Gr. 60
Reinforced Masonry:	
Concrete masonry units (CMU)	ASTM C-90, normal weight
Minimum 28-day masonry compressive strength	f'_m = 1,500 psi
Mortar	ASTM C-270 Type M or S
Minimum grout compressive strength	3,000 psi
Grout aggregate size	3/8" max.
Steel reinforcement	ASTM A615, Gr 60

SECTION 5 – PUMP STATION – ELECTRICAL DESIGN

5.1 ELECTRICAL BASIS OF DESIGN

5.1.1 RELIABILITY AND FLEXIBILITY

System reliability and flexibility are essential elements of the distribution system, which are required to maintain operation of the wastewater pump station and related equipment. The power distribution system will be configured to maximize this aspect, as well as providing adaptation for future system changes.

5.1.2 SAFETY

The materials and installation of the Electrical equipment will be performed in accordance with the latest editions of the following Codes and Standards:

- Virginia Uniform Statewide Building Code
- National Fire Protection Association – NFPA
- National Electric Code – NEC (NFPA 70)
- Underwriters Laboratories, Inc. – UL
- National Electrical Manufacturers Association – NEMA
- Institute of Electrical and Electronic Engineers – IEEE
- American Society of Testing Materials – ASTM
- Insulated Power Cable Engineers Association – IPECA
- American National Standard Institute – ANSI.

All electrical equipment will be UL listed and labeled by Underwriters Laboratories, Inc. (UL). Provisions will be made to allow access to power distribution equipment to be restricted to authorized personnel only.

5.1.3 CODES AND STANDARDS

The Electrical portion of the design for the proposed pump station will conform to the latest editions of the following Codes and Standards:

Codes:

- Virginia Uniform Statewide Building Code
- National Electrical Code (NFPA 70)
- National Electrical Safety Code (NFPA 70E).

Standards:

- NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

Where the requirements of more than one Code or Standard are applicable, the most stringent will take precedence.

5.2 POWER DISTRIBUTION SUMMARY

The scope of the Electrical work for the proposed pump station is as follows:

5.2.2 ELECTRICAL DISTRIBUTION

The Electrical Utility for this location is Dominion Power. It is anticipated that the Utility will provide an overhead primary Electrical Service to the building.

The building will be fed via two 4" direct buried PVC Schedule 80 conduits, with pull strings, from the utility primary riser pole to the location of the utility pad mounted transformer located adjacent to the building. It is anticipated that the transformer will be a 500kVA unit, with a 480/277-volt, 3 phase secondary voltage.

Within the building, provide an 800-amp, 480/277 volt rated service entrance rated main fused switch with 500-amp fuses, and an auxiliary metering section (for location of the utility CTs). The utility meter socket will be located on the exterior of the building. The main switch section will feed the normal side of the building's automatic transfer switch.

The load side of the automatic transfer switch will feed an 800-amp, 480/277 volt rated distribution switchboard to feed the pump station equipment, including the two 20 HP pumps.

A 45-kVA dry type transformer to step voltage down to 208/120 volts will be provided for convenience and lighting loads.

Based on preliminary Electrical load estimates, the proposed pump station's peak operating Electrical load would be approximately 262 kVA at 480/277 volts, 3-phase. This includes a 25% spare capacity to accommodate future Electrical loads. This dictates that the building be provided with a 500-amp Electrical service at 480/277 volts.

5.2.3 STANDBY POWER SYSTEM

The FMC PS is designated as a Reliability Class I facility, which is required to be provided with two separate and independent sources of power. Each power source will be capable of maintaining continuous pumping operation at peak design flow during power failures, flooding, or equipment malfunctions. The second source of power will have sufficient capacity to operate all components vital to the pump station's operations during peak wastewater flow conditions, together with critical lighting and ventilation equipment.

The second source of power for the proposed pump station will be provided by an on-site, standby generator system. Depending on the ultimate sizing and selection of the pumps, calculations have verified that up to a 275 kW, 480/277-volt diesel generator will be required. The unit will be located exterior to the building, at grade, within a Level 2 Sound Attenuated Enclosure. The unit will be provided with a minimum 500-gallon sub base, dual wall (rupture basin with leak detection) fuel tank. This will provide a minimum of 24 hours of operation at full load. The generator will be provided with a critical grade silencer to mitigate the noise while operational. The unit will be provided with an output circuit breaker for connection to a portable load bank to be used for load testing.

The main service entrance switch (normal power) and the generator (standby power) will each feed an 800-amp rated, three-pole automatic transfer switch. This unit will be provided with a time clock to exercise the generator to meet NFPA 110 requirements for periodic testing. The automatic transfer switch will be located within the proposed pump station.

5.2.4 VARIABLE FREQUENCY DRIVES

Variable frequency drives will be provided to control the speed of the sewage pumps. The VFDs are expected to be PWM type drives (18-pulse drives). Each VFD would include a main circuit breaker, fusing, surge protective equipment and bypass starters where required. The VFDs would be designed to meet IEEE 519 Standards for both current and voltage harmonic distortion limits.

5.2.5 TRANSIENT VOLTAGE SURGE SUPPRESSION EQUIPMENT

Transient Voltage Surge Suppression Equipment (TVSS) will be provided in accordance with UL 1449 Standards to minimize the impacts of voltage surges on the electrical distribution system.

- Class C TVSS equipment will be provided for the electrical service entrance equipment.

- Class B TVSS equipment will be provided to protect individual distribution and control system components.
- Class A TVSS equipment will be provided for protection of branch circuit wiring where appropriate.

TVSS equipment will be integrated into the equipment component enclosures, where practical, to minimize the grounding lead lengths. Instrumentation circuits would also be provided with surge protection equipment for circuits that enter/exit the pump station building.

5.2.6 DISCONNECT SWITCHES

Disconnect switches will be provided, where required by the NEC, to disconnect equipment and motors. Disconnect switches will be heavy-duty, enclosed safety switches. Disconnect switches will be non-fused, unless fusing is required for HACR equipment or other specific applications. Disconnect switches will not be provided where the motor short circuit and ground fault protective device is permitted to be used in lieu of a separate disconnect switch located at the motor (i.e., combination motor starter applications where the circuit breaker is lockable in the open position), unless preferred for specific applications.

5.2.7 ELECTRIC MOTORS

Electrical motors will be premium high efficiency squirrel cage induction type, with one common specification for all NEMA frame motors in the plant. Submersible, hermetic compressor, valve actuator motor, and other special application motors will be specified in individual mechanical Division 21 - 25 Sections.

NEMA frame motors other than explosion-proof motors will have nominal and minimum guaranteed efficiencies in accordance with NEMA MG1-2016 Table 12-12 Full-Load Efficiencies for NEMA Premium™ Efficiency Electric Motors Rated 600 Volts or Less (Random Wound).

Motor enclosures will be TEFC in non-hazardous wet and damp indoor locations. Open drip-proof enclosures will be used in non-hazardous dry indoor locations. IEEE 841 motors (mill and chemical duty TEFC) with anti-condensation heaters or sealed insulation systems will be used in non-hazardous outdoor locations. Explosion-proof motors will be used in Hazardous (Classified) Locations.

Motors in variable frequency drive applications will be inverter duty rated, in accordance with NEMA MG1-2016 31.4.4.3 recommendations, to provide long insulation life when operating on PWM variable frequency controller output voltage waveforms.

Motors 1/3 HP and smaller will be 120 V single phase 60 Hz. Motors 1/2 HP and larger will be 460 V, 3-phase, 60 Hz.

5.2.8 LIGHTING

New interior and exterior LED lighting, conforming to the State of Virginia Energy Conservation Code, will be provided within the pump station where needed for access to and illumination of the pump station equipment. Lighting provided in the drywell will be unclassified per the National Electrical Code. Lighting within the pump station itself will be gasketed and vandal resistant. A minimum of 30 foot-candles of illumination will be provided within the pump station, in accordance with the Illuminating Engineering Society and the ASCE – Design of Municipal Wastewater Treatment Plants guidelines. The exterior lighting will be provided with photo controls for dusk to dawn operation, and will be provided with step dimming (50% dimmed when no activity is detected) so that the lighting will only be at full brightness when activity is detected.

5.2.9 TELECOMMUNICATIONS

A new telecommunications service will be brought to the new FMC PS from the utility demarcation point. Provide one 4" schedule 80 PVC direct buried conduit, with pull strings, from the Telecommunications Utility demarcation point on the project site. The conduit shall be stubbed up within the building at the telecommunications backboard location. A 4' x 8' plywood backboard will be provided for the telecommunications equipment.

5.2.10 FIRE ALARM SYSTEM

By code, an automatic fire alarm system is not required for the control building, but this report assumes that one would be provided. The system would consist of single station smoke detectors tied to the SCADA system for reporting of fire conditions. These units would provide protection and notification in the event of a fire at the building.

SECTION 6 – PUMP STATION – INSTRUMENTATION AND CONTROLS DESIGN

6.1 INTRODUCTION

The new FMC PS will be capable of unmanned operation while providing remote monitoring through the MWWTP's existing SCADA system. The wet well will be provided with a level transmitter as well as backup floats for redundant control. The suction lift sewage pumps will be controlled to maintain level set-point. A magnetic flow meter will monitor instantaneous station flow rate. Local control of the pumping station will be provided by a Process Automation Controller. Visibility of the process control system will be provided locally through a panel mounted Operator Interface Terminal (OIT). This graphical depiction of the process conditions providing local control will be coordinated with the SCADA graphical presentation to provide a consistent user experience.

6.2 CODES AND STANDARDS

The overall design of the instrumentation and control (I&C) systems will conform to the guidelines of *Virginia DEQ SCAT Regulations and Spotsylvania County Department of Utilities – Water and Sewer Design and Construction Standards Manual*. The specifics of how many of these requirements will be met will be determined during final design. Additionally, the instrumentation systems provided by this project will comply with industry standards and OBG's experience with similar projects.

6.3 BASIS OF DESIGN

6.3.1 PROCESS CONTROL

Local control of the pumping station will be provided by a Programmable Logic Controller (PLC). A 12-inch color touch-screen OIT will provide centralized automated operation and monitoring of new equipment. This new PLC will be capable of running autonomously, as standalone systems, in the absence of a network connection.

- PLC will be located in a free-standing enclosure that will be in proximity to the motor control center (MCC), variable frequency drives (VFDs) and other equipment to minimize wiring. Enclosure will contain a door-mounted OIT to provide real-time color graphic monitoring and control of the local equipment and processes. PLC will be equipped with Ethernet connectivity and will communicate with other equipment (VFD, SCADA, Odor Control, etc.) where possible, non-critical parameters. Parameters vital to the process will be communicated via hardwire to provide a robust system.
- Field inputs and outputs from instruments and controlling devices, critical to the operation of the equipment, will be hard-wired to PLC Control Panel's I/O using conventional electrical signals over copper conductors. Intelligent I/O networks will not be employed (i.e. DeviceNet, FieldBus, ProfiBus). Discrete (on/off) inputs will be 24Vdc powered. Discrete (on/off) outputs will be dry relay contacts for motor starter circuits, control system start permissive and interlocks, and powered discrete outputs for solenoid valves (solenoid valve circuits to be equipped with fuses). All analog inputs and outputs to be 4-20 mA dc current loops.

6.3.2 CONTROL PANEL

PLC Control Panels will be mounted in Electrical Rooms, in non-classified environments, away from classified areas and/or zones. Should equipment need to interface with instruments or equipment in such areas, intrinsic safety barriers (ISB) and conduit with filled seal-offs will be used for signal wiring - isolating the hazardous area from the safe area electrically.

PLC, I/O and components will be designed to today's conventional standards. It is assumed that the pump station processes are determined to be of low risk and thus Safety Instrumented Systems (SIS) and Safety Integrity Level (SIL) will not be part of this design.

Some new equipment may be provided with OEM control panels. The PLC Control Panel will interface to these vendor control panels to varying degrees allowing an operator some capability to monitor and/or control the equipment through the PLC Control Panel OIT.

6.3.3 REDUNDANCY AND RELIABILITY

The FMC PS design will consider redundancy and reliability as much as practical. As minimum, the following will be included in the design.

- The control panel will house an Uninterruptible Power Supply (UPS) that will protect to the control system against line frequency variations, power line noise voltage transients, and will provide voltage regulation and back-up power for a minimum duration of 15 minutes.
- Wiring of I/O will be specified such that the failure of any single PLC I/O module minimally affects an overall process. In general, control outputs for multiple pumps of similar purpose will be distributed across separate PLC output modules.
- Where redundant process monitoring is designed, the signals shall be located on separate I/O modules.

6.3.4 REMOTE COMMUNICATIONS

Redundant communications paths will be established to County's existing MWWTP providing a robust link for remote monitoring of the facility through SCADA. Primary communications could be via a land-line, fiber-optic based Ethernet LAN interconnect service coordinated with the WWTP and local utility. Cellular, wireless radio, or cable modem connection can provide a secondary communication link. Details will be explored through final design.

NOTE: Land line communications is not currently available at the FMC PS site. It is anticipated that a new land-line will need to be extended from the FMC WWTP to the FMS PS site. Alternatively, a new service could be installed at the site should the existing be in need of an upgrade or a new Internet Service provider (ISP) is available. Details will be explored during final design when the intended site development plans can be further understood, affecting details such as communications service.

6.3.5 CONSTRUCTABILITY

The distributed control approach of this design provides a modular, robust and readily expandable control system. Each module (PLC) can be taken off-line for service, maintenance, or enhancements with little to no disruption to other process area modules. Each PLC system will be provided with significant spare capacity and panel space to facilitate modifications and expansions without any panel modifications required. This includes:

- 50% spare PLC CPU available memory
- 25% spare I/O points of each type, at each new location, pre-wired to terminal strips.

SECTION 7 – PUMP STATION – MECHANICAL DESIGN

7.1 BASIS OF DESIGN

The HVAC, plumbing, and fire protection systems provided by this project will comply with the following codes and standards:

- Virginia Uniform Statewide Building Code
- Virginia Sewage Collection and Treatment (SCAT) Regulations
- NFPA 820 – Fire Protection in Wastewater Treatment and Collection Facilities

- American National Standards Institute (ANSI)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

7.1.1 HVAC

The HVAC systems provided by this project are recommended to include the following features:

- Electric unit heaters for heat in the process areas.
- Exhaust fans and louvers for ventilation in the process areas.
- Supply air fans and exhaust fans in hazardous process areas as required by NFPA 820.
- Heat for ventilation supply air or make-up air will be evaluated for airflow rates that create possible freezing problems within the buildings. Heating source energy will be electric.
- Wet Well – Ventilation of 12 air changes per hour intermittent operation is to be provided. This ventilation rate results in a requirement for the electrical classification for this space as 'Class I Division 2 Group D'. There is no minimum ventilation rate required for the electrical classification of this space.

7.1.2 PLUMBING

The plumbing systems provided by this project are recommended to include the following features:

- Building drainage with floor drains to sanitary wet well
- Hose bibs and reels for wash-down, where required.

For purposes of design development, it is assumed that the potable water flow and pressure is adequate.

7.1.3 FIRE PROTECTION

Fire protection systems are not required, but will be provided.

7.2 VIRGINIA SCAT GUIDELINES

Design requirements for HVAC, plumbing and fire protection systems as part of the FMC PS project will be in accordance with the SCAT Regulations, latest edition.

7.3 CONSTRUCTABILITY

The HVAC, plumbing, and fire protection systems will be designed as unitary systems without central plants.

SECTION 8 – PRELIMINARY CONSTRUCTION COST ESTIMATE

8.1 SUMMARY

Preliminary construction costs have been estimated for the FMC Pump Station and Force Main based on available material costs and available bid tab data for similar projects completed in Central Virginia.

The following is a summary of the estimated construction costs for the FMC Pump Station and Force Main (reference the Appendix for a complete cost breakdowns):

Table 8.1: Summary – FMC PS and FM Cost Estimate

Item	Cost*
Subtotal – Influent Sewer and Pump Station	$1,417,900
Subtotal – Force Main	$264,500
Subtotal – FMC WWTP Decommissioning	$220,950
Subtotal – Project	$1,903,350
Contingency (25%)	$475,000
Capital Construction Cost – 2018 Dollars	**$2,378,350**

Source: O'Brien & Gere

*An additional estimate was undertaken to determine the required cost of operating the FMC WWTP for the next 5 years. Based on discussions with the County and the various memos compiled to date, it was determined that an additional $3-4M would be required. This is broken down into the following upgrades:

- #3 Generator - $525,000
- #1 Generator - $650,000
- Motor Control Centers – 4 at $150,000 ($600,000 total)
- PTU Building - $200,000
- Lagoon Liners – 3 at $105,000 ($315,000 total)
- Digester Mixers – 2 at $75,000 ($150,000 total).

SECTION 9 – CONCLUSION AND RECOMMENDATIONS

9.1 SUMMARY

The following is a listing of conclusions and recommendations for the FMC PS and FM Project:

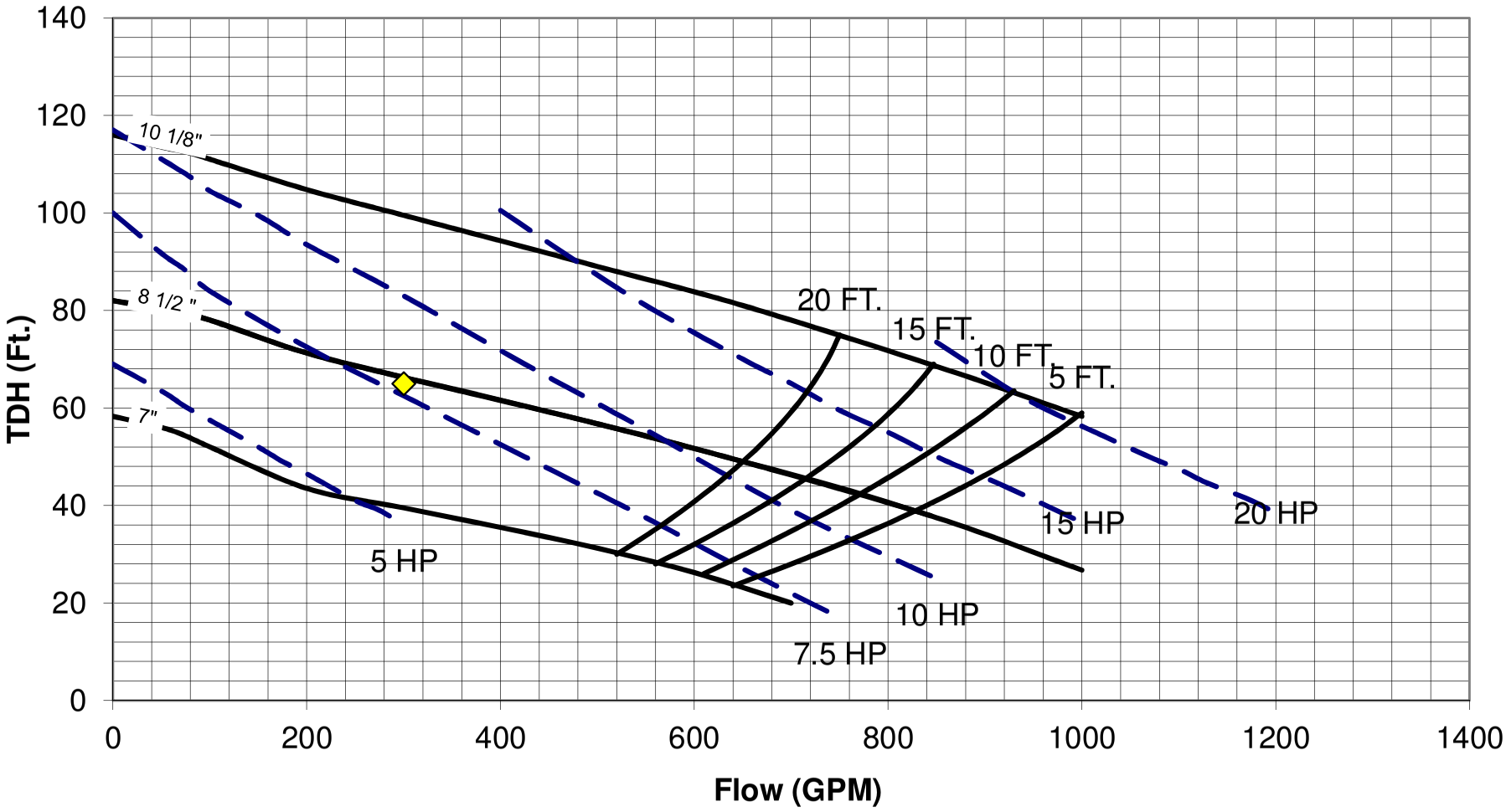
- With the proposed decommissioning of the FMC WWTP, all influent flows will be directed elsewhere in the County. A project is currently proposed for the Hazel Run PS to convey County and City flow to the MIS and MWWTP and bypass the City WWTP. As part of the decommissioning project, the Deep Run PS will be modified to convey all flow to the Massaponax gravity sewer system. A new pump station is proposed in the vicinity of the existing FMC WWTP to receive existing gravity flows in the Industrial Park area, as well as future economic growth at the treatment plant site.
- Using the County's most recent Water and Wastewater Master Plan Update, the Wastewater Plan Update draft memo (dated 1/26/17) and various flow metering programs as a guide, the projected average daily flow received by the pump station is 40,000 GPD. Using a peaking factor of 3.0, the estimated peak daily flow received by the pump station is 120,000 GPD. Future growth is projected to add an additional 90,000 GPD average daily flow and 270,000 GPD peak daily flow. Based on these projections, the pump station is recommended to convey a peak design flow of 300 gpm at 65 TDH.
  - The proposed pumps will be installed with VFDs to allow them to operate between approximately 120-350 gpm.
- The proposed pump station should be located adjacent to and behind the existing IPPS. A decommissioned control building and set of flash mix tanks from the original treatment plant construction is located in this general area and will need to be demolished before construction can begin.

- The new pump station will require a new gravity approach sewer and headworks structure.
  - Flow will be redirected from an existing manhole just upstream from the existing IPPS using a 12-inch PVC sewer to the influent of the proposed pump station.
  - A new, channel grinder should be incorporated into the proposed headworks structure to alleviate concerns with pump ragging and clogging.
- Suction lift pumps are recommended due to the County's past experience with this type of pump and the expected site/civil cost savings associated with utilizing a suction lift pump instead of a flooded suction pump.
  - Two Smith & Loveless Model 4B2D pumps, installed in parallel, are recommended and will provide 100% redundancy at the FMC PS.
- Approximately 1,400 LF of 6" diameter force main is recommended, extending from the proposed pump station to the existing 12" diameter Deep Run FM currently serving the FMC WWTP. Flow will be reversed in the existing 12" FM and combined with the existing 16" Deep Run FM to discharge into the MWWTP gravity sewer system. Near the existing connection between the 12" FM and the 16" FM, new inline check valves will be installed – a 12" check valve on the existing 12" FM and a 16" check valve upstream of the existing connection on the 16" FM.
- Ductile iron pipe shall be the selected pipe material for the force main's pipe material, in accordance with the County's Water and Sewer Design and Construction Standards Manual.
  - Combination air valves shall be installed at every intermediate high point along the section of new 6" FM.

Appendix A – Process Mechanical Literature

Pump Curve

Smith & Loveless Inc.



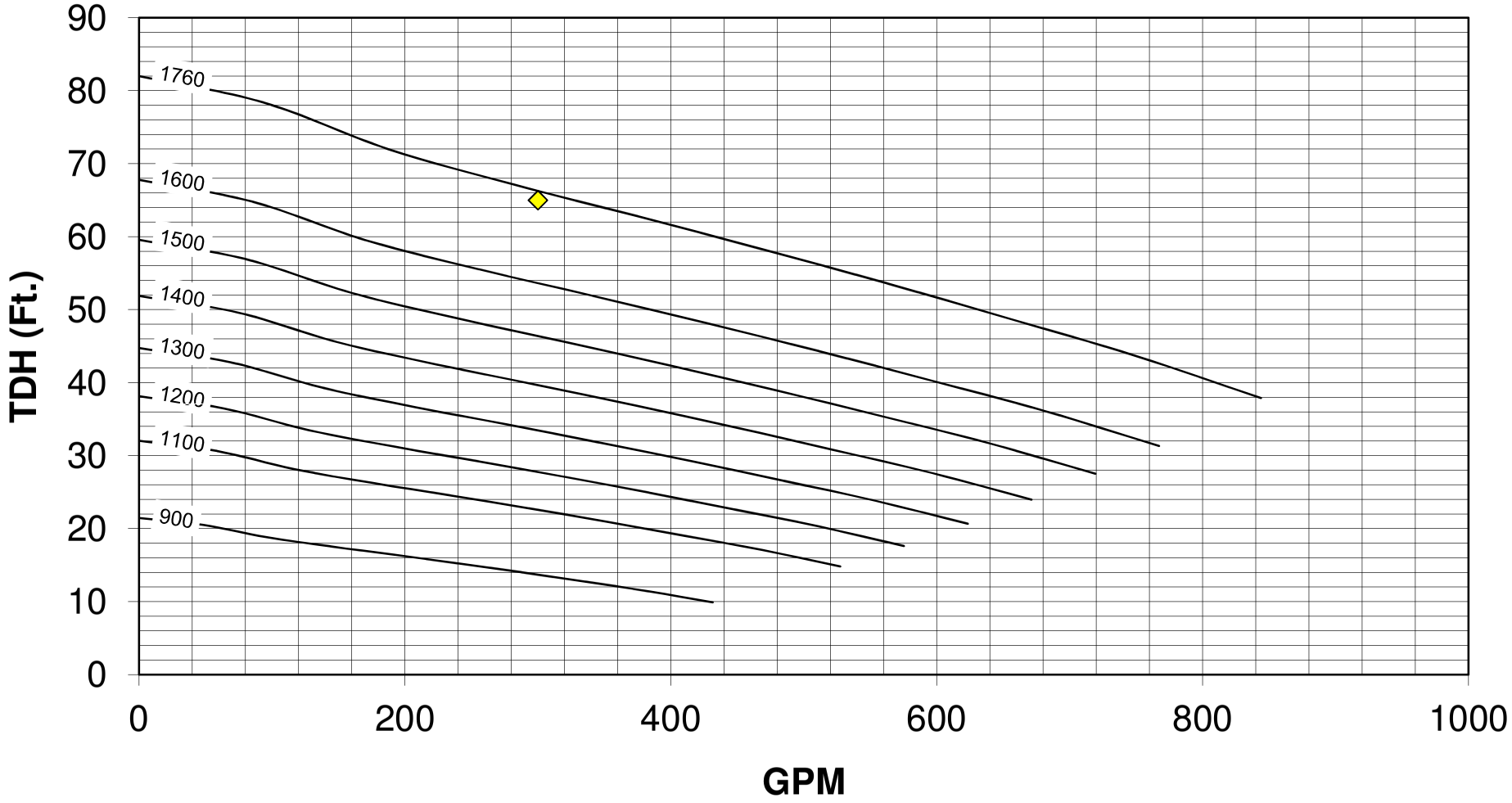
Location: FMC PS
Project Name: 0

Design Point: 300 GPM@ 65'
Impeller Trim: 8 1/2"

Pump Model: 4B2D, 1760 RPM
Hp & Efficiency: 10Hp & 63%

Pump Curve

Smith & Loveless



Location: FMC PS
Project Name: 0

Design Point: 300 GPM@ 65'
Impeller Trim: 8 1/2"

Pump Model: 4B2D, 1760 RPM
HP & Efficiency: 10Hp & 63%

PERFORMANCE CURVE

REPRIMING LIFTS							
RPM	650	750	850	950	1050	1150	1250 - 1950
FEET	5	8	16	19	22	24	25
METERS	1,5	2,4	4,9	5,8	6,7	7,3	7,6

Figure NPSH required prior to using above table. DO NOT use as available Suction Lifts.

3.00"/[76,2 MM] DIA. MAX. SPHERICAL SOLIDS

VOLUTE 10525D / 10525B CURVE T4A-B-4

IMPELLER 10528 MODEL T4A-B

SIZE 4"X4" IMP.DIA. 9.75"

SP.GR. 1.0 RPM NOTED

Select performance within operating range of curve.

TOTAL HEAD

M: 0 4 8 12 16 20 24 28 32 36 40 44

PSI: 0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60

FT: 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140

1950 RPM
1850
1750
1650
1550
1450
1350
1250
1150
1050
950
850
750
650

OPERATING RANGE
40%
50
52
52%

25 BHP[18,6 KW]
20[14,9]
15[11,2]
10[7,5]
7,5[5,6]
5[3,7]
3[2,2]
2[1,5]
1,5[1,1]
1[,75]
,75[,56]

NPSH@1950RPM

NPSH
FT: 0 10 20 30
M: 0 2 4 6 8 10

U.S.GALLONS PER MINUTE X 10: 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

LITRES PER SECOND: 0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64

CUBIC METRES PER HOUR X 10: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

GORMAN-RUPP PUMPS

T-1-07-R

FILE NO. t4ab.s04

Pump Data Sheet - Gorman-Rupp SEW 60Hz

Company: OBG
Name: Isaac Katz P.E.
Date: 5/1/2018

Pump:

Size: T4A-B-4

Type: T-SERIES
Synch speed: Adjustable

Speed: 1670 rpm
Dia: 9.75 in

Curve: T4A-B-4

Impeller: 10528

Specific Speeds:

Ns: ---
Nss: ---

Dimensions:

Suction: 4 in
Discharge: 4 in

Pump Limits:

Temperature: ---
Pressure: ---
Sphere size: 3 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 300 US gpm

Head: 78 ft

Fluid:

Water
Density: 62.3 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: ---
Enclosure: ---

Speed: ---
Frame: ---

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	300 US gpm
Head:	78.8 ft
Eff:	43%
Power:	13.8 hp
NPSHr:	5.94 ft

---- Design Curve ----

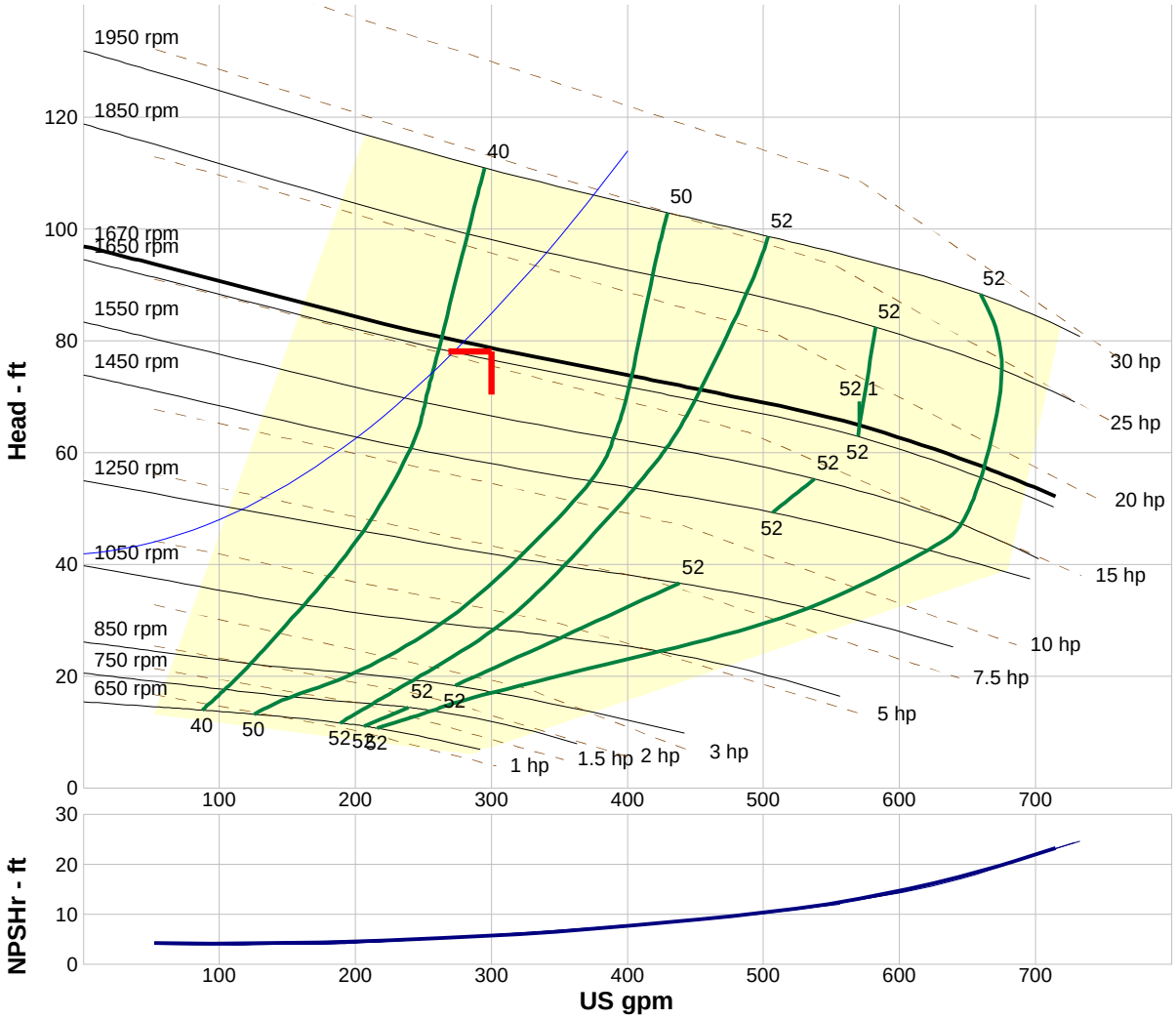
Shutoff head:	96.9 ft
Shutoff dP:	41.9 psi
Min flow:	---

BEP: 52% @ 570 US gpm

NOL power:
18.9 hp @ 714 US gpm

-- Max Curve --

Max power:
29.8 hp @ 733 US gpm



This curve is provided for preliminary selection only. Please consult factory before making final pump or motor selections.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
360	1670	75.9	47	14.5	7.01
300	1670	78.8	43	13.8	5.94
240	1670	82.1	36	13.6	5.17
180	1670	85.8	27	14.2	4.87
120	1670	89.5	18	14.9	4.58

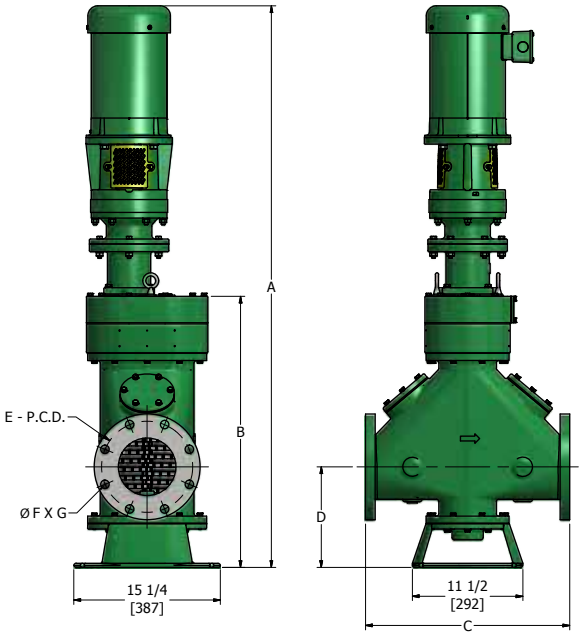
30K series Muffin Monster®

Materials of Construction

Housings: Ductile iron
Cutters: Hardened alloy steel
Shafts: Hardened alloy steel
Mechanical Seals: Tungsten carbide faces

Specifications

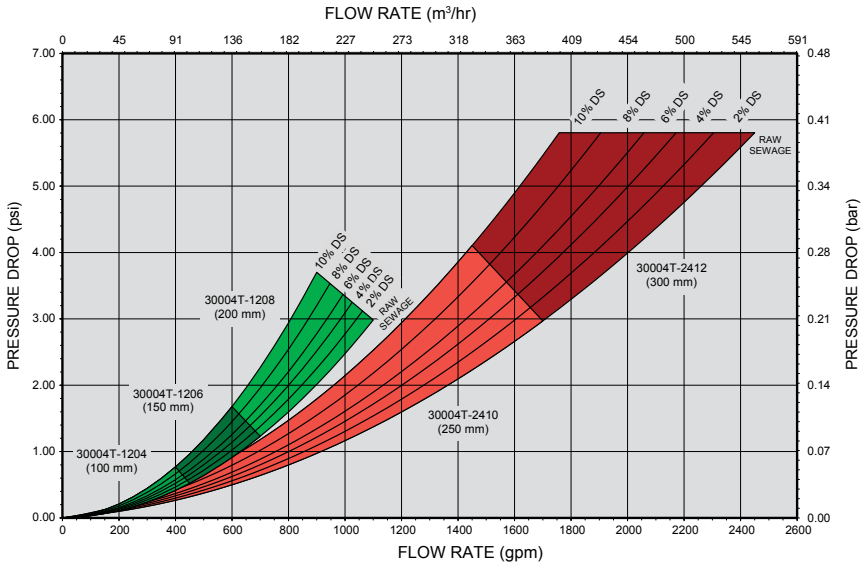
2” (50 mm) hex shafts;
Standard 3 HP (2.2 kW) motor; 29:1 reducer
Cutter Size: 4-3/4” (120 mm) diameter cutters
Seal Max Working Pressure: 90 PSI (6 bar)



OPTIONS AVAILABLE

	In-Line	Open Channel
7, 11, 13 Tooth Cutters	■	■
17 Tooth Wipes Ready™ Cutter	■	■
Custom Mounting Frames		■
SS & NEMA 7 Control enclosures	■	■
Solids Scrapers		■
Stainless Steel Feed Hopper		■
Alternate Voltage & HP Motors	■	■
Explosion Proof Motors	■	■
Immersible Motors	■	■
Hydraulic Power Pack	■	■
Extended Motor Shafts	■	■
ANSI, JIS, JWA, BS & AS Flanges	■	

MODEL 30004T



IN-LINE Model	Flow Rate - gpm (m³/hr)	Pipeline Size - inches (mm)	Pressure Drop - psi (bar)	Standard Dimensions - inches (mm)				Flange Dimensions - inches (mm)			Approximate Net Weight - lbs (kg)
				A	B	C	D	E	F	G	
30004T-1204	450 (102)	4 (100)	0.52 (0.04)	58-1/4 (1480)	28-1/4 (718)	19-1/4 (483)	9-3/8 (238)	7-1/2 (191)	3/4 (19)	8	562 (255)
30004T-1206	700 (159)	6 (150)	1.23 (0.08)	58-1/4 (1480)	28-1/4 (718)	21-1/4 (534)	10-3/8 (264)	9-1/2 (241)	7/8 (22)	8	559 (254)
30004T-1208	1100 (250)	8 (200)	3.00 (0.21)	58-1/4 (1480)	28-1/4 (718)	23-1/4 (584)	11-1/4 (238)	11-3/4 (286)	7/8 (22)	8	568 (258)
30004T-2410	1700 (386)	10 (250)	2.97 (0.20)	69-3/4 (1772)	39-3/4 (1010)	27-1/4 (686)	12-5/16 (313)	14-1/4 (362)	1 (25)	12	789 (358)
30004T-2412	2450 (556)	12 (300)	5.80 (0.40)	69-3/4 (1772)	39-3/4 (1010)	31-1/4 (787)	13-1/4 (337)	17 (431)	1 (25)	12	809 (367)

In-Line unit typically installed prior to suction side of pump. • Consult factory for analysis of application.
• Drive dimensions are a maximum based on a unit with a 3 HP (2.2 kW) drive.

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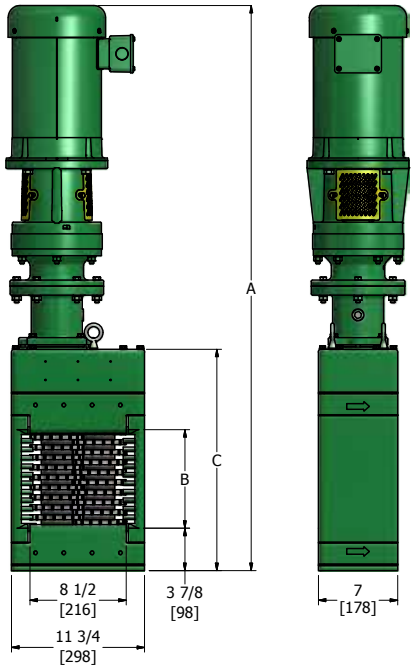
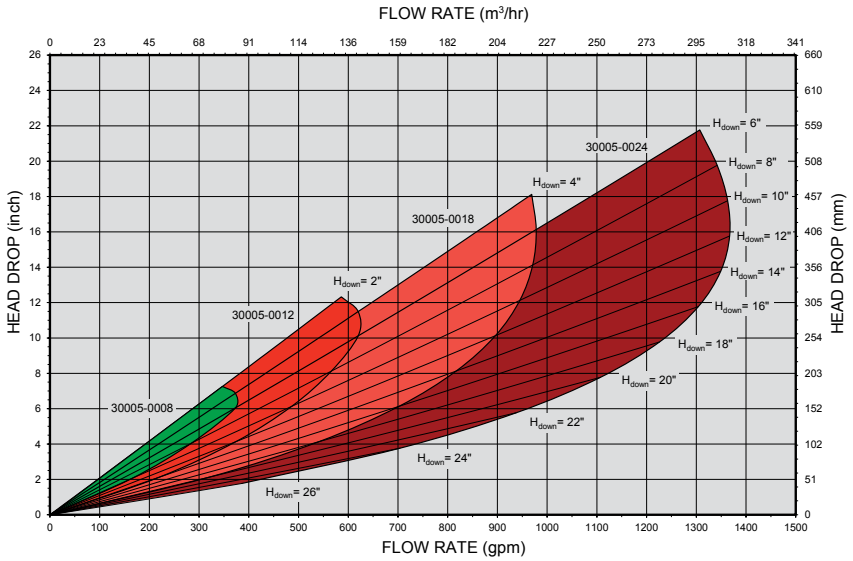
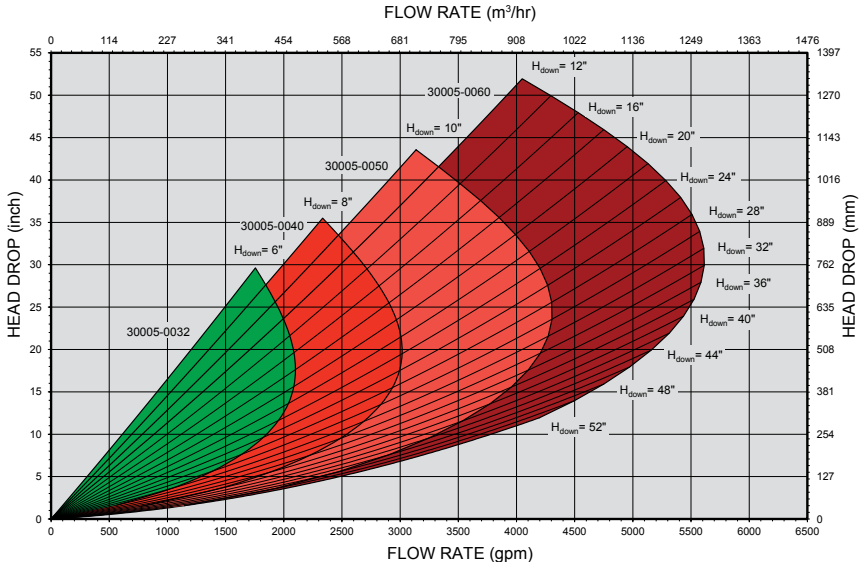
30K series Muffin Monster®



MODEL 30005



MODEL 30005



OPEN CHANNEL Model	Flow Rate - gpm (m³/hr)	Head Drop - inches (mm)	Standard Dimensions - inches (mm)			Approximate Net Weight - lbs (kg)
			A	B	C	
30005-0008	370 (84)	7 (178)	49-1/2 (1257)	8 (203)	19-1/2 (495)	370 (168)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30005-0018	980 (223)	16 (405)	59-1/2 (1511)	18 (457)	29-1/2 (749)	465 (211)
30005-0024	1370 (311)	16 (405)	65-1/4 (1657)	24 (609)	35-1/4 (895)	520 (236)
30005-0032	2100 (477)	17-1/2 (445)	73 (1854)	32 (813)	43 (1092)	580 (263)
30005-0040	3020 (686)	19-1/2 (495)	81 (2057)	40 (1016)	51 (1295)	650 (295)
30005-0050	4310 (979)	23-1/2 (595)	90-7/8 (2308)	50 (1270)	60-7/8 (1546)	740 (336)
30005-0060	5620 (1277)	30 (760)	101-3/8 (2575)	60 (1524)	71-3/8 (1813)	845 (383)

* Flow based on optimum channel conditions. • Consult factory for analysis of application.

• Drive dimensions are a maximum based on a unit with a 182T motor frame.• Extended drive shafts are available on request.

Santa Ana, CA. USA | **800.331.2277** | **jwce.com** | **jwce@jwce.com**

JWC Environmental®
Trust Monster Quality™

ECS

ENVIRONMENTAL SOLUTIONS

OFFERING A COMPLETE LINE OF ODOR CONTROL PRODUCTS AND ACCESSORIES

V1-TM

The V1-TM is a low cost, simple odor control system that utilizes activated carbon – sometimes in conjunction with a secondary polishing media to remove odor.

- Simple and easy to install and operate
- High efficiencies of H_2S and organic odor removal
- Perfect for applications between 50 and 1500 CFM
- High quality FRP construction manufactured to exceed industry standards

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V1-TM

SIMPLE, EASY, COST EFFECTIVE SOLUTION UP TO 3000 CFM

FEATURES	BENEFIT
Low Cost	V1-TM systems can economically treat up to 1500 cfm. Capital costs are reduced because of unit simplicity.
No Chemicals	Uses carbon media to treat odor compounds, no chemicals or additives are required.
High-Quality Construction	Manufactured using high-quality FRP components. Full 100-mil corrosion barriers on all surfaces exposed to the corrosive environment
Industry Standard Design Basis	Systems are sized to keep bed velocities between 50 and 60 f/m. Standard contact time for all V1 units is 3 seconds.
High Quality Media	The ECS V1 is available with a wide variety of media including Calgon Minotaur, one of only two A-Grade carbons with a .3 H_2S capacity and Calgon Centaur, a water regenerable carbon with ultimate H_2S capacity of .69
High Reliability	ECS carbon units require no acclimation time and can operate intermittently.
Options Available	V1-TM deep beds are available in a number of options • Custom colors available • Sound attenuation packages (enclosure and silencer) • Single or three phase operation

ECS Offers the Following Complete Line of Odor Control Products

- V1 Single Bed
- V2 Dual-Bed
- VX Radial Flow
- X-Pac Chemical Scrubber
- BioPure Biofilter Media
- FRP Ductwork Systems
- AMCA Certified Dampers
- Grease Filter / Mist Eliminators
- Control Panels
- FRP Fans
- Activated Carbon Media
- FRP Chemical Storage Tanks
- FRP Hoods / Covers
- Sound Enclosures and Silencers
- Field Services

ECS ENVIRONMENTAL SOLUTIONS

ECS is based out of a 100,000 sq/ft manufacturing / design facility located in central Texas. We offer a complete line of odor control equipment and services including carbon adsorbers, wet scrubbers, biofilters with the unique capability to manufacture and supply system components.

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P. 254.933.2270 / F. 254.933.2212

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Specification sheet

Diesel generator set QSL9-G7 series engine

250 kW - 300 kW Standby

Description

Cummins® commercial generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary Standby and Prime Power applications.

Features

Cummins heavy-duty engine - Rugged 4-cycle, industrial diesel delivers reliable power, low emissions and fast response to load changes.

Alternator - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads and fault clearing short-circuit capability.

Control system - The PowerCommand® electronic control is standard equipment and provides total genset system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, AmpSentry™ protection, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance.

Cooling system - Standard cooling package provides reliable running at the rated power level.

Enclosures - Optional weather protective and sound attenuated enclosures are available.

Fuel tanks - Dual wall sub-base fuel tanks are also available.

NFPA - The genset accepts full rated load in a single step in accordance with NFPA 110 for Level 1 systems.

Warranty and service - Backed by a comprehensive warranty and worldwide distributor network.

	Standby rating		Prime rating		Continuous rating		Data sheets	
Model	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz	50 Hz
DQDAA	250 (313)		225 (281)				D-3442	
DQDAB	275 (344)		250 (313)				D-3443	
DQDAC	300 (375)		270 (338)				D-3444	

Generator set specifications

Governor regulation class	ISO 8528 Part 1 Class G3
Voltage regulation, no load to full load	± 0.5%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.5%
Radio frequency emissions compliance	IEC 801.2 through IEC 801.5; MIL-STD-461C, Part 9

Engine specifications

Bore	114.0 mm (4.49 in)
Stroke	145 mm (5.69 in)
Displacement	8.9 L (543 in^3)
Configuration	Cast iron, in-line 6 cylinder
Battery capacity	750 amps minimum at ambient temperature of -18 °C (-0.4 °F) and above
Battery charging alternator	70 amps
Starting voltage	24 volt, negative ground
Fuel system	Direct injection: number 2 diesel fuel, fuel filter, automatic electric fuel shutoff
Fuel filter	Dual element with water separator
Air cleaner type	Normal duty
Lube oil filter type(s)	Single spin-on, combination full flow and bypass filters
Standard cooling system	High ambient radiator

Alternator specifications

Design	Brushless, 4 pole, drip proof revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible discs
Insulation system	Class H
Standard temperature rise	125 °C Standby, 105 ºC Prime
Exciter type	Permanent Magnet Generator (PMG)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower
AC waveform Total Harmonic Distortion (THDV)	< 5% no load to full linear load, < 3% for any single harmonic
Telephone Influence Factor (TIF)	< 50 per NEMA MG1-22.43
Telephone Harmonic Factor (THF)	< 3

Available voltages

60 Hz 3-phase			**50 Hz** 3-phase	
Reconnectable		Non-Reconnectable	Reconnectable	Non-Reconnectable
• 110/90 • 139/240 • 240/416	• 120/208 • 120/240 • 254/440	• 277/480 • 347/600		

Note: Consult factory for other voltages.

Generator set options and accessories

Engine

- 120/240 V 1500 W coolant heater
- 120/240 V 150 W lube oil heater
- Heavy duty air cleaner
- Engine oil temperature

Control panel

- 120/240 V 100 W control anti-condensation heater
- Exhaust pyrometer
- Ground fault indication
- Remote fault signal package
- Run relay package
- Paralleling configuration

Alternator

- 105 °C rise
- 125 °C rise
- 120/240 V 100 W anti-condensation heater
- PMG excitation
- Single phase

Exhaust system

- Genset mounted muffler
- Heavy duty exhaust elbow
- Slip on exhaust connection
- NPT exhaust connection

Fuel system

- 1022 L (270 gal) sub-base tank
- 1136 L (300 gal) sub-base tank
- 1514 L (400 gal) sub-base tank
- 1893 L (500 gal) sub-base tank
- 2271 L (600 gal) sub-base tank
- 2498 L (660 gal) sub-base tank
- 2725 L (720 gal) sub-base tank
- 5565 L (1470 gal) sub-base tank

Generator set

- AC entrance box
- Battery
- Battery charger
- Export box packaging
- UL 2200 Listed
- Main line circuit breaker
- PowerCommand network
- Communications Module (NCM)
- Remote annunciator panel
- Spring isolators
- Enclosure: aluminum, steel, weather protective or sound attenuated
- 2 year Standby power warranty
- 2 year Prime power warranty
- 5 year Basic power warranty
- 10 year major components warranty

Note: Some options may not be available on all models - consult factory for availability.

Control system PCC 2100

PowerCommand control is an integrated generator set control system providing governing, voltage regulation, engine protection and operator interface functions. Major features include:

- Integral AmpSentry™ protective relay providing a full range of alternator protection functions that are matched to the alternator provided.
- Battery monitoring and testing features and smart starting control system.
- Three phase sensing, full wave rectified voltage regulation system, with a PWM output for stable operation with all load types.
- Standard PCCNet™ and optional Echelon® LonWorks® network interface.
- Control suitable for operation in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and altitudes to 5000 meters (13,000 feet).
- Prototype tested; UL, CSA, and CE compliant.
- InPower™ PC-based service tool available for detailed diagnostics.

Operator/display panel

- Off/manual/auto mode switch
- Manual run/stop switch
- Panel lamp test switch
- Emergency stop switch
- Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup, controls and adjustments
- LED lamps indicating genset running, not in auto, common warning, common shutdown
- Configurable LED lamps (5)
- Configurable for local language

Engine protection

- Overspeed shut down
- Low oil pressure warning and shut down
- High coolant temperature warning and shut down
- High oil temperature warning (some models)
- Low coolant level warning or shut down
- Low coolant temperature warning
- High and low battery voltage warning
- Weak battery warning
- Dead battery shut down
- Fail to start (overcrank) shut down
- Fail to crank shut down
- Redundant -start disconnect
- Cranking lockout
- Sensor failure indication

Engine data

- DC voltage
- Lube oil pressure
- Coolant temperature
- Lube oil temperature (some models)
- Engine speed

AmpSentry AC protection

- Over current and short-circuit shut down
- Over current warning
- Single and three phase fault regulation
- Over and under voltage shut down
- Over and under frequency shut down
- Overload warning with alarm contact
- Reverse power and reverse Var shut down
- Excitation fault

Alternator data

- Line-to-Line and Line-to-Neutral AC volts
- Three phase AC current
- Frequency
- Total and individual phase power factor, kW and kVA

Other data

- Genset model data
- Start attempts, starts, running hours
- kW hours (total and since reset)
- Fault history
- Load profile (hours less than 30% and hours more than 90% load)
- System data display (optional with network and other PowerCommand gensets or transfer switches)

Governing

- Digital electronic isochronous governor
- Temperature dynamic governing
- Smart idle speed mode
- Glow plug control (some models)

Voltage regulation

- Digital PWM electronic voltage regulation
- Three phase Line-to-Neutral sensing
- Suitable for PMG or shunt excitation
- Single and three phase fault regulation
- Configurable torque matching

Control functions

- Data logging on faults
- Fault simulation (requires InPower)
- Time delay start and cooldown
- Cycle cranking
- PCCNet interface
- Configurable customer inputs (4)
- Configurable customer outputs (4)
- Configurable network inputs (8) and outputs (16) (with optional network)
- Remote emergency stop

Options

- LED bargraph AC data display
- Thermostatically controlled space heater
- Key-type mode switch
- Ground fault module
- Auxiliary relays (3)
- Echelon LONWORKS interface
- Modlon Gateway to convert to Modbus (loose)
- PowerCommand iWatch web server for remote monitoring and alarm notification (loose)
- Digital input and output module(s) (loose)
- Remote annunciator (loose)

For further detail see document S-1409.

Ratings definitions

Emergency Standby Power (ESP):

Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Limited-Time Running Power (LTP):

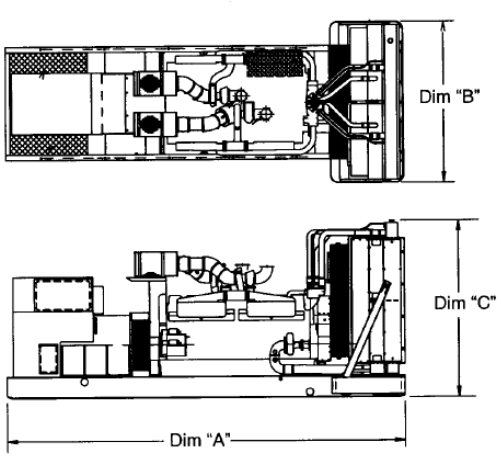
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

Prime Power (PRP):

Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Base Load (Continuous) Power (COP):

Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.



This outline drawing is for reference only. See respective model data sheet for specific model outline drawing number.

Do not use for installation design

Dimensions and weights with standard cooling system

Model	Dim "A" mm (in.)	Dim "B" mm (in.)	Dim "C" mm (in.)	Estimated set weight* dry kg (lbs)	Estimated set weight* wet kg (lbs)
DQDAA	3023 (119.0)	1270 (50.0)	1617 (64.0)	2184 (4814)	2234 (4926)
DQDAA	3023 (119.0)	1270 (50.0)	1617 (64.0)	2184 (4814)	2234 (4926)
DQDAC	3023 (119.0)	1270 (50.0)	1617 (64.0)	2319 (5113)	2370 (5225)

Dimensions and weights with optional cooling system with seismic feature codes L228-2 and/or L225-2

Model	Dim "A" mm (in.)	Dim "B" mm (in.)	Dim "C" mm (in.)	Estimated set weight* dry kg (lbs)	Estimated set weight* wet kg (lbs)
DQDAA	3023 (119.0)	1270 (50.0)	1676 (66.0)	2184 (4814)	2234 (4926)
DQDAB	3023 (119.0)	1270 (50.0)	1676 (66.0)	2184 (4814)	2234 (4926)
DQDAC	3023 (119.0)	1270 (50.0)	1676 (66.0)	2319 (5113)	2370 (5225)

*Note: Weights represent a set with standard features. See outline drawings for weights of other configurations.

Codes and standards

Codes or standards compliance may not be available with all model configurations – consult factory for availability.

	This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002.		The PowerCommand control is Listed to UL 508 - Category NITW7 for U.S. and Canadian usage.
	The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Cummins products bearing the PTS symbol meet the prototype test requirements of NFPA 110 for Level 1 systems.	**U.S. EPA**	Engine certified to Stationary Emergency U.S. EPA New Source Performance Standards,40 CFR 60 subpart IIII Tier 3 exhaust emission levels. U.S. applications must be applied per this EPA regulation.
	All low voltage models are CSA certified to product class 4215-01.	**International Building Code**	The generator set package is available certified for seismic application in accordance with the following International Building Code: IBC2000, IBC2003, IBC2006, IBC2009 and IBC2012.

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

For more information contact your local Cummins distributor or visit power.cummins.com

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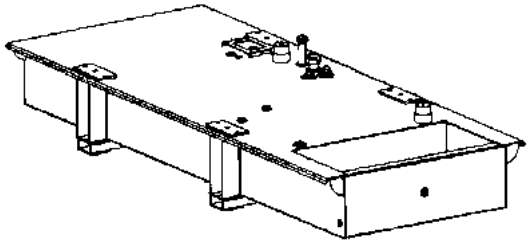
S-1585 (10/17)

Fuel tanks, 230-500 kW, Dual wall, sub-base



> Specification sheet

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Power Generation

Description

Cummins Power Generation dual wall diesel fuel tanks are rectangular steel tanks with a sealed, separately vented, integral fuel containment basin.

They carry a dual UL listing for the United States (UL 142) and Canada (CAN/ULC-S601-07) under the category of a secondary containment generator base tank. Inner and outer tanks are pressurized at 3 psi and leak checked to ensure integrity of weld seams per these UL standards prior to shipment.

Tanks are constructed of heavy gauge steel and include a reinforced steel box channel for generator support. Full height gussets are provided at generator set mounting holes. Tanks are load rated at 5,000 pounds per generator set mounting point. The design has been tested extensively under conditions far in excess of normal use to ensure that it can safely support the full weight of the generator set.

All tanks are pressure washed with an iron phosphate solution and then finished with an acrylic primer and black enamel paint. The interior is coated with a solvent-based rust preventative.

Tanks with local code approvals share the same construction features of standard sub-base tanks and are configured with additional options necessary to meet requirements of the city of Chicago Department of Inspectional Services, the Florida Department of Environmental Protection (FDEP) and Department of Environmental Resource Management (DERM) or the city of Los Angeles Bureau of Fire Prevention.

Reference instruction sheet - G478 for installation.

Note: Pre-drilled mounting pads accept Cummins Power Generation accessories spring vibration isolators (0402-0220, 0402-0222, 0402-0234, 0402-0427, 0402-0431, 0402-0750-01) between tank and genset but will not accept 0402-0690 or 0402-0691 series isolators.

Features

UL Listed for USA - Secondary containment generator sub-base tank meets UL requirements.

Designed to meet requirements of NFPA - NFPA 30, NFPA 37 and NFPA 110.

Emergency pressure relief vent cap - Meets or exceeds UL requirements - insures adequate venting and pressure relief for inner and outer tank under extreme temperature and emergency conditions.

Atmospheric vent cap - Accommodates normal venting (oversized 2" vent is raised above the fuel fill).

Raised fuel fill - Includes lockable flip top to prevent tampering and/or fuel contamination.

Fuel level gauge - Provides direct reading, top mounted.

Low fuel level switch - Annunciates a 50% low fuel level condition at generator set control panel.

Leak detection switch - Side mounted, annunciates a contained primary tank fuel leak at generator set control.

Modular tank design - Genset support and mounting design accepts multiple Cummins Power Generation generator sets within designated genset groupings.

Enclosure Compatible - Accepts drop-over weather protective and sound attenuated enclosures.

Tank to foundation ground clearance - Allows for visual secondary containment leak detection.

Tank top mounting bracket - Provides mounting for (optional) pump and control for day tank operation.

Removable panel/channel - Provides access to a full width, electrical stub-up area.

Specifications - Standard, Chicago and Los Angeles tanks

Model	Kit 0159-1486-xx			Full load operating hours (60 Hz)	Tank capacity usable Gal (L)	Tank dimensions			Dry tank weight Lb (Kg)
	Std	Chicago	LA			Length in (mm)	Width In (mm)	Height in (mm)	
DFAB	-21	-41	-61	13.2	210 (795)	134.0 (3404)	54.0 (1372)	15.25 (387)	1300 (590)
	-22	-42	-62	26.9	420 (1590)	134.0 (3404)	54.0 (1372)	26.75 (679)	1700 (771)
	-32	-52	-72	15.9	248 (939)	134.0 (3404)	54.0 (1372)	18.25 (464)	1390 (632)
	-33	-53	-73	32.2	502 (1900)	134.0 (3404)	54.0 (1372)	32.25 (819)	1860 (845)
DFAC	-21	-41	-61	12.5	210 (795)	134.0 (3404)	54.0 (1372)	15.25 (387)	1300 (590)
	-22	-42	-62	25.0	420 (1590)	134.0 (3404)	54.0 (1372)	26.75 (679)	1700 (771)
	-32	-52	-72	14.8	248 (939)	134.0 (3404)	54.0 (1372)	18.25 (464)	1390 (632)
	-33	-53	-73	29.9	502 (1900)	134.0 (3404)	54.0 (1372)	32.25 (819)	1860 (845)
DFBF	-23	-43	-63	17.2	350 (1325)	142.0 (3607)	54.0 (1372)	21.25 (540)	1575 (714)
	-24	-44	-64	24.5	500 (1893)	142.0 (3607)	54.0 (1372)	28.75 (730)	1850 (840)
	-25	-45	-65	29.4	600 (2271)	142.0 (3607)	54.0 (1372)	34.25 (870)	2025 (919)
	-26	-46	-66	34.3	700 (2650)	142.0 (3607)	54.0 (1372)	38.25 (972)	2175 (987)
DFCB	-23	-43	-63	15.6	350 (1325)	142.0 (3607)	54.0 (1372)	21.25 (540)	1575 (714)
	-24	-44	-64	22.2	500 (1893)	142.0 (3607)	54.0 (1372)	28.75 (730)	1850 (840)
	-25	-45	-65	26.7	600 (2271)	142.0 (3607)	54.0 (1372)	34.25 (870)	2025 (919)
	-26	-46	-66	31.1	700 (2650)	142.0 (3607)	54.0 (1372)	38.25 (972)	2175 (987)
DFCC	-23	-43	-63	14.3	350 (1325)	142.0 (3607)	54.0 (1372)	21.25 (540)	1575 (714)
	-24	-44	-64	20.5	500 (1893)	142.0 (3607)	54.0 (1372)	28.75 (730)	1850 (840)
	-25	-45	-65	24.6	600 (2271)	142.0 (3607)	54.0 (1372)	34.25 (870)	2025 (919)
	-26	-46	-66	28.7	700 (2650)	142.0 (3607)	54.0 (1372)	38.25 (972)	2175 (987)
DFCE	-23	-43	-63	12.0	350 (1325)	142.0 (3607)	54.0 (1372)	21.25 (540)	1575 (714)
	-24	-44	-64	17.2	500 (1893)	142.0 (3607)	54.0 (1372)	28.75 (730)	1850 (840)
	-25	-45	-65	20.6	600 (2271)	142.0 (3607)	54.0 (1372)	34.25 (870)	2025 (919)
	-26	-46	-66	24.1	700 (2650)	142.0 (3607)	54.0 (1372)	38.25 (972)	2175 (987)
DFEB	-27	-47	-67	14.7	425 (1609)	156.0 (3962)	63.5 (1613)	18.75 (476)	1850 (840)
	-28	-48	-68	29.4	850 (3218)	156.0 (3962)	63.5 (1613)	34.75 (883)	2525 (1145)
DFEC	-27	-47	-67	13.7	425 (1609)	156.0 (3962)	63.5 (1613)	18.75 (476)	1850 (840)
	-28	-48	-68	27.4	850 (3218)	156.0 (3962)	63.5 (1613)	34.75 (883)	2525 (1145)
DFED	-27	-47	-67	12.5	425 (1609)	156.0 (3962)	63.5 (1613)	18.75 (476)	1850 (840)
	-28	-48	-68	25.0	850 (3218)	156.0 (3962)	63.5 (1613)	34.75 (883)	2525 (1145)
DFEG	-30	-50	-70	17.6	425 (1609)	152.3 (3868)	63.0 (1600)	20.25 (514)	1850 (841)
	-31	-51	-71	35.3	850 (3218)	152.3 (3868)	63.0 (1600)	36.25 (921)	2525 (1148)
DFEH	-30	-50	-70	15.6	425 (1609)	152.3 (3868)	63.0 (1600)	20.25 (514)	1850 (841)
	-31	-51	-71	31.1	850 (3218)	152.3 (3868)	63.0 (1600)	36.25 (921)	2525 (1148)
DFEJ	-30	-50	-70	14.1	425 (1609)	152.3 (3868)	63.0 (1600)	20.25 (514)	1850 (841)
	-31	-51	-71	28.3	850 (3218)	152.3 (3868)	63.0 (1600)	36.25 (921)	2525 (1148)
DFEK	-30	-50	-70	12.4	425 (1609)	152.3 (3868)	63.0 (1600)	20.25 (514)	1850 (841)
	-31	-51	-71	24.7	850 (3218)	152.3 (3868)	63.0 (1600)	36.25 (921)	2525 (1148)
DQAB	-21	-41	-61	12.3	210 (795)	134.0 (3404)	54.0 (1372)	15.25 (387)	1300 (590)
	-22	-42	-62	24.6	420 (1590)	134.0 (3404)	54.0 (1372)	26.75 (679)	1700 (771)
	-32	-52	-72	14.5	248 (939)	134.0 (3404)	54.0 (1372)	18.25 (464)	1390 (632)
	-33	-53	-73	29.4	502 (1900)	134.0 (3404)	54.0 (1372)	32.25 (819)	1860 (845)
DQAD	-21	-41	-61	12.1	210 (795)	134.0 (3404)	54.0 (1372)	15.25 (387)	1300 (590)
	-22	-42	-62	24.3	420 (1590)	134.0 (3404)	54.0 (1372)	26.75 (679)	1700 (771)
	-32	-52	-72	14.3	248 (939)	134.0 (3404)	54.0 (1372)	18.25 (464)	1390 (632)
	-33	-53	-73	29.0	502 (1900)	134.0 (3404)	54.0 (1372)	32.25 (819)	1860 (845)
DQAE	-21	-41	-61	10.8	210 (795)	134.0 (3404)	54.0 (1372)	15.25 (387)	1300 (590)
	-22	-42	-62	21.6	420 (1590)	134.0 (3404)	54.0 (1372)	26.75 (679)	1700 (771)
	-32	-52	-72	12.8	248 (939)	134.0 (3404)	54.0 (1372)	18.25 (464)	1390 (632)
	-33	-53	-73	25.9	502 (1900)	134.0 (3404)	54.0 (1372)	32.25 (819)	1860 (845)

Specifications - Standard, Chicago, and Los Angeles tanks (continued)

Model	Kit 0159-1486-xx			Full load operating hours (60 Hz)	Tank capacity usable Gal (L)	Tank dimensions			Dry tank weight Lb (Kg)
	Std	Chicago	LA			Length in (mm)	Width In (mm)	Height in (mm)	
DQAF	-21	-41	-61	9.8	210 (795)	134.0 (3404)	54.0 (1372)	15.25 (387)	1300 (590)
	-22	-42	-62	19.6	420 (1590)	134.0 (3404)	54.0 (1372)	26.75 (679)	1700 (771)
	-32	-52	-72	11.6	248 (939)	134.0 (3404)	54.0 (1372)	18.25 (464)	1390 (632)
	-33	-53	-73	23.5	502 (1900)	134.0 (3404)	54.0 (1372)	32.25 (819)	1860 (845)
DQBA	-23	-43	-63	16.8	350 (1325)	142.0 (3607)	54.0 (1372)	21.25 (540)	1575 (714)
	-24	-44	-64	24.0	500 (1893)	142.0 (3607)	54.0 (1372)	28.75 (730)	1850 (840)
	-25	-45	-65	28.8	600 (2271)	142.0 (3607)	54.0 (1372)	34.25 (870)	2025 (919)
	-26	-46	-66	33.7	700 (2650)	142.0 (3607)	54.0 (1372)	38.25 (972)	2175 (987)

Model	Kit 0179-4621-xx			Full load operating hours (60 Hz)	Tank capacity usable Gal (L)	Tank dimensions			Dry tank weight Lb (Kg)
	Std	Chicago	LA			Length in (mm)	Width In (mm)	Height in (mm)	
DQDAA	-03	N/A	N/A	16.9	300 (1136)	119.0 (3027)	54.0 (1372)	22.25 (565)	1723 (783)
	-04	N/A	N/A	30.9	550 (2082)	119.0 (3027)	54.0 (1372)	38.25 (972)	2233 (1015)
DQDAB	-03	N/A	N/A	15.2	300 (1136)	119.0 (3027)	54.0 (1372)	22.25 (565)	1723 (783)
	-04	N/A	N/A	27.8	550 (2082)	119.0 (3027)	54.0 (1372)	38.25 (972)	2233 (1015)
DQDAC	-03	N/A	N/A	13.8	300 (1136)	119.0 (3027)	54.0 (1372)	22.25 (565)	1723 (783)
	-04	N/A	N/A	25.2	550 (2082)	119.0 (3027)	54.0 (1372)	38.25 (972)	2233 (1015)
DQHAA	A026J345	N/A	N/A	13.8	300 (1136)	136.0 (3454)	60.0 (1524)	17.0 (432)	1800 (816)
	A026J348	N/A	N/A	27.5	600 (2271)	136.0 (3454)	60.0 (1524)	31.0 (787)	2230 (1012)
DQHAB	A026J345	N/A	N/A	13.0	300 (1136)	136.0 (3454)	60.0 (1524)	17.0 (432)	1800 (816)
	A026J348	N/A	N/A	25.9	600 (2271)	136.0 (3454)	60.0 (1524)	31.0 (787)	2230 (1012)

Specifications - Florida tanks

Model	Kit 0159-1486-xx	Full load operating hours (60 Hz)	Tank capacity usable Gal (L)	Tank dimensions			Dry tank weight Lb (Kg)
	Std			Length in (mm)	Width In (mm)	Height in (mm)	
DFAB	-92	15.9	248 (939)	154.0 (3912)	54.0 (1372)	15.75 (400)	1400 (636)
	-93	32.2	502 (1900)	154.0 (3912)	54.0 (1372)	27.25 (692)	1800 (818)
DFAC	-92	14.8	248 (939)	154.0 (3912)	54.0 (1372)	15.75 (400)	1400 (636)
	-93	29.9	502 (1900)	154.0 (3912)	54.0 (1372)	27.25 (692)	1800 (818)
DFBF	-83	17.2	350 (1325)	162.0 (4115)	54.0 (1372)	18.75 (476)	1650 (750)
	-84	24.5	500 (1893)	162.0 (4115)	54.0 (1372)	25.25 (641)	1890 (859)
	-85	34.8	710 (2688)	162.0 (4115)	50.0 (1270)	34.20 (868)	2282 (1037)
	-86	39.2	800 (3028)	162.0 (4115)	50.0 (1270)	38.20 (970)	2460 (1116)
DFCB	-83	15.6	350 (1325)	162.0 (4115)	54.0 (1372)	18.75 (476)	1650 (750)
	-84	22.2	500 (1893)	162.0 (4115)	54.0 (1372)	25.25 (641)	1890 (859)
	-85	31.6	710 (2688)	162.0 (4115)	50.0 (1270)	34.20 (868)	2282 (1037)
	-86	35.6	800 (3028)	162.0 (4115)	50.0 (1270)	38.20 (970)	2460 (1116)
DFCC	-85	29.1	710 (2688)	162.0 (4115)	50.0 (1270)	34.20 (868)	2282 (1037)
	-86	32.8	800 (3028)	162.0 (4115)	50.0 (1270)	38.20 (970)	2460 (1116)
DFCE	-83	12	350 (1325)	162.0 (4115)	54.0 (1372)	18.75 (476)	1650 (750)
	-84	17.2	500 (1893)	162.0 (4115)	54.0 (1372)	25.25 (641)	1890 (859)
	-85	24.4	710 (2688)	162.0 (4115)	50.0 (1270)	34.20 (868)	2282 (1037)
	-86	27.5	800 (3028)	162.0 (4115)	50.0 (1270)	38.20 (970)	2460 (1116)
DFEB	-87	14.7	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-88	31.1	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)
DFEC	-87	13.7	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-88	29	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)
DFED	-87	12.5	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-88	26.5	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)

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Cummins Power Generation

Specifications - Florida tanks (continued)

Model	Kit 0159-1486-xx Std	Full load operating hours (60 Hz)	Tank capacity usable Gal (L)	Tank dimensions Length in (mm)	Width In (mm)	Height in (mm)	Dry tank weight Lb (Kg)
DFEG	-90	17.6	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-91	37.3	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)
DFEH	-90	15.6	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-91	33.0	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)
DFEJ	-90	14.1	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-91	29.9	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)
DFEK	-90	12.4	425 (1609)	176.0 (4470)	60.0 (1524)	18.80 (476)	2250 (1023)
	-91	26.2	900 (3407)	176.0 (4470)	60.0 (1524)	34.80 (883)	3090 (1402)
DQAB	-92	14.5	248 (939)	154.0 (3912)	54.0 (1372)	15.75 (400)	1400 (636)
	-93	29.4	502 (1900)	154.0 (3912)	54.0 (1372)	27.25 (692)	1800 (818)
DQAD	-92	14.3	248 (939)	154.0 (3912)	54.0 (1372)	15.75 (400)	1400 (636)
	-93	29.0	502 (1900)	154.0 (3912)	54.0 (1372)	27.25 (692)	1800 (818)
DQAE	-92	12.8	248 (939)	154.0 (3912)	54.0 (1372)	15.75 (400)	1400 (636)
	-93	25.9	502 (1900)	154.0 (3912)	54.0 (1372)	27.25 (692)	1800 (818)
DQAF	-92	11.6	248 (939)	154.0 (3912)	54.0 (1372)	15.75 (400)	1400 (636)
	-93	23.5	502 (1900)	154.0 (3912)	54.0 (1372)	27.25 (692)	1800 (818)
DQBA	-83	16.8	350 (1325)	162.0 (4115)	54.0 (1372)	18.75 (476)	1650 (750)
	-84	24.0	500 (1893)	162.0 (4115)	54.0 (1372)	25.25 (641)	1890 (859)
	-85	34.1	710 (2688)	162.0 (4115)	50.0 (1270)	34.20 (868)	2282 (1037)
	-86	38.5	800 (3028)	162.0 (4115)	50.0 (1270)	38.20 (970)	2460 (1116)
DQDAA	N/A	NA	NA	NA	NA	NA	NA
	N/A	NA	NA	NA	NA	NA	NA
DQDAB	N/A	NA	NA	NA	NA	NA	NA
	N/A	NA	NA	NA	NA	NA	NA
DQDAC	N/A	NA	NA	NA	NA	NA	NA
	N/A	NA	NA	NA	NA	NA	NA
DQHAA	N/A	NA	NA	NA	NA	NA	NA
	N/A	NA	NA	NA	NA	NA	NA
DQHAB	N/A	NA	NA	NA	NA	NA	NA
	N/A	NA	NA	NA	NA	NA	NA

Additional unique features by local approval

Chicago

- Tank approval indicated by the city of Chicago, Department of Inspectional Services, Plan No. 0451.
- Low fuel level switch (95% high and 50%) - Wired to a terminal block for local/remote annunciation within an electrical junction box.
- Leak detection switch (top-mount) - Wired to a terminal block for local/remote annunciation within an electrical junction box.
- No bottom fittings - Meets requirement that all tank fittings are to be located above the fuel level of the tank.

Los Angeles

- Tank approval indicated by the Los Angeles Bureau of Fire Prevention, Tag No. 2-94-1 for a sub-base tank.
- Tank design meets seismic requirements when appropriate vibration isolators are installed beneath the tank.
- Normal atmospheric and emergency vents must be exhausted out of a building (indoor applications) at a safe location by a qualified service technician.
- Additional options required when the “tank fill” location does not allow the fuel level gauge to be supervised.

Florida

- Tank approval by the Florida Department of Environmental Protection.
- Florida Department of Environmental Protection (FDEP) approval for:
  - FDEP approval is required for capacities greater than 550 gallon. Approval listed within FDEP File #EQ-662 (manufactured by Tramont Corporation).
  - 90% high fuel level sensor manufactured by INCON subsidiary of Franklin Fueling Systems). FDEP approval listed within File #EQ-456.
  - Leak detection switch approval listed within FDEP File #EQ-456.
  - Aboveground spill container, contains fuel overfill spills that may occur during fill-up (5-gallon capacity).
  - FDEP tanks are 20” longer on the radiator end of the genset to accommodate the above ground spill container, listed with the tank FDEP File #EQ-662.
  - Additional options required when the “tank fill” location does not allow the fuel level gauge to be supervised.
- Department of Environmental Resource Management (DERM) as required by Dade and Broward counties. Tank to foundation ground clearance for visual secondary leak detection (support channels located beneath tank).

Options

Fuel transfer control and pump kit - Enables field upgrade of standard tank to a day tank. Must purchase through Tramont 414-906-2040.

Standards and certifications / codes

Dual United States and Canadian Underwriter's Laboratories (UL) Listing – US listing is filed under the Special Purpose Tank Category of UL 142 and the Canadian listing is pursuant CAN/ULC-S601-07 Standard for Shop Fabricated Steel Aboveground Tanks and Combustible Liquids. C UL and US UL listing is under UL File No. MH17470 as a "Secondary Containment Generator Base Tank."

NFPA – Cummins Power Generation tanks are designed to be installed in accordance with all applicable NFPA codes:

- NFPA 30 - Flammable and Combustible Liquids Code
- NFPA 37 - Standard for Installation and use of Stationary Combustible Engine and Gas Turbines
- NFPA 110 - Standard for Emergency and Standby Power Systems

Chicago Local Approval

Optional City of Chicago local approval - Meets the local code required for approval by the Chicago Department of Inspectional Services - Plan No. 0451

L.A. Local Approval

Optional local approval - Meets the local code required for approval by the City of Los Angeles Bureau of Fire Prevention

Florida Local Approval

Optional local approval - Meets the local code required for approval by the Florida Department of Environmental Protection

ISO9001 - This product was designed and manufactured in facilities certified to ISO9001

Americas
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Minneapolis, MN 55432 USA
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Fax: 763 574 5298

Europe, CIS, Middle East and Africa
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Kent CT 12 5BF United Kingdom
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Fax 44 1843 255902

Asia Pacific
10 Toh Guan Road #07-01
TT International Tradepark
Singapore 608838
Phone 65 6417 2388
Fax 65 6417 2399

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect generator sets to any building electrical system except through an approved device or after building main switch is open.

Warning: For professional use only. Must be installed by a qualified service technician. Improper installation presents hazards of electrical shock and improper operation, resulting in severe personal injury and/or property damage.

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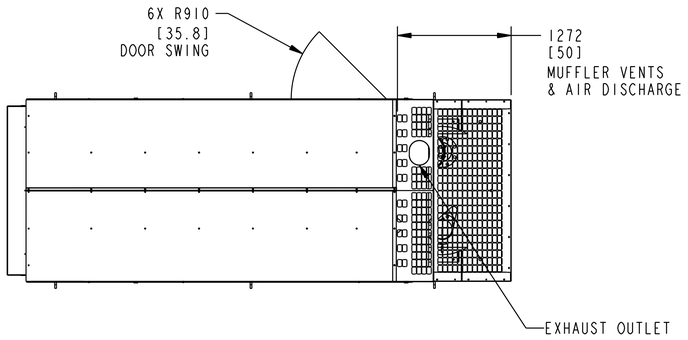
Pro/ENGINEER

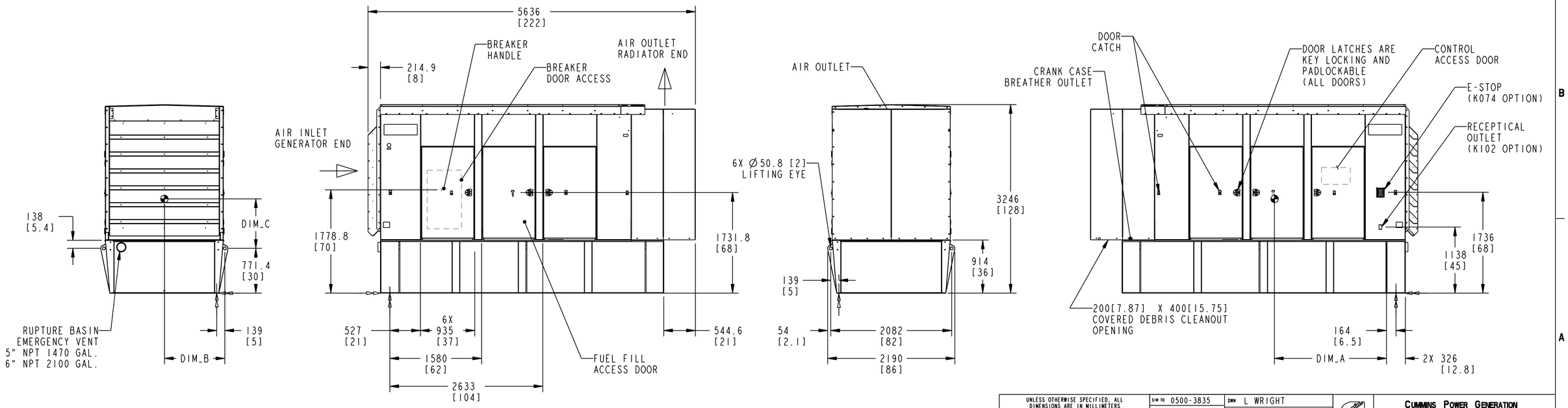
REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-113473	A	1	PRODUCTION RELEASE	LEW	ZYM	Z MOGES	18NOV10

TABULATION		
TANK/LIFT BASE FEATURE CODE	TANK CAPACITY	TANK WEIGHT DRY KG (LBS)
C208	1470	1704 (3756)

OPTIONAL FEATURE F202,F205

TABULATION						
MODEL	KW	CG_DIM "A"	CG_DIM "B"	CG_DIM "C"	WEIGHT KG (LBS)	WEIGHT IBC ENCLOSURE WITH L-161-2 FEATURE CODE KG (LBS)
DQDAA	250	1862 [73.3]	1041 (41)	647 [25.5]	6000 (13200)	6199 (13639)
DQDAB	275					
DQDAC	300	1880 [74.0]		651 [25.6]	6100 (13500)	6299 (13939)
***WEIGHT & CG'S ARE SHOWN WITH AN HIGHEST GALLON FUEL TANK, ENCLOSURE, AND STANDARD GENSET. ADDITION OF OTHER FEATURES MAY CHANGE THE WEIGHT. FOR F205 ENCLOSURE (ALUMINUM) REDUCE WEIGHT BY 490 (1090)						





NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. FOUNDATION REFERENCE POINT (⊢⊂⊃). SEE FOUNDATION DRAWING FOR DETAILS.
3. FOR FEATURE CODE L116 (FLORIDA TANKS) ADD 105.6 [4.16"] TO DIMS D-J
4. SEE SHEET 2 FOR TANK VENT LOCATIONS.
5. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:
   - 5.1 REFER TO ONAN APPLICATION MANUAL T030 FOR GENERAL GENSET/TANK MOUNTING GUIDELINES.
   - 5.2 AFTER PLACING SET ON FOUNDATION, VERIFY ALL MOUNTING PADS CONTACT FOUNDATION.
   - 5.3 INSERT THE MAXIMUM HEIGHT STACK OF SHIMS THAT WILL SLIDE INTO THE GAP.
   - 5.4 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° | SCALE: 1/32

SIM TO 0500-3835

DO NOT SCALE PRINT

- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN L WRIGHT | CKD Z MOGES | APVD Z MOGES | DATE 18NOV10

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 | FIRST USED ON DFA-DFC

SITE CODE PGA

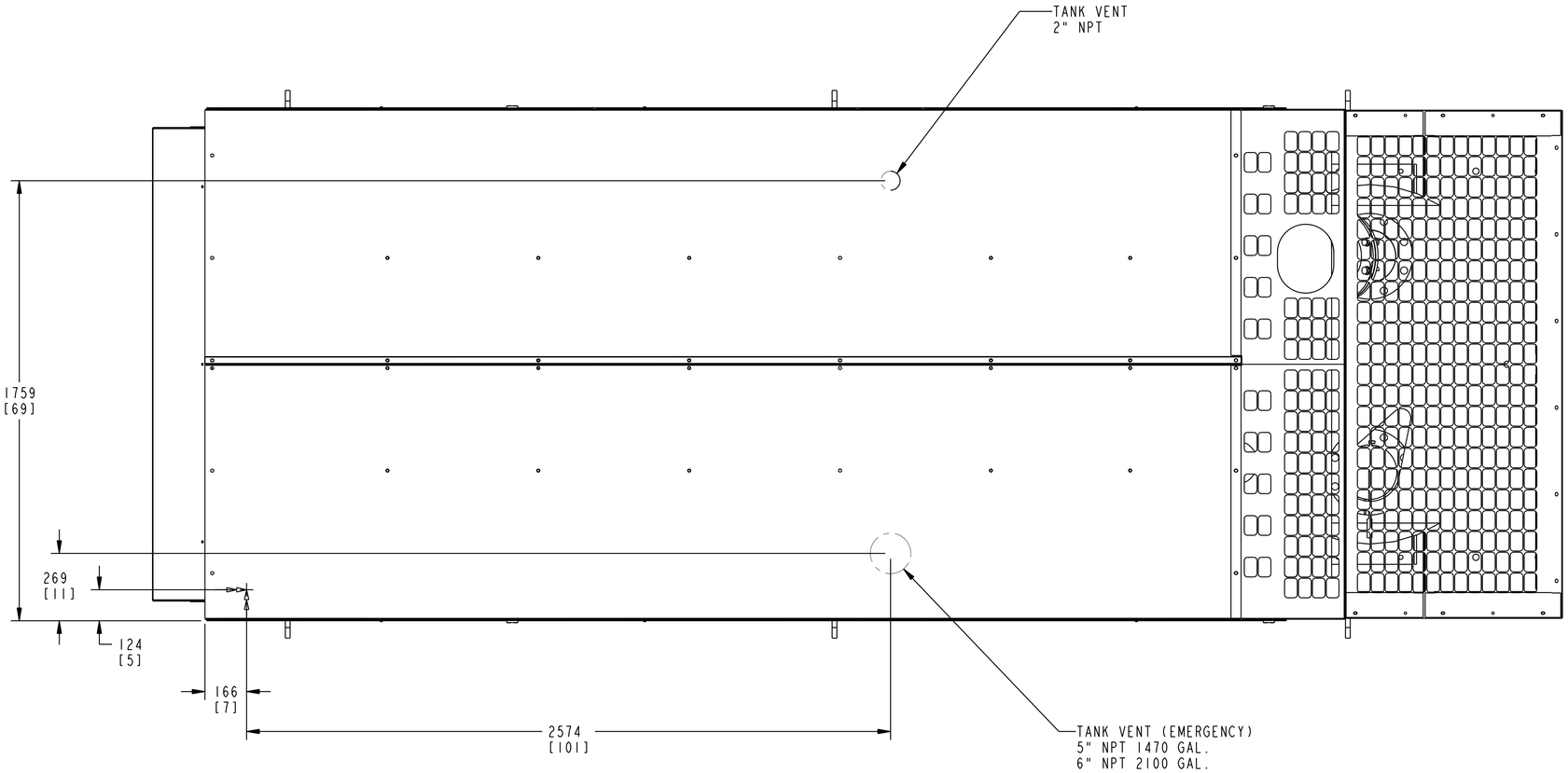
CUMMINS POWER GENERATION

OUTLINE, GENSET
(LEVEL 2)

DWG SIZE D | A035B146 | SHEET 1 OF 3 | DWG REV A

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-113473	A	1	PRODUCTION RELEASE	LEW	ZYM	Z MOGES	18NOV10



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM		HOLE	
	X ± 1		0.00- 4.99 +0.15/-0.08
	.X ± 0.8		5.00- 9.99 +0.20/-0.10
	.XX± 0.38		10.00-17.49 +0.25/-0.13
			17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° | SCALE: 3/32

SIM TO 0500-3835

DO NOT SCALE PRINT

- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN	L WRIGHT
CKD	Z MOGES
APVD	Z MOGES
DATE	18NOV10

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DFA-DFC

SITE CODE PGA

CUMMINS POWER GENERATION

OUTLINE, GENSET
(LEVEL 2)

DWG SIZE		SHEET	DWG REV
D	A035B146	2 OF 3	A

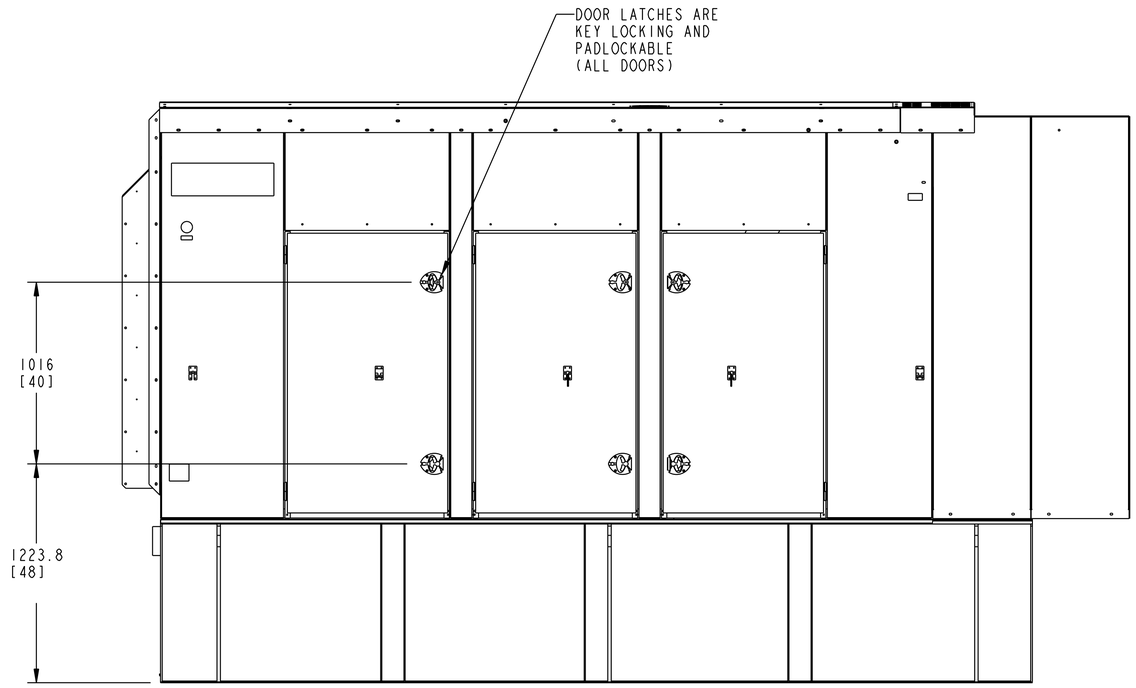
Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-113473	A	1	PRODUCTION RELEASE	LEW	ZYM	Z MOGES	18NOV10

OPTIONAL FEATURE
150 MPH RATING
F206

NOTES:

1. ALL DIMENSIONS NOT SHOWN ARE INDENTICAL TO THOSE SHOWN ON SHEET 1.
2. THE ENCLOSURE IS ENGINEERED TO MAINTAIN IT'S INTEGRITY WITH A 150 MPH WIND LOAD CONDITION.



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM		HOLE	
X	± 1	0.00- 4.99	+0.15/-0.08
.X	± 0.8	5.00- 9.99	+0.20/-0.10
.XX	± 0.38	10.00-17.49	+0.25/-0.13
		17.50-24.99	+0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/32

SIM TO 0500-3835

DO NOT SCALE PRINT

- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN L WRIGHT
CKD Z MOGES
APVD Z MOGES
DATE 18NOV10

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DFA-DFC

SITE CODE PGA

CUMMINS POWER GENERATION

OUTLINE, GENSET
(LEVEL 2)

DWG SIZE D | A035B146 | SHEET 3 OF 3 | DWG REV A

Part A035B146 A

Description	Legacy Name	External Regulations	Application Status	Release Phase Code	Security Classification	Alternates
OUTLINE,GENSET	A035B146	None	Production & Service	Production	Proprietary	

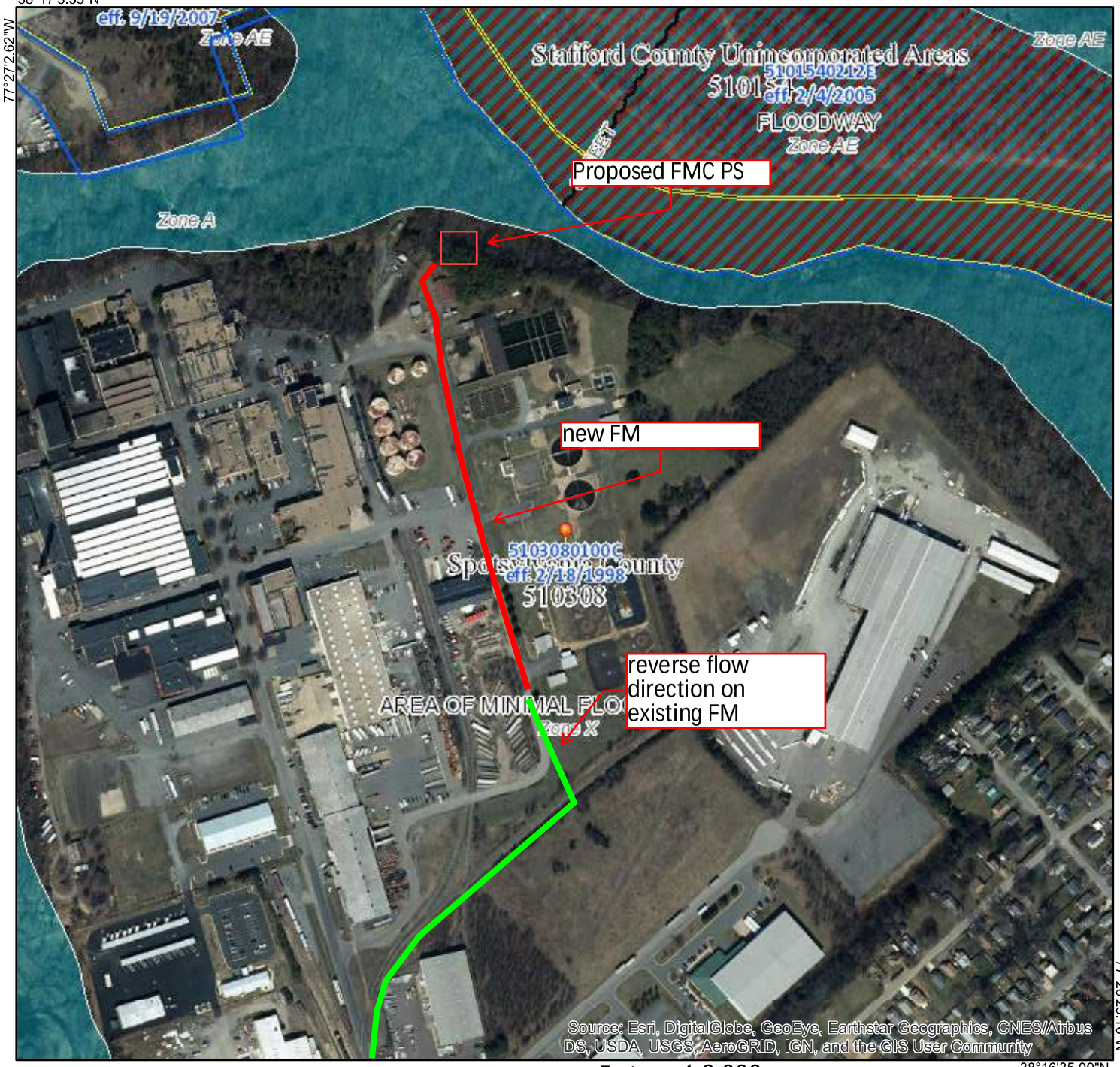
Part Specifications :A035B146 A

Name	Description	Legacy Name
A030B356	SPECIFICATION,MATERIAL	CES10903
A035B147	DRAWING,ENGINEERING	A035B147

Appendix B – Flood Plain Information

National Flood Hazard Layer FIRMette

FEMA



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/7/2018 at 3:58:31 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix C – Pump Station Preliminary Plans

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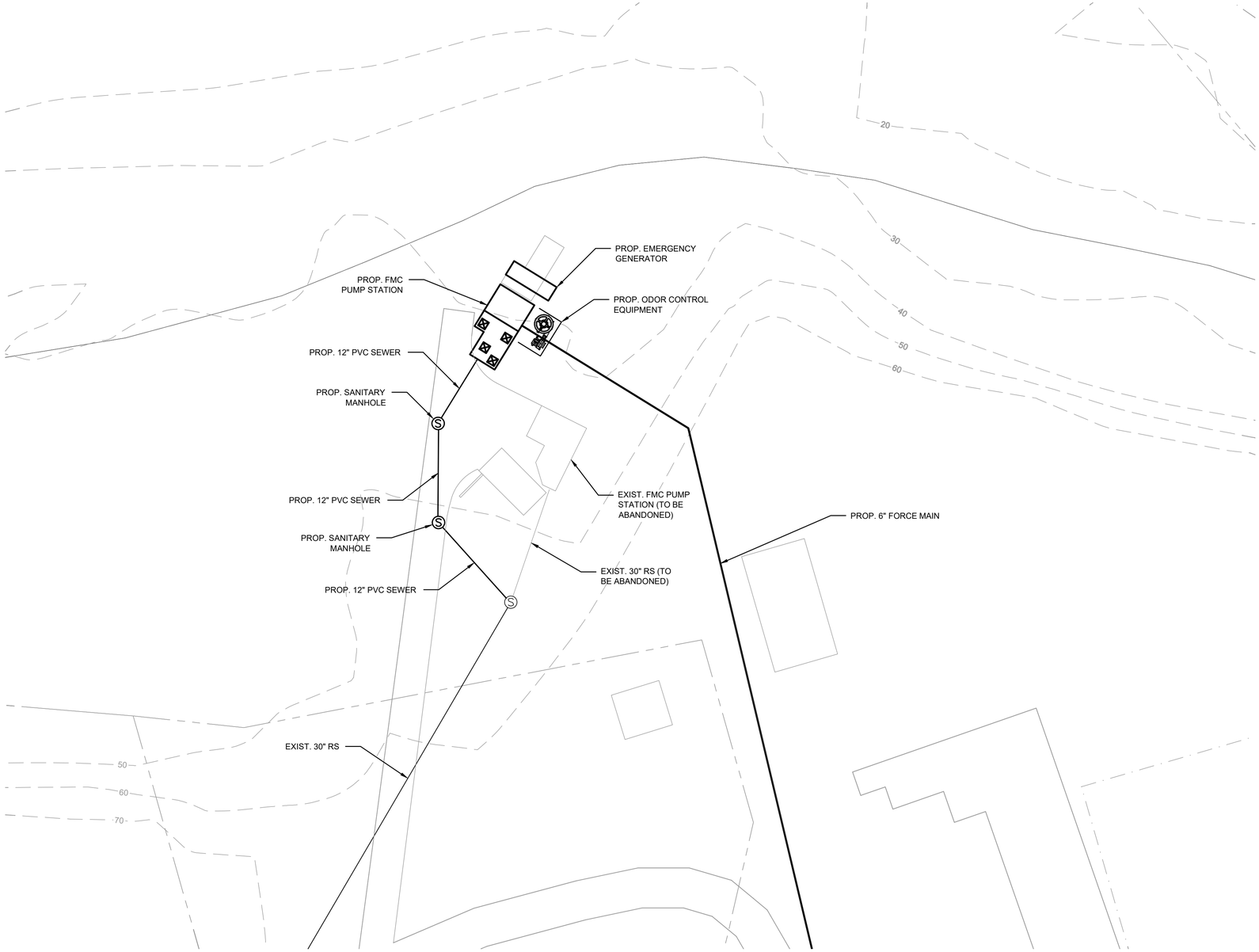

TRUE NORTH

SITE PLAN

1"=30'

1' 0 1'

PRELIMINARY
NOT FOR CONSTRUCTION
DATE PRELIMISSUEDATE

IN CHARGE OF
DESIGNED BY
CHECKED BY
DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC

SPOTSYLVANIA COUNTY DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

CIVIL

PUMP STATION SITE PLAN

FILE NO. 5842.67353

DATE XX/XX/XX

C-001

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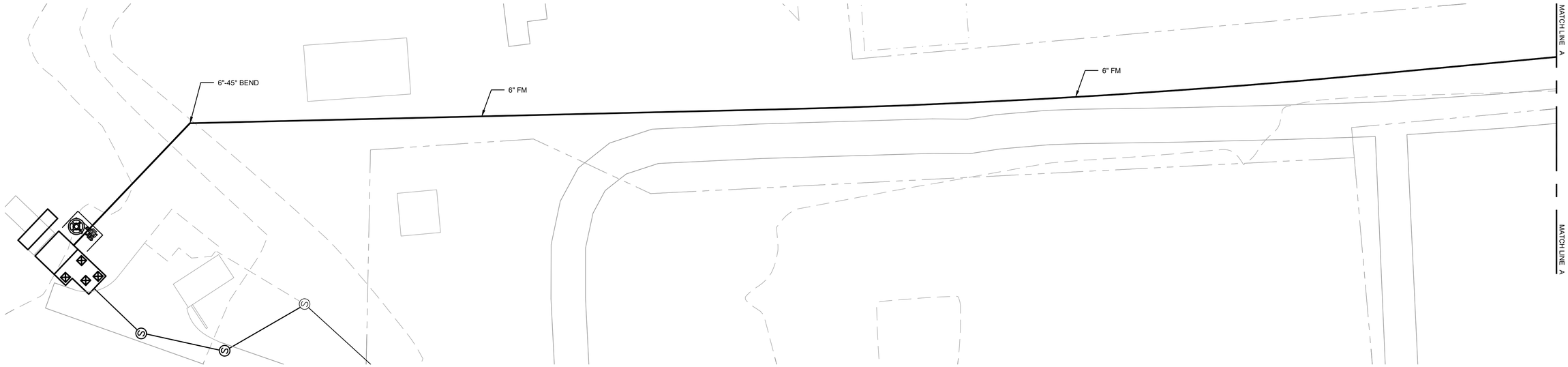
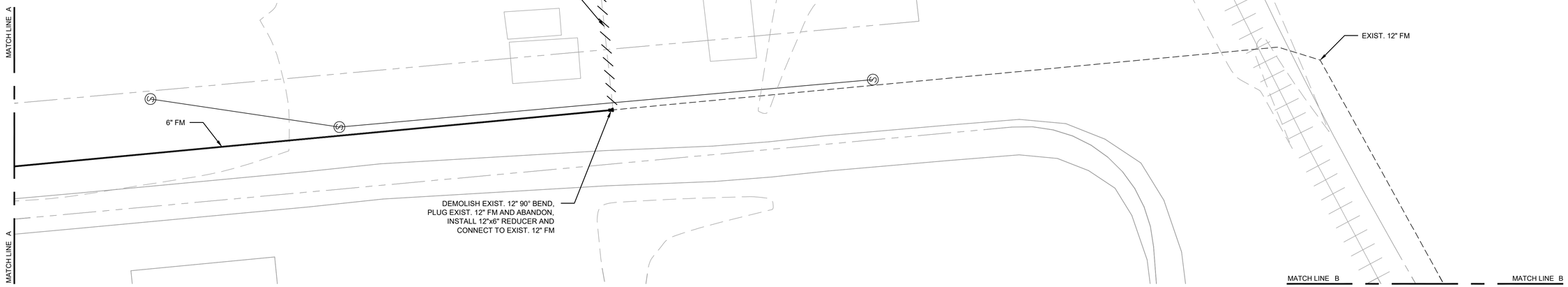


SITE PLAN

1"=30'



SITE PLAN

1"=30'

PRELIMINARY
NOT FOR CONSTRUCTION
DATE PRELIMISSUEDATE

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. DRAWING IS NOT SCALABLE WHEN NO SCALE BAR IS PRESENT.

IN CHARGE OF
DESIGNED BY
CHECKED BY
DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC

SPOTSYLVANIA COUNTY DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

CIVIL

PROPOSED FORCE MAIN
STA. 0+00 TO STA. X+XX

FILE NO. 5842.67353

DATE XX/XX/XX

C-002

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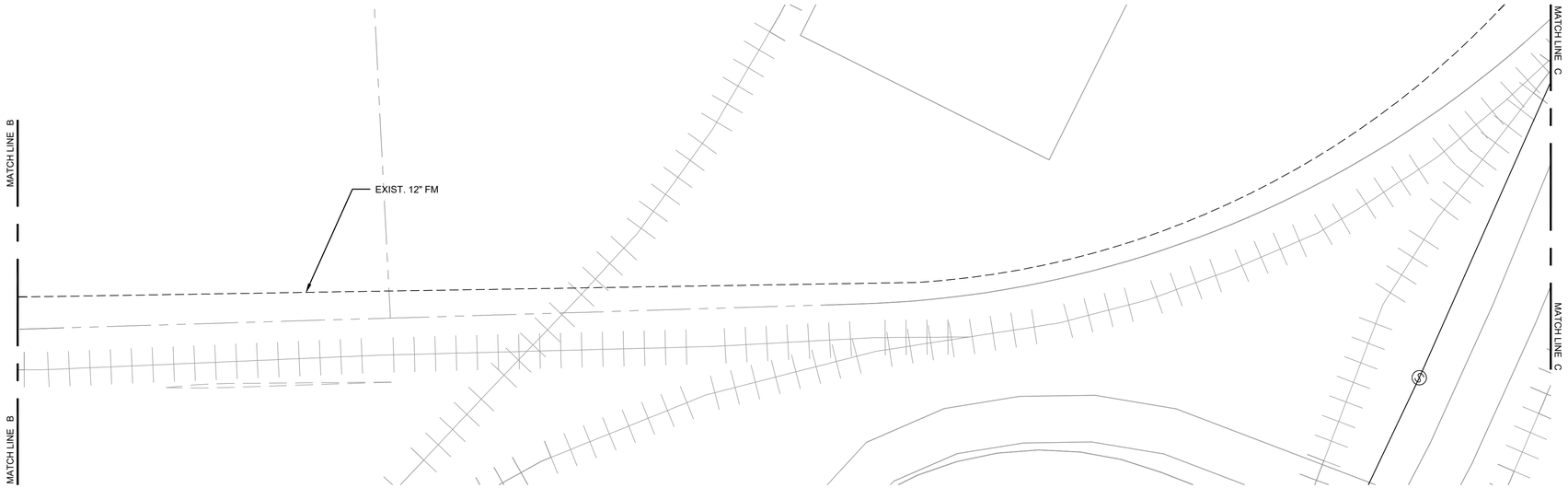
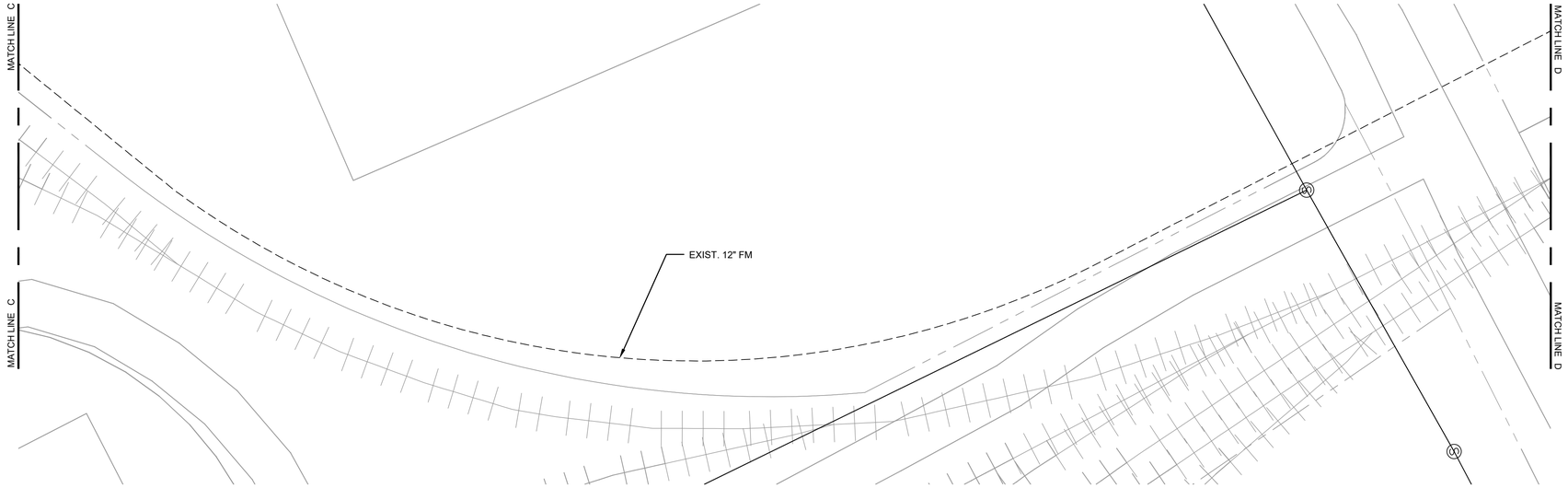


TRUE NORTH

SITE PLAN

1"=30' 1' 0 1'



TRUE NORTH

SITE PLAN

1"=30' 1' 0 1'

PRELIMINARY
NOT FOR
CONSTRUCTION

DATE PRELIMISSUEDATE

IN CHARGE OF

DESIGNED BY

CHECKED BY

DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC

SPOTSYLVANIA COUNTY DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

CIVIL

PROPOSED FORCE MAIN STA. X+XX TO STA. X+XX

FILE NO. 5842.67353

DATE XX/XX/XX

C-003

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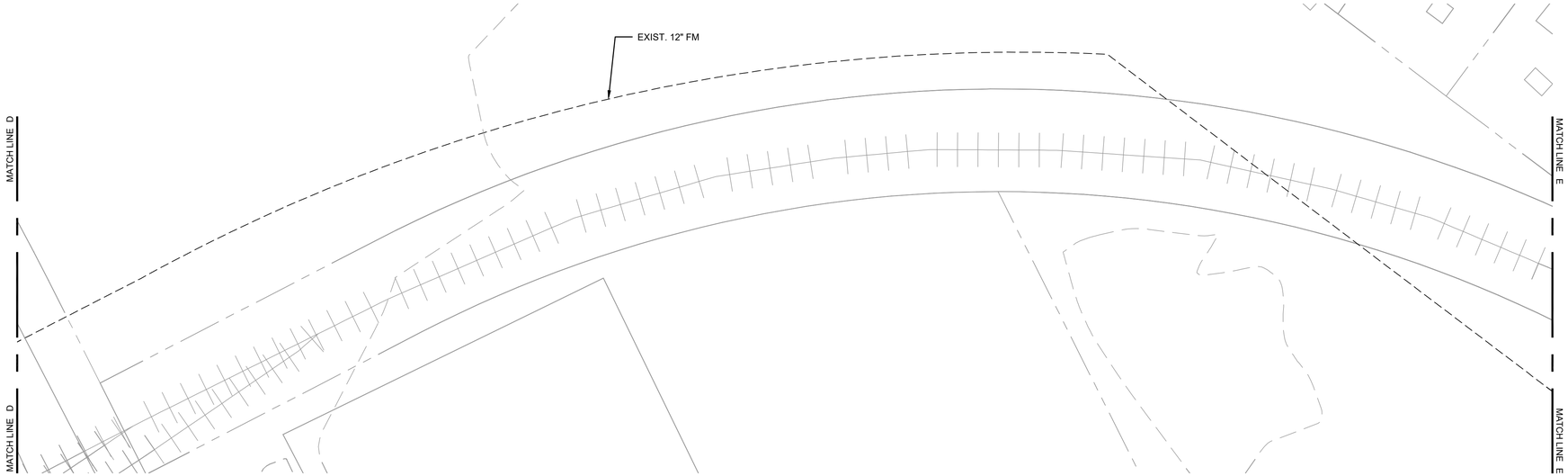
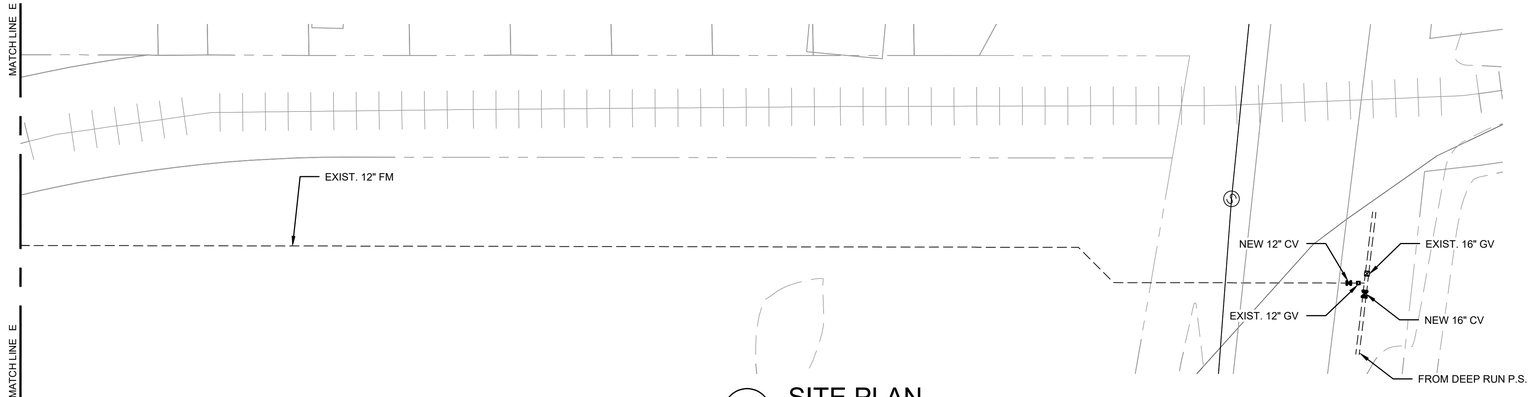


TRUE NORTH

SITE PLAN

1"=30'

1' 0 1'



TRUE NORTH

SITE PLAN

1"=30'

1' 0 1'

PRELIMINARY
NOT FOR
CONSTRUCTION

DATE:PRELIMISSUEDATE

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. DRAWING IS NOT SCALABLE WHEN NO SCALE BAR IS PRESENT.

IN CHARGE OF

DESIGNED BY

CHECKED BY

DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC

SPOTSYLVANIA COUNTY DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

CIVIL

PROPOSED FORCE MAIN STA. X+XX TO STA. X+XX

FILE NO. 5842.67353

DATE XX/XX/XX

C-004

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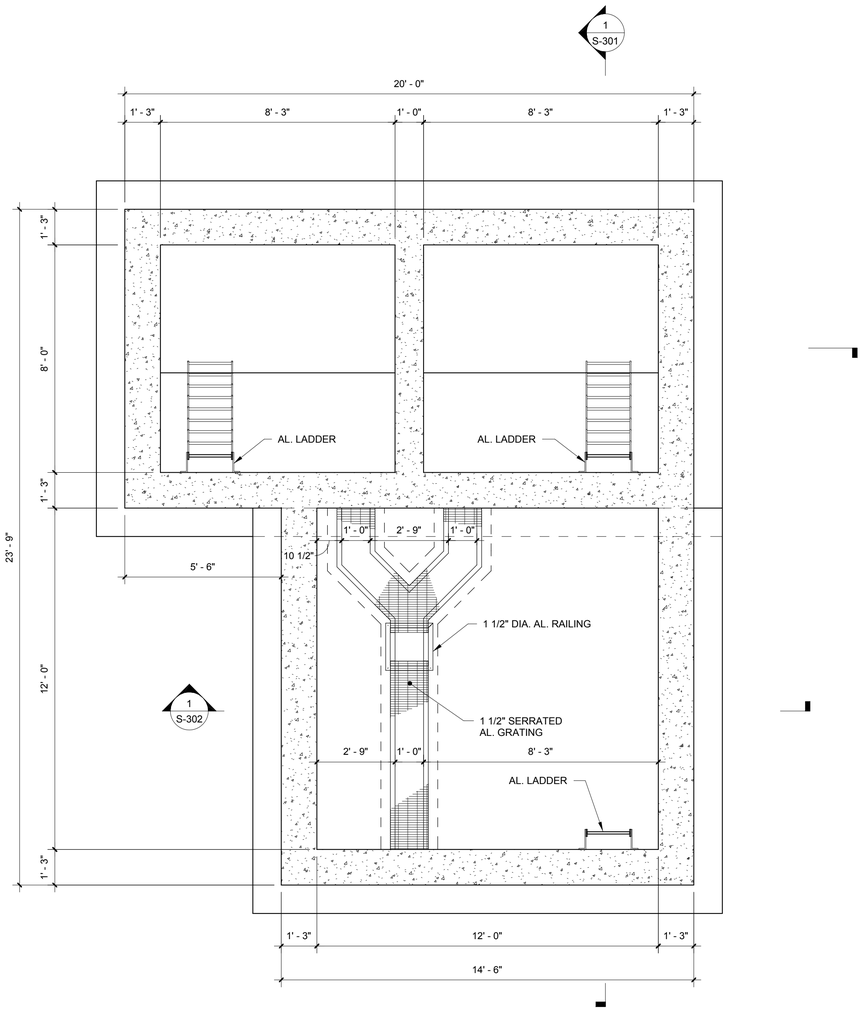
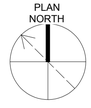
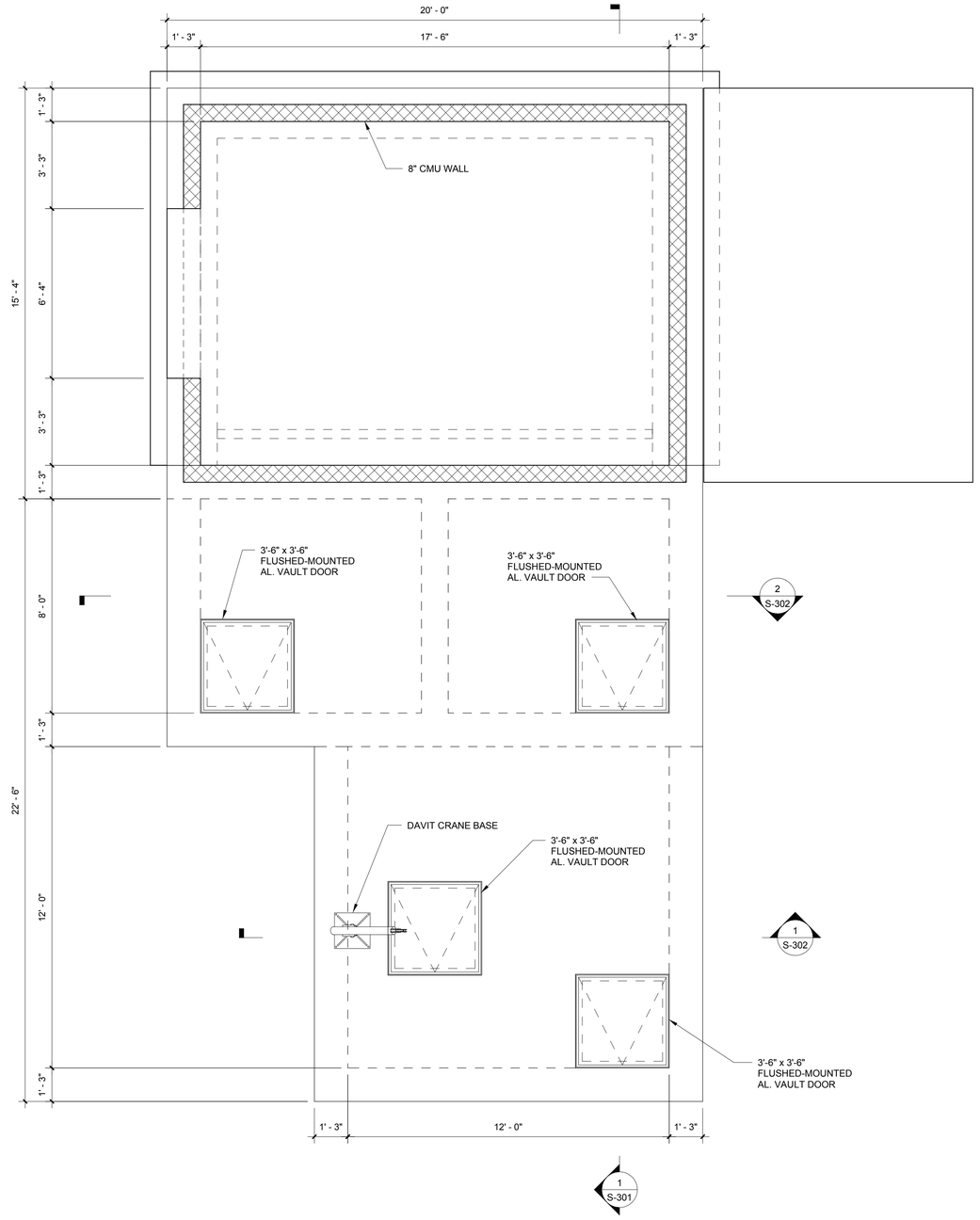


PLAN AT EL. 43'-0"

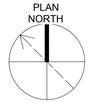
3/8" = 1'-0"





PLAN AT EL. 50'-0"

3/8" = 1'-0"



PRELIMINARY
NOT FOR
CONSTRUCTION

DATE: 6/11/2018

IN CHARGE OF	L. WOODS		
DESIGNED BY	L. BYRNE		
CHECKED BY	T. KIVISTO		
DRAWN BY	R. EGAN		

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

STRUCTURAL

PLANS

FILE NO. 5842.67353

DATE

S-101

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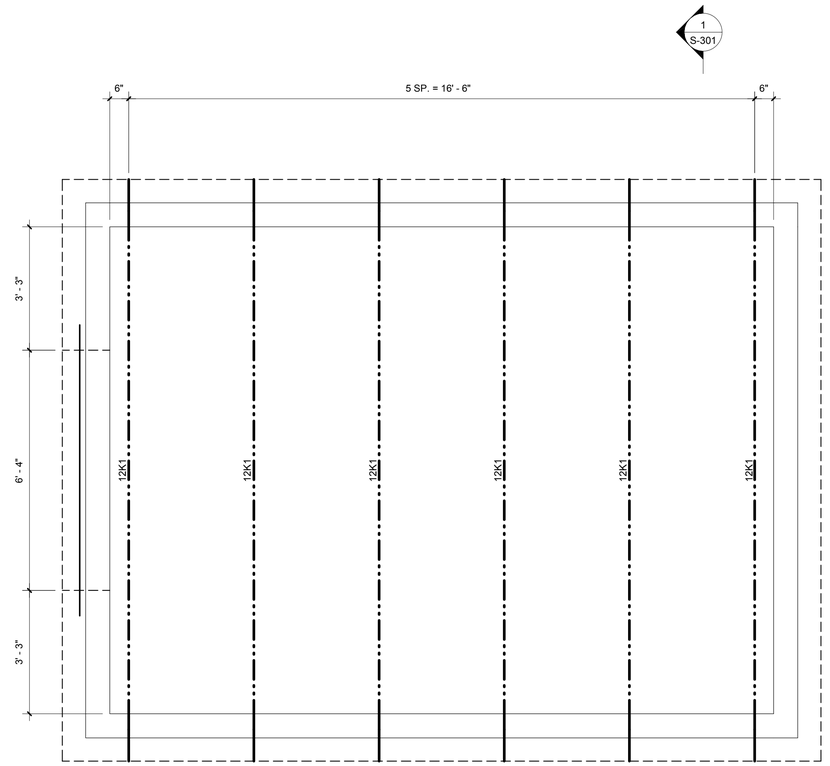

ROOF FRAMING PLAN

1/2" = 1'-0"

2' 1' 0 1' 2'

PLAN NORTH

PRELIMINARY
NOT FOR CONSTRUCTION
DATE: 6/11/2018

IN CHARGE OF L. WOODS
DESIGNED BY L. BYRNE
CHECKED BY T. KIVISTO
DRAWN BY R. EGAN

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

STRUCTURAL

ROOF FRAMING PLAN

FILE NO. 5842.67353
DATE

S-102

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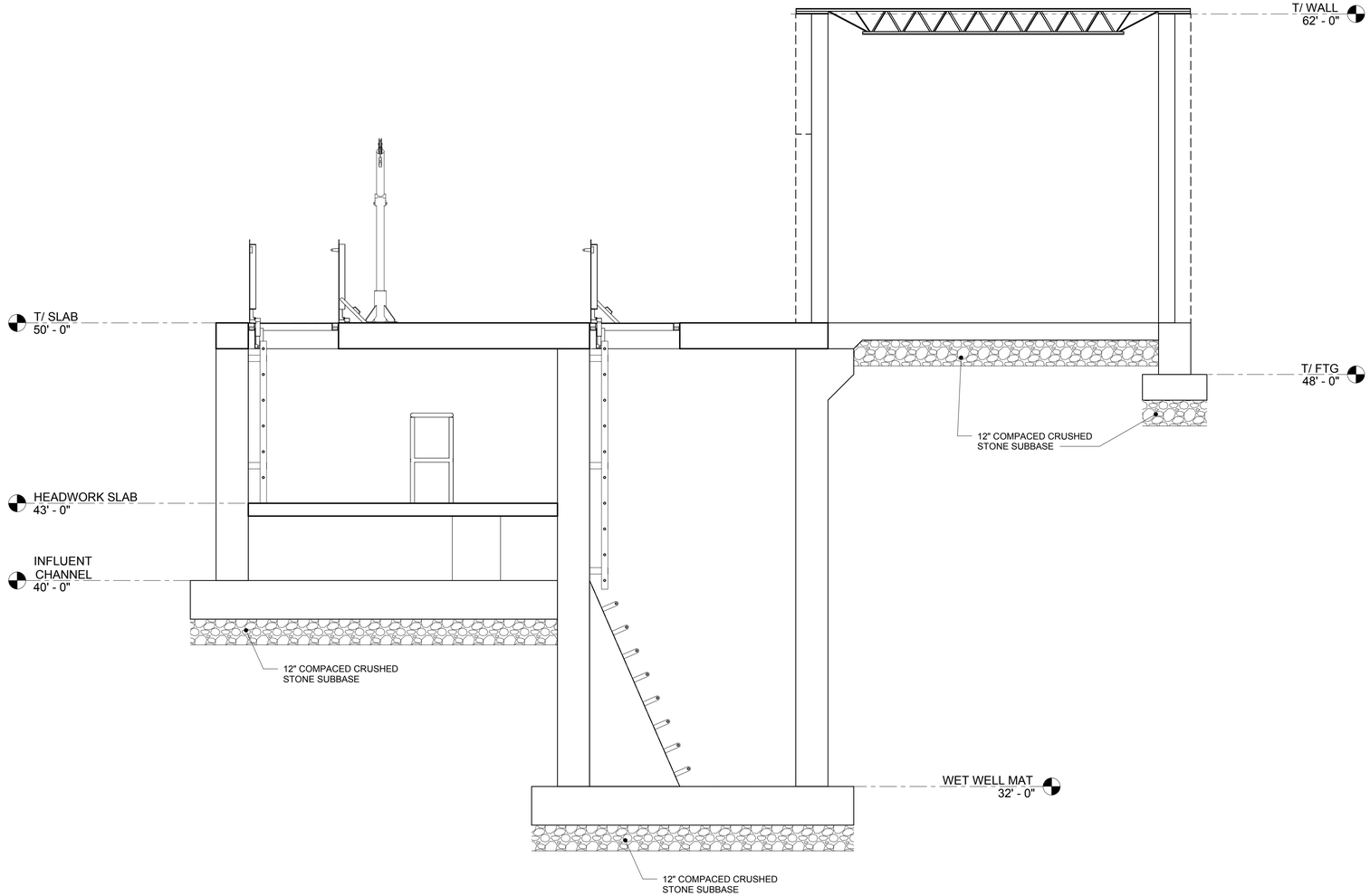


1 SECTION
3/8" = 1'-0"
3' 2' 1' 0 1' 2' 3'

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 6/11/2018

IN CHARGE OF L. WOODS
DESIGNED BY L. BYRNE
CHECKED BY T. KIVISTO
DRAWN BY R. EGAN

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

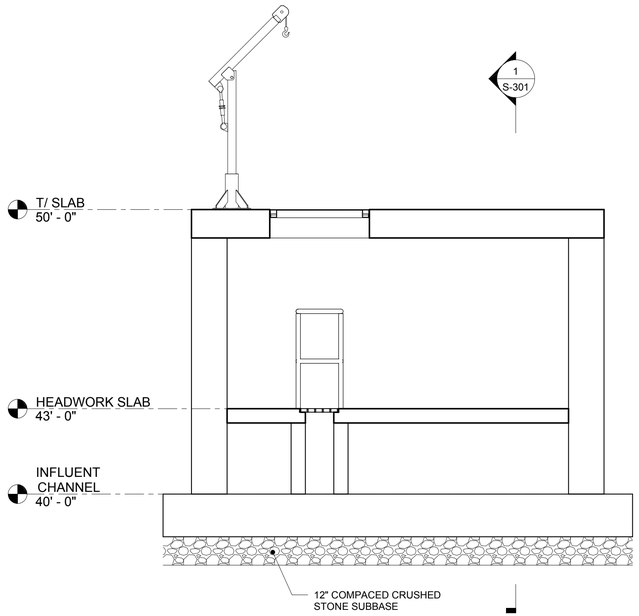
SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

STRUCTURAL

SECTION

FILE NO. 5842.67353
DATE

S-301



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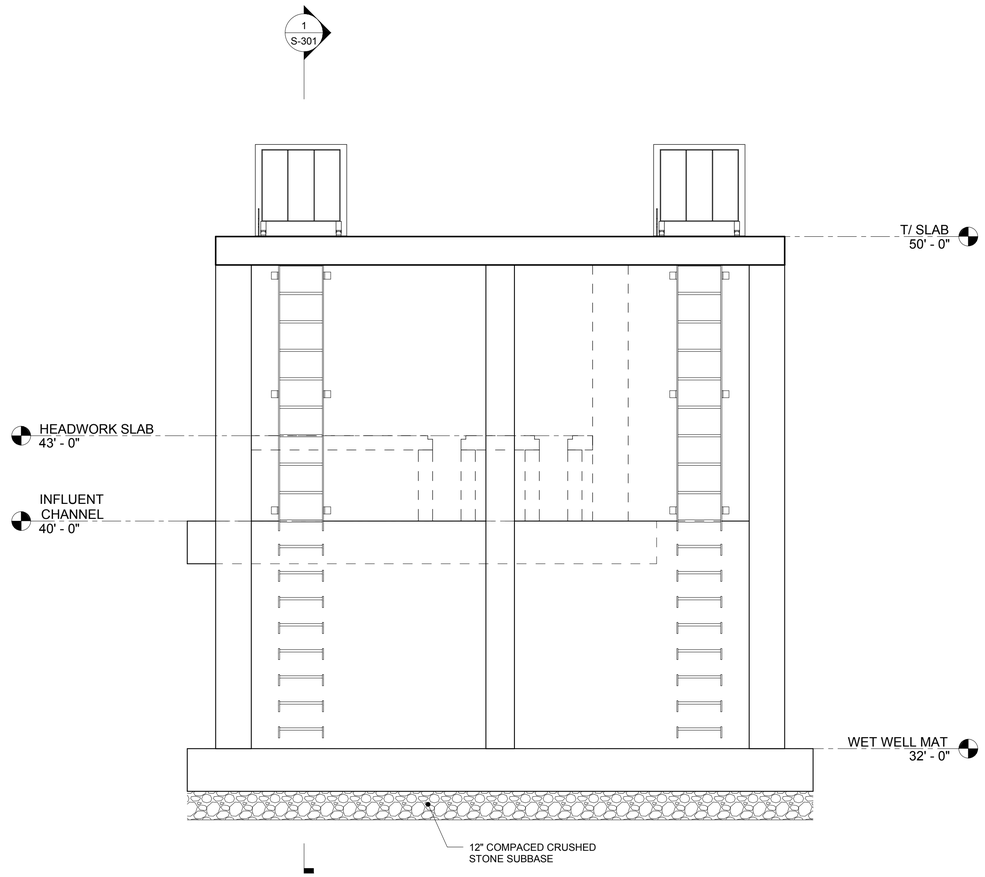
3' 2' 1' 0 1' 2' 3'



2 SECTION
3/8" = 1'-0"
3' 2' 1' 0 1' 2' 3'

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 6/11/2018

IN CHARGE OF	L. WOODS
DESIGNED BY	L. BYRNE
CHECKED BY	T. KIVISTO
DRAWN BY	R. EGAN

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

STRUCTURAL

SECTIONS

FILE NO. 5842.67353

DATE

S-302

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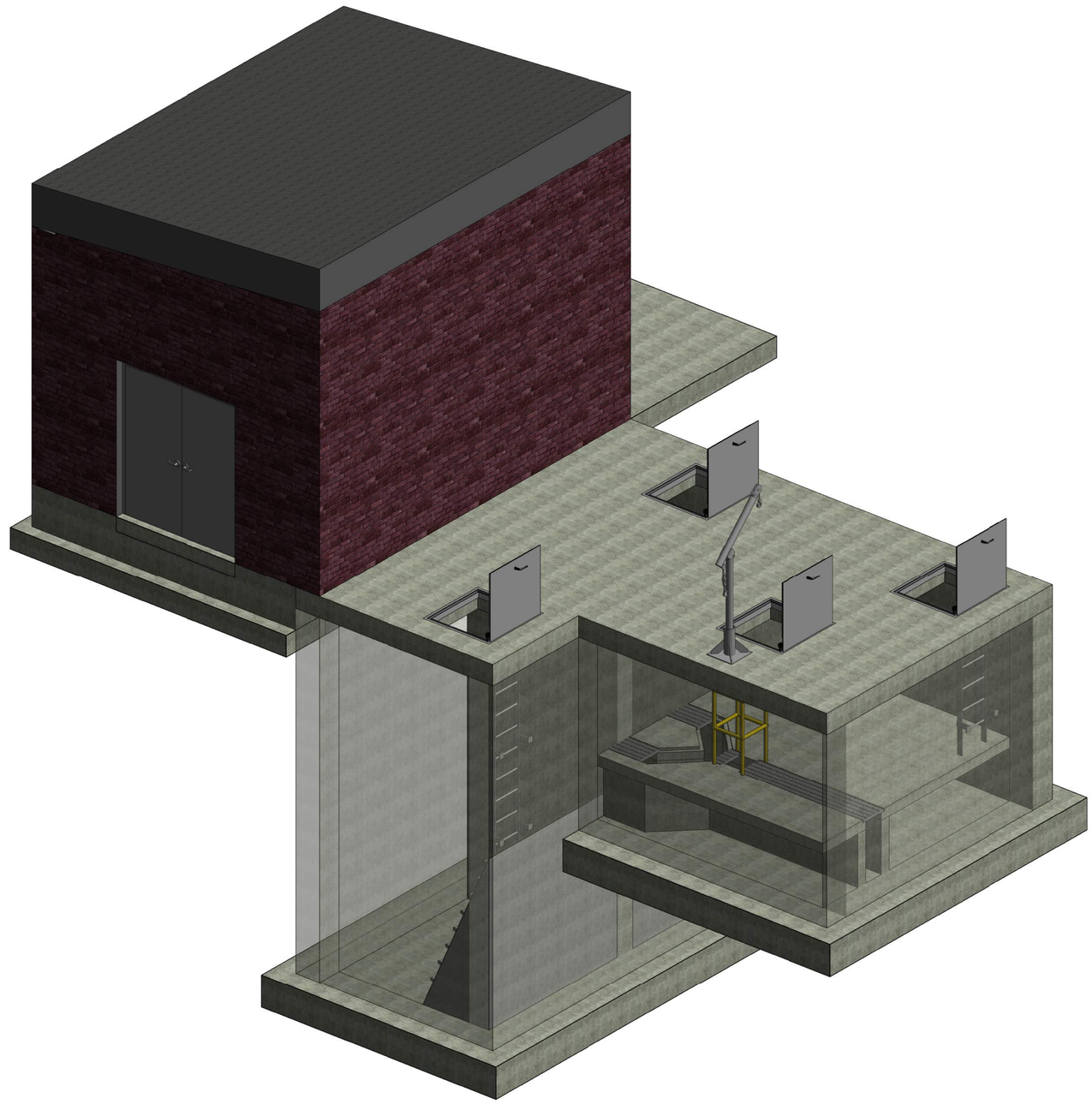

3D VIEW
NOT TO SCALE

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 6/11/2018

IN CHARGE OF L. WOODS
DESIGNED BY [Enter Name]
CHECKED BY T. KIVISTO
DRAWN BY R. EGAN

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

STRUCTURAL

3D REPRESENTATIONS

FILE NO. 5842.67353
DATE

S-901

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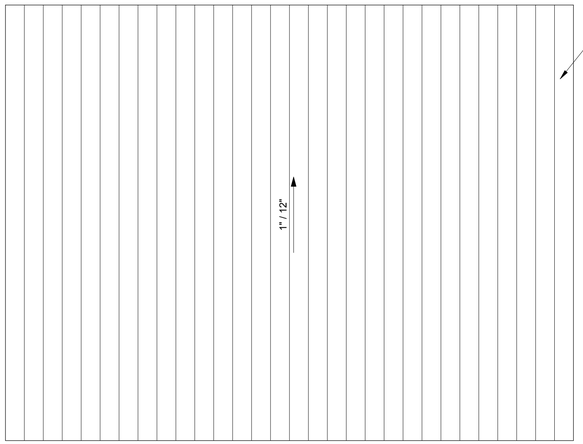
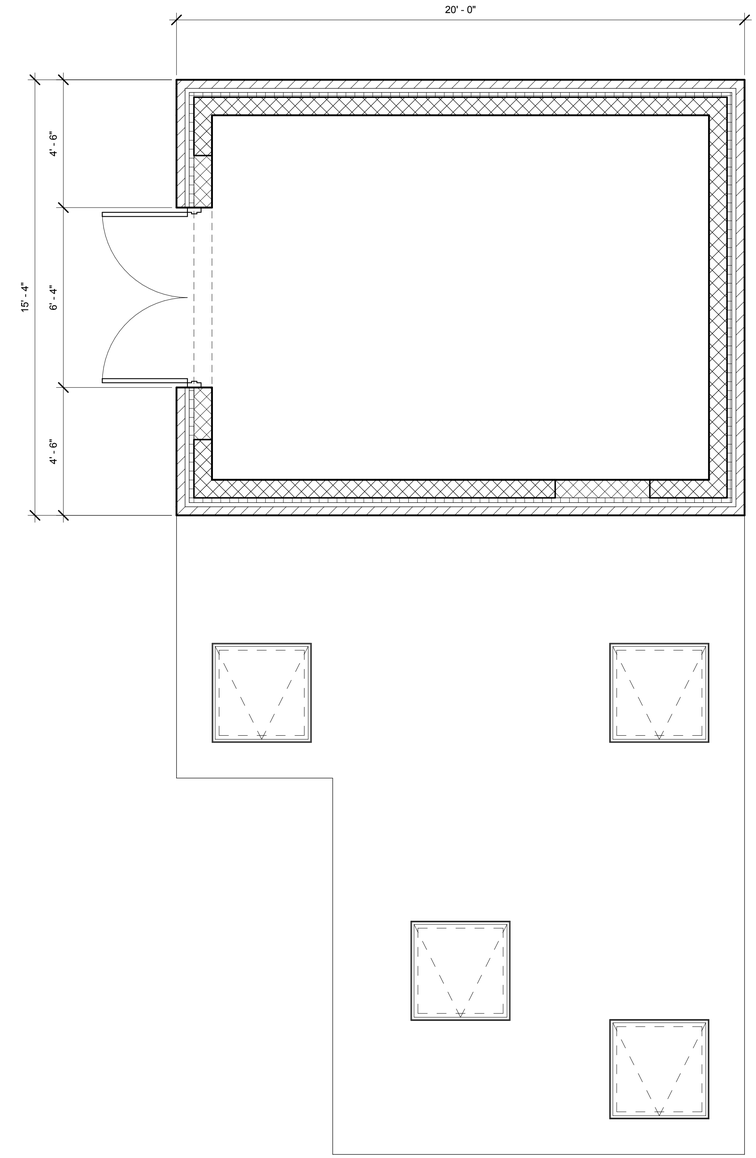


ROOF PLAN

3/8" = 1'-0"

3' 2' 1' 0 1' 2' 3'



FLOOR PLAN

3/8" = 1'-0"

3' 2' 1' 0 1' 2' 3'

PLAN NORTH

PRELIMINARY
NOT FOR
CONSTRUCTION

DATE:

IN CHARGE OF	L. WOODS
DESIGNED BY	B. TAYLOR
CHECKED BY	W. COTTER
DRAWN BY	B. TAYLOR

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VA

ARCHITECTURAL

FLOOR PLAN

FILE NO. 5842.67353

DATE

B-101

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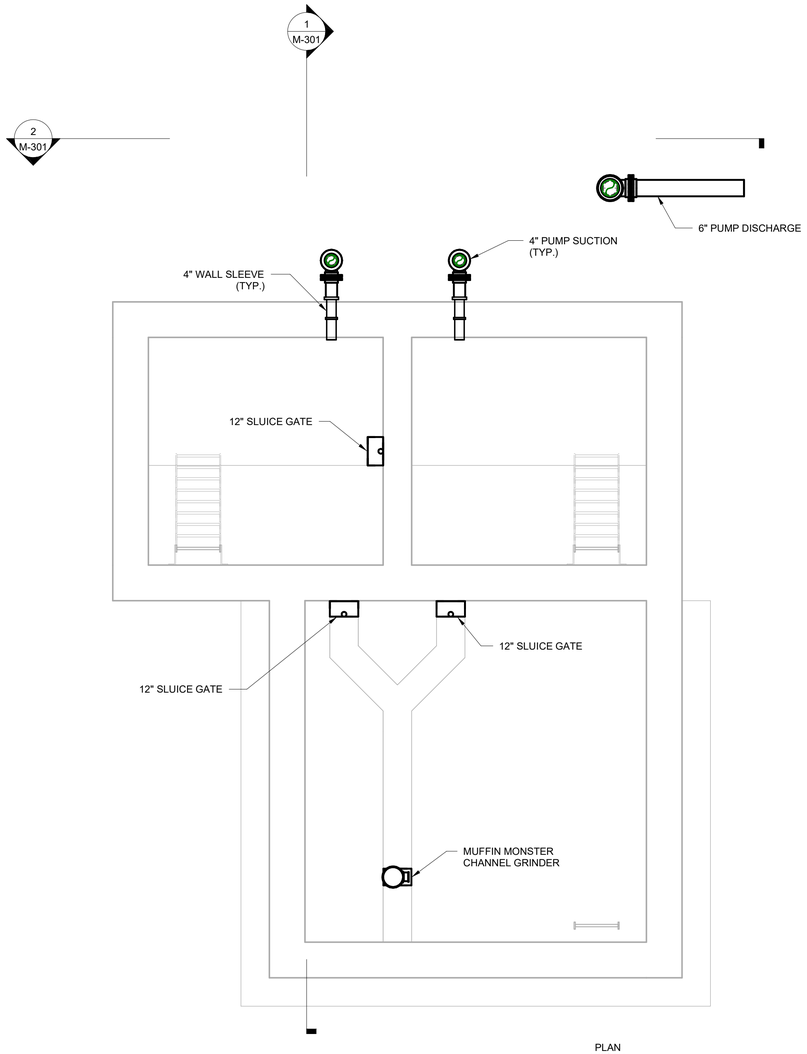
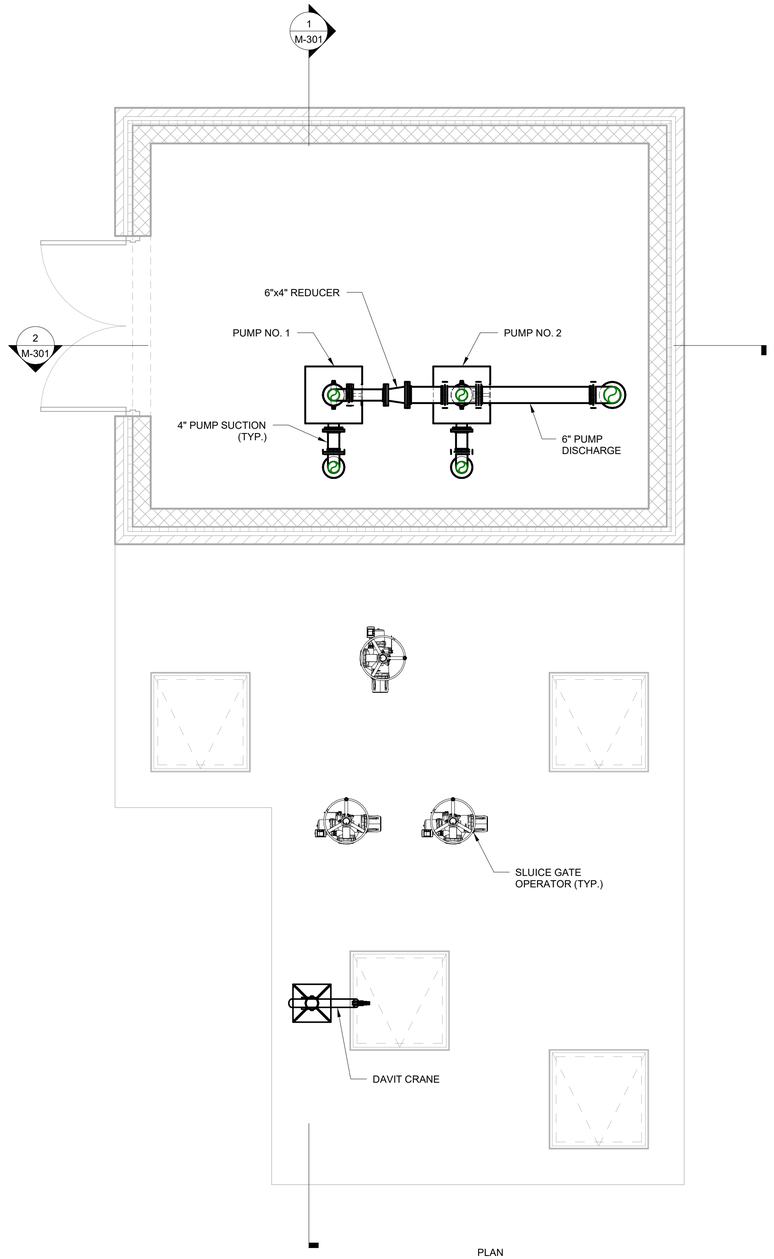


PLAN AT EL. 43'-0"

3/8" = 1'-0"



PLAN AT EL. 50'-0"

3/8" = 1'-0"

PRELIMINARY
NOT FOR
CONSTRUCTION

DATE:

IN CHARGE OF RJD
DESIGNED BY IK
CHECKED BY IK
DRAWN BY RPW

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

MECHANICAL

FLOOR PLANS

FILE NO. 5842.67353

DATE

M-101

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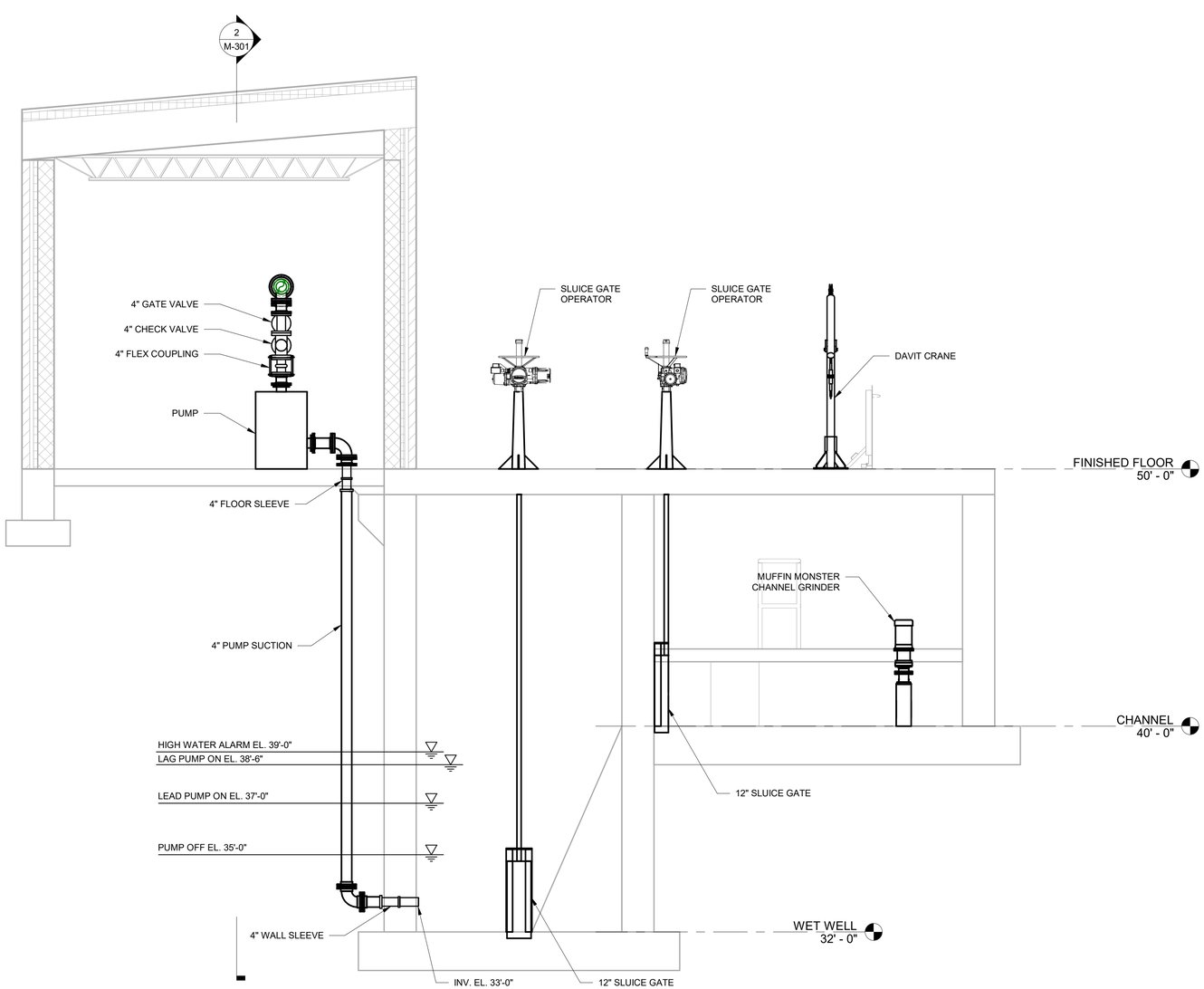

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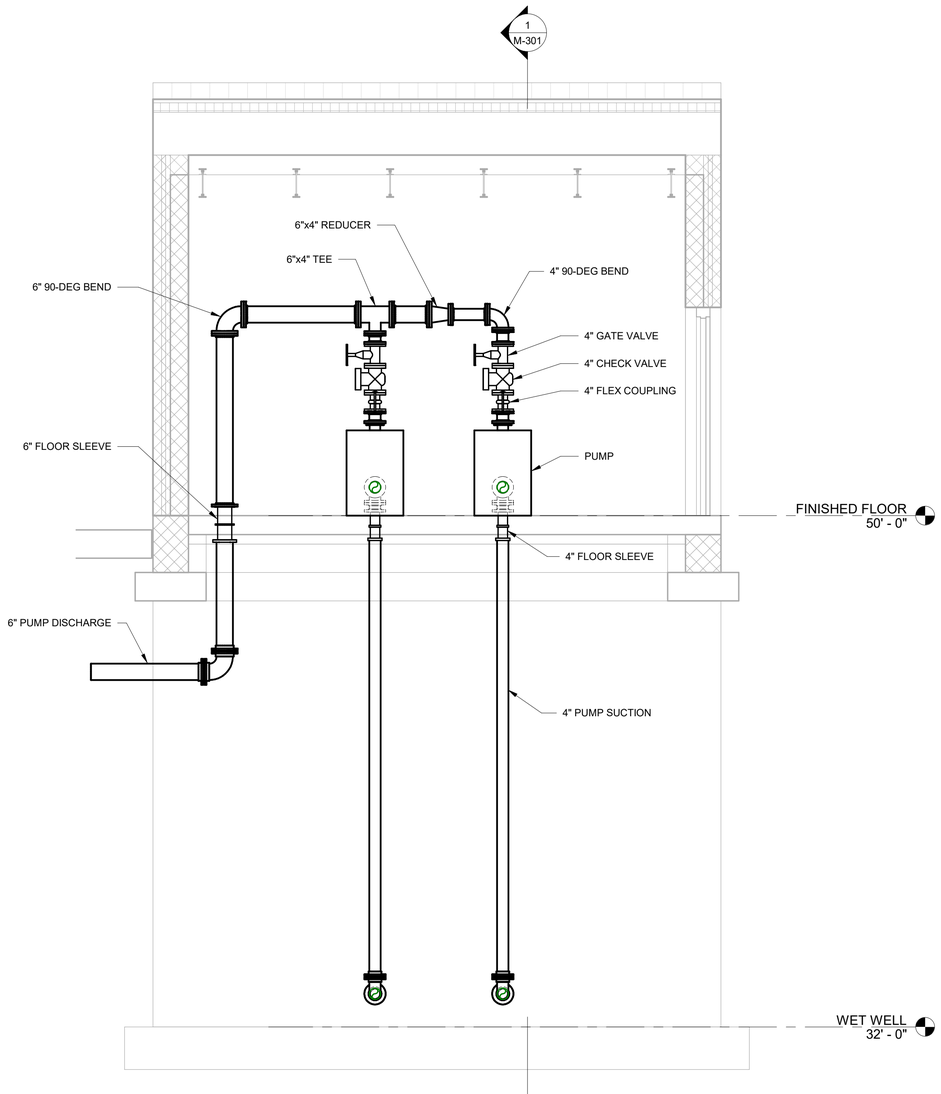
3/8" = 1'-0"



2 SECTION
3/8" = 1'-0"

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE:

IN CHARGE OF RJD
DESIGNED BY IK
CHECKED BY IK
DRAWN BY RPW

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC.

SPOTSYLVANIA COUNTY, DEPARTMENT OF UTILITIES
FMC WWTP DECOMMISSIONING AND RELATED UPGRADES
FREDERICKSBURG, VIRGINIA

MECHANICAL

SECTIONS

FILE NO. 5842.67353
DATE

M-301

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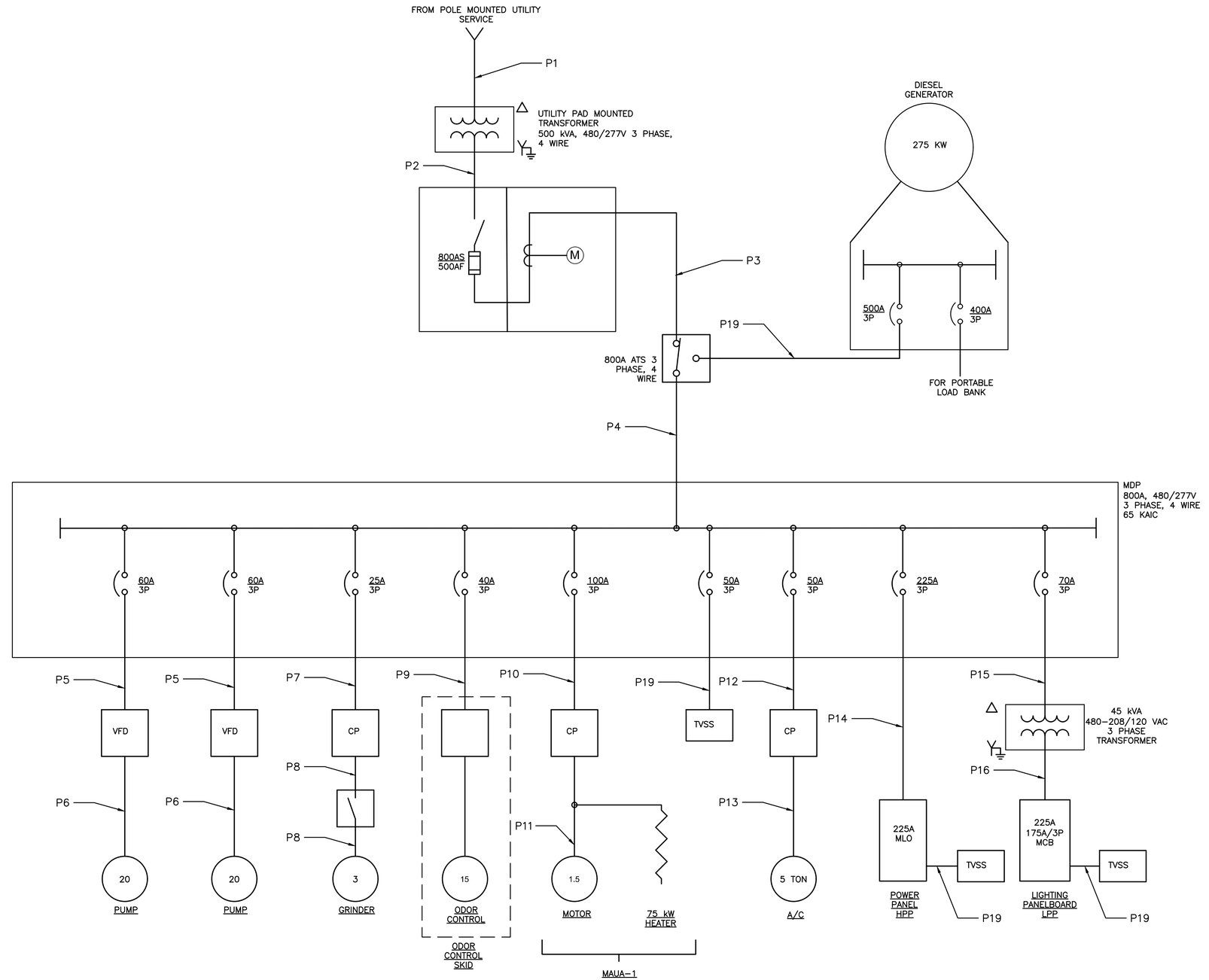


IN CHARGE OF	J. DOMANSKI
DESIGNED BY	J. DOMANSKI
CHECKED BY	J. DOMANSKI
DRAWN BY	J. LAGOY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC
SYRACUSE, NEW YORK

SPOTSYLVANIA COUNTY
FMC DECOMMISSIONING AND FMC PUMP STATION
PRELIMINARY ENGINEERING REPORT
FREDERICKSBURG, VIRGINIA

ELECTRICAL

ONE-LINE DIAGRAM

FILE NO. 5842.67353-E101

DATE JUNE 11, 2018

E-101

POWER - CONDUCTOR AND CONDUIT SCHEDULE					
DESIGNATION	FROM	TO	CONDUIT SIZE	CONDUCTORS QTY/SIZE	REMARKS
P1	UTILITY RISER POLE	UTILITY 500 KVA PAD MOUNTED TRANSFORMER	2 SETS 4"	UTILITY PROVIDED	PROVIDE NYLON PULL STRING IN EACH CONDUIT
P2	UTILITY 500 KVA PAD MOUNTED TRANSFORMER	MAIN SWITCH MS-1	2 SETS 4"	4# 350MCM, 1 #1G, PER CONDUIT	
P3	MAIN SWITCH MS-1	ATS	2 SETS 4"	4# 350MCM, 1# 1G, PER CONDUIT	-
P4	ATS	SWITCHBOARD MDP	2 SETS 4"	4# 350MCM, 1#1G, PER CONDUIT	
P5	SWITCHBOARD MDP	20 HP PUMP VFD	3/4"	3# 8, 1# 10G	
P6	20 HP PUMP VFD	20 HP PUMP VFD	3/4"	3# 8, 1# 10G	-
P7	SWITCHBOARD MDP	3 HP GRINDER CONTROLLER	3/4"	3# 12, 1# 12G	-
P8	3 HP GRINDER CONTROLLER	3 HP GRINDER	3/4"	3# 12, 1# 12G	-
P9	SWITCHBOARD MDP	ODOR CONTROL SYSTEM CONTROL PANEL	3/4"	3# 10, 1# 10G	-
P10	SWITCHBOARD MDP	MAHU-1 CONTROL PANEL	2"	3# 1/0, 1# 6G	-
P11	MAHU-1 CONTROL PANEL	MAHU-1 CONTROL	2"	3# 1/0, 1# 6G	-
P12	SWITCHBOARD MDP	AC CONTROL PANEL	3/4"	3# 6, 1# 10G	-
P13	AC CONTROL PANEL	AC UNIT	3/4"	3# 6, 1# 10G	
P14	SWITCHBOARD MDP	PANEL HPP	2-1/2"	4# 4/0, 1# 4G	
P15	SWITCHBOARD MDP	45 KVA TRANSFORMER	1-1/2"	3# 4, 1# 8G	
P16	45 KVA TRANSFORMER	PANEL LPP	2"	4# 2/0, 1# 6G	
P17	GENERATOR	ATS	4 SETS 4"	4# 500MCM, 1#4/0G, PER CONDUIT	
P18	METERING SECTION OF MAIN SWITCH	METER SOCKET	1"	COORDINATE WITH UTILITY	LOCATE METER SOCKET ON EXTERIOR OF BUILDING
P19	METERING SECTION OF MAIN SWITCH	TVSS EQUIPMENT	1-1/2"	4-#4, 1-#10 GRD	

IN CHARGE OF J. DOMANSKI
DESIGNED BY J. DOMANSKI
CHECKED BY J. DOMANSKI
DRAWN BY J. LAGOY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC
SYRACUSE, NEW YORK

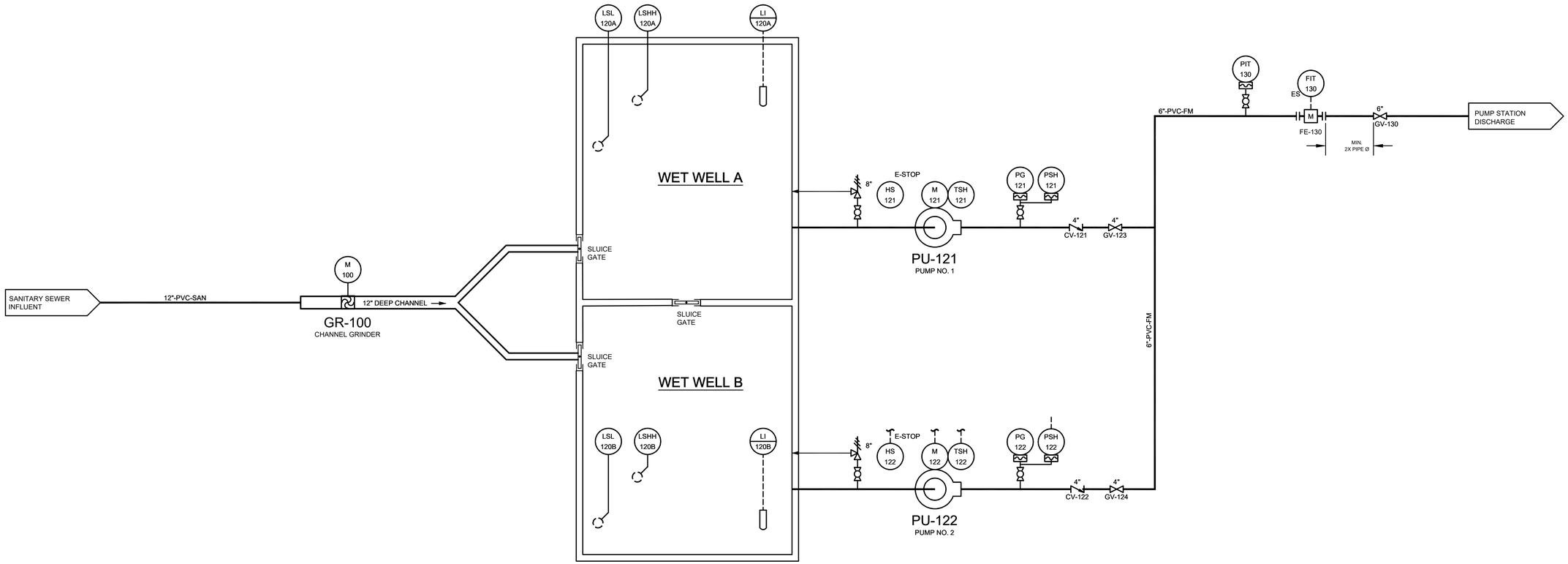
SPOTSYLVANIA COUNTY
FMC DECOMMISSIONING AND FMC PUMP STATION
PRELIMINARY ENGINEERING REPORT
FREDERICKSBURG, VIRGINIA

ELECTRICAL

CONDUIT & CONDUCTOR SCHEDULE

FILE NO. 5842.67353-E102
DATE JUNE 11, 2018

E-102



PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 6/11/2018

IN CHARGE OF
DESIGNED BY
CHECKED BY
DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC
BOWIE, MD

SPOTSYLVANIA COUNTY
FMC DECOMMISSIONING & FMC PUMP STATION
PRELIMINARY ENGINEERING REPORT
FREDERICKSBURG, VIRGINIA

INSTRUMENTATION

PFD - PUMPING STATION

FILE NO. 5842.67353
DATE XX/XX/XX

FIG-1