



Alexandria Renew Nutrient Management Facility

Clark Foundations, LLC is the winner of the PDCA Project of the Year Award in the category of Land – Greater than \$5 Million

By Eric Fulton, Clark Foundations LLC

Alexandria Renew Enterprises (AlexRenew) serves approximately 350,000 people in Northern Virginia by processing more than 13 billion gallons of wastewater every year at its 35-acre facility in Alexandria, Va. As part of AlexRenew's State-of-the-Art Nutrient Upgrade Project, the organization is building a Nutrient Management Facility (NMF) to reduce the amount of nitrogen in water that's discharged through local waterways into the Chesapeake Bay.

The NMF includes an 18-million-gallon capacity concrete tank extending 30 to 50 feet below existing grade. The below-grade structure will be topped by an artificial turf playing surface, adding value to the local community. Concurrent with the NMF, AlexRenew is constructing an environmental center/office building and elevated deck (to connect to future development) just north of the NMF.

The intensive foundation work required on this project demanded complex coordination, innovative construction planning and techniques, extensive cost-saving value engineering measures, seamless project management and creative solutions to construction problems.



Sheet pile installations along the west and north portions of the NMF project site showing the excavation progression and existing debris within the top layer of soils

Site conditions

The site was an unregulated post-Civil War landfill. The overall existing site grade was low elevation, requiring an extensive support of excavation design that could be installed through the landfill debris and around the new deep foundation system.

Scope of work

Clark Foundations, LLC, was subcontracted to Clark Construction Group/Ulliman Schutte Construction (Clark/US), a joint venture construction manager at risk to design and install the support of excavation, dewatering system and deep foundations scope of work for the NMF project.

The support of excavation design was comprised of both internal and external components working in concert to achieve an overall water-tight excavation. The exterior design was continuously locked sheet piles that provided groundwater cutoff and allowed the use of traditional cantilevered soldier piles and timber lagging along the interior NMF wet wells and pipe gallery. This revised design was more efficient and economical. Both interior and exterior support of excavation systems included over 1,400 linear feet of driven cantilevered and braced sheet piles ranging between 50 and 65 feet deep, 55 drilled and pressure grouted tiebacks, 132 driven soldier piles and 8,300 sq. ft. of hardwood timber lagging.

The dewatering system scope of work included designing, installing and maintaining 24 deep wells, groundwater treatment, and localized sumping as needed to effectively dewater the project site without lowering the exterior groundwater elevation.

The deep foundations scope of work was divided between three main structures and consisted of 2,430 each 14-inch pre-cast concrete bearing piles manufactured by fellow PDCA member, Atlantic Metrocast, with capacities ranging between 100, 150 and 175 tons and lengths between 55 and 80 feet. More specifically, 1,942 piles were installed within the NMF tank structure including surrounding site utilities, a generator pad, culvert bridge and exhaust stack along with 231 piles within the New Environmental Center and 257 pile within the deck connector structures.

The deep foundation scope of work proved to be extremely difficult due to the high level of coordination with other trades working throughout the 20- to 50-foot bowl-shaped excavation/working bench. At any given time, all three locations were working concurrently.

The team also sought opportunities to implement cost-saving measures whenever possible. Most notably, Clark Foundations recommended pre-cast concrete bearing piles instead of the originally proposed steel H-piles.

Production

Installing the exterior sheet piles was complicated as the upper 20 feet of fill layer contained tires, concrete debris, contaminated soils and alternating layers of clay. The uncertainty of location and type of debris required crews to abruptly adjust and interchange ICE 28C and 44B vibratory and I30 single-acting diesel impact hammers to drive the sheet piles to the designed pile tip embedment.

Crews installed the sheet piles in a linear approach within quadrants and around the perimeter of the project footprint. Crews successfully sequenced the sheet pile template and driving operations with the initial slope cut and pre-trenching operations even though there were several issues with removal of obstructions and contaminated soils. Ultimately, crews installed the sheets plumb, properly locked and to the required embedment to achieve the groundwater cutoff within the project schedule duration.

Pile driving and installation

The NMF's counterclockwise-quadrant excavation required coordination within the deep foundation operations due to the extreme variance in subgrade elevation, proximity of excavation and size of equipment. Often, the proximity of adjacent driving and handling equipment needed a dynamic pile laydown plan and continuous alterations to benching. In some cases, crews would revert to storing the piles outside of the excavation and lower the precast piles into the excavation as needed due to site access. Even with the site access and differing elevations, the deep foundations crew was able to alternate between driving soldier piles and precast bearing piles as needed. Clark Foundations used three driving crews consisting of three driving rigs and three assist rigs (six total crawler cranes) working alongside the excavation operations, driven piles and sloping subgrade conditions to complete the 1,805 interior of the 1,942 total NMF piles and 132 soldier piles within the allotted scheduled duration.

Following the below-grade deep foundations scope of work, Clark Foundations began installing the remaining 137 exterior utility and bridge abutment piles adjacent to the NMF structure.



An active set of low hanging high-voltage distribution lines impeded the progression of the pile installation and forced the overall sequencing of the project to accelerate the installation of the utility piles prior to the removal of the distribution lines. Whereas these piles were planned to be installed at the completion of the below-grade NMF structure, Clark Foundations was required to pre-drill through the fill material and active tiebacks along the eastern active sheet pile cutoff wall. Through an extreme amount of planning, coordination and skill, Clark Foundations was able to perform this work without harm to the existing exterior support of excavation and safely near the high-voltage distribution lines.

Additional work

Clark Foundations was awarded scopes of work on AlexRenew's environmental center/office building and elevated deck connector as work on the below-grade NMF tank structure's piles ended.

Project Credits

Clark Foundations could not have performed this project as successfully as we did without the dedication and quality of service we received from our project partners and fellow PDCA Members:

- Atlantic Metrocast – Precast concrete piling
- Bayshore Concrete Products – Precast concrete piling
- Emeca-SPE \USA, LLC – Precast concrete pile splices
- Skyline Steel – Steel sheet pile and soldier beams
- International Construction Equipment – Vibratory and diesel impact hammers and leads
- Sunbelt Rentals – Hydraulic pile cutters
- D.W. Kozera, Inc. – PDA testing
- Mueser Rutledge Consulting Engineers – Geotechnical engineers, NMF Tank Structure
- ECS Mid-Atlantic – Geotechnical engineers, Environmental Center & Deck Connector

The team then began installing the combined 488 piles along the northern excavation. Of the 488 piles, approximately 150 piles had to be driven within six to 10 feet of an active 72-inch diameter sewer main supplying Alexandria Sanitation Authority campus. This required an extensive pre-drilling operation consisting of 3,700 linear feet of 12-inch diameter augured shafts and a significant amount of coordination. To add to the difficulty of the environmental center and connector piles, the overall site was located within the influence of the NMF's support of excavation and initial slope cutting operations. The pile driving crews had to install over 100 of the remaining 338 piles within the 20-foot slope cuts while maintaining the acceptable pile tolerance.

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The final scope of work included the pile cutoff operations. This proved to be very difficult. The sloping bottom of the tank structure and resulting varying subgrade elevations dictated multiple pile cutoff elevations throughout the proposed structure. Nevertheless, through the utilization of outstanding craftsmanship and quality control, the crews were able to provide accurate field engineering, resulting in correct layout and as-built survey for over 52 alternating sets of pile cutoff elevations scattered throughout the 2,430 piles.

Value engineering and cost savings

Throughout the initial phases of the AlexRenew NMF project, Clark Foundations provided value engineering alternatives to the original deep foundations and support of excavation designs. The team also sought opportunities to implement cost-saving measures whenever possible. Most notably, Clark Foundations recommended pre-cast concrete bearing piles instead of the originally proposed steel H-piles.

Prior to the award of the deep foundations' package, Clark Foundations performed a value engineering feasibility study that led to a pre-cast concrete pile deep foundations alternate. The proposed pre-cast concrete pile resulted in lower furnishing costs by decreasing the overall lead time, increasing material availability and potentially reducing the overall pile length throughout the project. Unlike the original H-piles design, the pre-cast concrete piles could be fabricated to the exact length requirements of the varying subgrade elevations with a maximum lead time of seven days, including shipping to the jobsite. By contrast, the overall quantity of the steel required in the original design would have required multiple suppliers, multiple splices and multiple mill rollings to meet the project schedule.

To solidify the pre-cast concrete pile alternate, Clark Foundations recommended performing a pile load test program that included statically and dynamically testing steel and pre-cast concrete piles to verify the recommended pile tip and potentially shorten the overall pile. Upon award and completion of this scope of work, Clark Foundations had dynamically tested 12 bearing piles – six pre-cast concrete and six steel piles.

Following the completion of the pile load testing program, the



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design alternative was submitted, accepted and incorporated into the design. Clark Foundation's pre-cast concrete pile alternative consisted of 1,942 pre-cast piles within the NMF tank portion of the project, driven to proposed depths ranging between of 55 and 80 feet. This alternative reduced the overall length of pile by more than 25 percent: from 152,000 linear feet to 111,463 linear feet.

Excellence in planning and innovative project management

The Clark Foundations team employed extensive planning, quality control and innovation to maintain the schedule during the pre-cast concrete pile installation. The initial design revisions corresponding to the cast-in-place to precast concrete structure and steel H-pile to pre-cast pile foundations system resulted in a tight production schedule that required extensive planning for pile procurement. The notice to proceed for the pre-cast concrete pile operation was provided prior to the completion of the below-grade excavation operations and required Clark Foundations to obtain piles quickly from the pile distributor to build stock for up to three continuous driving crews.

With up to three rigs driving at the peak, the project team had to perform daily updates to the pile ordering plans to ensure that the exact quantity was cast by Atlantic Metrocast and Bayshore Concrete Products seven days prior to the need and delivered on day seven to the site for each of the rigs to install. At any given day, one of three driving rigs could require six different piles lengths while only needing the one length the following day. The team continuously coordinated with the construction manager, county, field



Installation of pre-cast piles along the northern, western and southern portions of the project. This photo shows the completed excavation within the NMF deep gallery and the progression of the pile cutoff operations throughout. Additionally, this photo shows three driving and three assist rigs working together within the installed piles, excavation, pile cutoff operations and internal SOE operations.

crews, suppliers and local establishments to maintain the extensive amount of daily deliveries to facilitate approximately 30 to 40 piles a day at the peak of operations. To add to the difficulty in scheduling, piles 71 feet or greater required one truck per two piles to ship.

Despite all of the project's complexities and challenges, Clark Foundations maintained the NMF's overall schedule and through value engineering, innovative project management and great relationships with project partners, successfully delivered their scope of work efficiently, safely and with the highest level of craftsmanship. ▼



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