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## **ARTICLE 1 - PROJECT DESCRIPTION**

### **Scope of Work**

- 1.1 The work to be performed shall consist of the demolition and removal of existing troughs in the two northern basins (noted as “Clarifier No. 1” and “Clarifier No. 2” on Project Plans) of the Intermediate Clarifier at the Water Reclamation Facility of the Metropolitan Sewerage District of Buncombe County, North Carolina. The project shall generally consist of the furnishing of all services, supplies, materials and equipment, and performing of all labor for the demolition and disposal of existing flights and chain system, troughs and supports, as well as installation of flight and chain system (pre-ordered by MSD) and design, delivery, and installation of replacement troughs.
- 1.2 Underdeck equipment (flight and chain system) has been pre-ordered and will be supplied by MSD to the CONTRACTOR. Underdeck equipment is manufactured and supplied to MSD by Brentwood Industries. Details and specifications can be found at the end of this section.
- 1.3 Approximate trough quantities are as follows:  
12” W x 18” D\* troughs: 1,879.5 LF (626.5 LF per basin)  
24” W x 37” D\* troughs: 390 LF (130 LF per basin[HC1])

\*Depths are taken from approximate top of weir plate.

Existing steel I-beam supports and FRP baffles will remain in place.

CONTRACTOR shall be responsible for field-verifying dimensions and locations of individual[SA2] troughs prior to ordering materials. LIDAR scan or traditional survey is suggested to ensure highest accuracy and best fit of new troughs[SA3].

- 1.3 The work shall be performed under lump sum price contract, and shall consist of furnishing all materials, supplies, and equipment; performing all labor and services incidental to or necessary for the completion of the project in accordance with the Plans and Specifications; and maintenance of each completed portion of the work until final acceptance of the entire project by the DISTRICT, unless otherwise approved by the ENGINEER. Project shall be awarded based on lowest bid price.
- 1.4 Effluent trough MANUFACTURER shall warrantee the fiberglass reinforced troughs to be free of defects in materials and workmanship for a minimum of two (2) years after installation under normal use, operation, and service.

In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide a replacement part without cost to the Owner. The contractor shall provide, without cost, such labor as may be required to replace, repair or modify all materials and equipment

provided pursuant to this specification.

## **ARTICLE 2 - PHYSICAL CONDITIONS/CONTRACT PLANS**

- 2.1 **Site Conditions.** MSD Plant Operations staff shall be responsible for draining and initial washdown of the basins. Some residual clarifier sludge may be present in the bottom of the basins.

- 2.2 **Coordination with MSD Staff**

The CONTRACTOR shall coordinate with MSD Plant Operations staff regarding the timing of the project, including draining and filling of the clarifier basins. MSD Plant Operations staff will be responsible for draining and an initial washdown of the basin, which generally takes 48 hours. **The CONTRACTOR shall complete work in one basin prior to beginning work in the next basin to maximize the flow capacity of the Intermediate Clarifiers.**

- 2.3 **Contract Plans.** The work shall be performed in accordance with these specifications and contract plans, which are incorporated herein as part of the contract and which are identified by the following numbers and titles:

| <u>Sheet No.</u> | <u>Description</u>                                   |
|------------------|------------------------------------------------------|
| PL-1             | Effluent troughs - plan and detailed sectional views |
| PL-2             | Effluent troughs – Elevations and details            |
| D-1              | Existing Trough as-builts                            |
| D-2              | Existing Trough as-builts                            |
| D-3              | Existing Trough as-builts                            |

## **ARTICLE 3 - PROJECT COORDINATION**

- 3.1 **Intent of Plans and Specifications**

The intent of the Plans and Specifications is to prescribe a complete work that the CONTRACTOR undertakes to do in full compliance with the Contract. The CONTRACTOR shall do all work as provided in the Plans and Specifications and other parts of the Contract and shall do such additional, extra, and incidental work as may be considered necessary to complete the work in a satisfactory and acceptable manner. Any work or material not shown on the Plans or described in the Specifications, but which may be fairly implied as included in any item of the Contract, shall be performed and/or furnished by the CONTRACTOR without additional charge, therefore. The CONTRACTOR shall furnish all labor, materials, tools, equipment, and incidentals necessary for the prosecution of the work.

- 3.2 **Interpretation of Estimate**

The quantities of the work and materials shown on the Proposal form or on the Plans are believed to approximately represent the work to be performed and materials to

be furnished and are to be used for comparison of bids. Payment to the CONTRACTOR will be made only for the actual quantities of work performed or materials furnished in accordance with the Plans and Specifications, and it is understood that the quantities may be increased or decreased as hereinafter provided without in any way invalidating the bid prices.

3.3 **Time of Completion**

The CONTRACTOR shall commence ordering of troughs on a date to be specified in a written Notice to Proceed from the DISTRICT. Final approved submittals are expected from the MANUFACTURER within ninety (90) calendar days of Notice to Proceed. [SA4] Delivery of the troughs for the first basin is expected within one hundred and eighty (180) calendar days of Notice to Proceed.[SA5][HC6]

All work to be performed on the project under this agreement shall be duly completed within **three hundred and sixty (360) consecutive calendar days** from Notice to Proceed.[SA7] Working times shall be normal MSD working hours, Monday through Friday, 8:00 a.m. – 4:30 p.m. No work is to be done on MSD holidays or weekends or outside of normal MSD working hours without prior approval of the Engineer and MSD Inspections Manager.

For each day in excess of the completion time limits specified above, the CONTRACTOR shall pay the DISTRICT the sum of Five Hundred Dollars (\$500.00) as liquidated damages reasonably estimated in advance to cover the losses incurred by the DISTRICT by reason of failure of said CONTRACTOR to complete the work within the time specified, such time being in the essence of this Contract and a material consideration thereof. MSD will award the CONTRACTOR an early completion bonus of \$500 per day should the work be completed prior to the contract end date.[HC8]

3.4 **Pre-Construction Conference**

Prior to starting any construction work on this project, a conference will be held in the Construction Office of the DISTRICT for the purpose of verifying general construction procedures, expediting the handling of shop drawings and schedules, and to establish a working understanding between the parties concerned on the project. Present at the conference shall be a responsible representative of the CONTRACTOR and the CONTRACTOR's job superintendent. The time of the conference shall be as agreed upon by the CONTRACTOR and DISTRICT.

3.5 **Progress Meetings**

The CONTRACTOR and any subcontractors, material suppliers or vendors whose presence is necessary or requested shall attend meetings, referred to as Progress Meetings, when requested by the DISTRICT for the purpose of discussing the execution of the work. Each meeting will be held at the time and place designated

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by the DISTRICT. A schedule for monthly meetings will be agreed upon at the pre-construction conference. The ENGINEER will call for and schedule additional meetings if necessary. All decisions, instructions and interpretations made at these meetings shall be binding and conclusive of the CONTRACTOR and such decisions, instructions and interpretations shall be confirmed in writing by the DISTRICT.

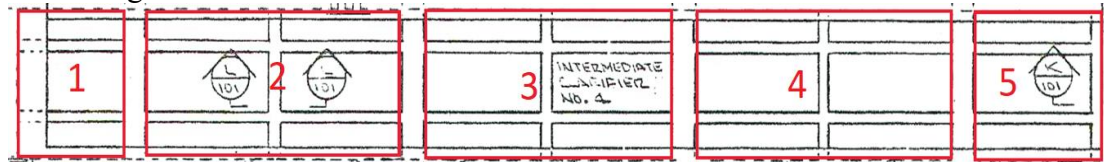
The proceedings of these meetings will be recorded, and the CONTRACTOR will be furnished with a reasonable number of copies for his use and for his distribution to the subcontractors' material suppliers and vendors involved.

### 3.6 **Startup Testing**[SA9]

MANUFACTURER shall provide a representative for a minimum of two (2) days[HC10] of startup testing per basin.

Startup testing for the underdeck equipment is included in Brentwood's equipment supply contract with MSD and will include[HC11] verification that all equipment has been installed in accordance with the MANUFACTURER's specifications and starting and running the chain through a minimum of two (2) complete revolutions.

Startup testing, coordinated by the CONTRACTOR, for the trough system shall include leak testing of the trough system and verification of weir heights. Leak testing shall be conducted as follows:



- All troughs shall be drained, and the clarifier basin shall be filled by MSD staff to within 1" of weir valleys. MSD staff and the CONTRACTOR will conduct a visual inspection to observe any leaks in trough walls or weir plates in need of adjustment. Weir plates shall be adjusted to bring all weirs to the within 0.1" of a standard elevation.
- Once all weir plates are adjusted and leaks found in previous tests have been patched, MSD staff will again fill the basin to within 1" of weir valleys. Each 24" wide trough is expected accumulate no more than 300 gallons (7 inch increase in water depth) from their respective portion of the trough system over the course 60 minutes.

## **ARTICLE 4 - SPECIAL REQUIREMENTS – FIBERGLASS REINFORCED PLASTIC TROUGH SPECIFICATIONS**

### 4.1 **Quality Assurance**

The material covered by the specifications shall be furnished by a reputable and qualified manufacturer of proven ability that is regularly engaged in the manufacture

and installation of FRP products.

The trough manufacturer shall be experienced in successfully producing FRP products specified for this project, with sufficient production capacity to produce required units without causing delay in the work.

The trough manufacturer shall provide with their bid, a list of five (5) installations of comparable size in operation for at least five (5) years.[SA12]

#### 4.2 **Submittals**

The following shall be submitted in accordance with the General and Special Conditions:

- a. Shop Drawings
  1. Dimensions.
  2. Job specific layout.
  3. Sectional assembly.
  4. Location and identification mark.
  5. Weir locations and attachment
  6. Scum Baffle locations and attachment.
  7. Accessories, attachments, transition pieces.
  8. Connection details, including gasket or sealing material
  9. Support details[SA13]
- b. Manufacturer's catalog data showing:
  1. Dimensions, spacing, and construction details.
  2. Materials of construction.
  3. Description.
- c. Certificates
  1. Manufacturer shall submit design calculations showing trough design meets the requirements of this specification[SA14], as well as a certification that all materials furnished are in compliance with the applicable requirements of this specification.
- d. Manufacturer's Instructions
  1. Submit complete information and instructions relating to the storage, handling, installation, and inspection of all equipment related to this Section.

#### 4.3 **Shipping and Storage Instructions**

- a. All FRP components shall be shop fabricated and assembled into the largest practical size suitable for transporting.

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- b. The parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
- c. All FRP materials shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials.

### 4.4 **Manufacturers**

The following FRP trough manufacturers have been pre-approved for this project:  
NEFCO, Incorporated  
Fiberglass Fabricators Incorporated  
Midwest Fabricators  
Protectolite Composites, Inc.

Other FRP trough manufacturers/fabricators must submit specifications and be pre-approved prior to the bid opening. Pre-approved manufacturers, in addition to those listed above will be incorporated into the specifications via addendum prior to bid opening.

Submissions for pre-approval must be received no later than 14 days prior to the published bid date.

### 4.5 **Design Criteria**

- a. Gravity Load - Downward vertical loads shall include the weight of the trough and appurtenance attachments, such as weir plates, baffles and spreader bars, together with the weight of water to fill the trough. Any additional loads, such as piping, etc., shall also be considered.
- b. Buoyant Load - The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected). The line of action passes through the centroid of the submerged cross-sectional area.
- c. Lateral Load - Loads acting against the trough sidewalls; specifically, those induced by differential water levels on either side of the trough walls. The maximum possible differential, existing when the trough is empty and the tank is full, or, when the trough is full and when the tank is empty, shall be used when calculating deflection, fiber stress, etc.
- d. Thermal Stresses - The troughs shall be designed to accommodate temperature induced stresses resulting from differences in coefficients of thermal expansion (contraction) between the trough and tank/support materials over temperature range of -10°F to 100°F.

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- e. Torsional Stability - The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Any or all of the following trough stabilization techniques shall be considered:
  - 1. Trough-to-trough stabilization
  - 2. Torsional stiffness
  - 3. Support spacing and rigidity
  - 4. Internal baffles and/or flow straighteners
- f. Deflection under Load - Maximum vertical deflection under full buoyant or gravity load shall be less than or equal to  $L/1000$ , where L is defined as the unsupported trough length in inches. Under no circumstances shall the maximum vertical deflection, measured at mid-point between trough supports, exceed 3/16".
- g. Maximum trough sidewall horizontal deflection under full lateral load shall be less than or equal to  $D/100$ , where D is defined as the trough depth, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16".
- h. Trough bottom deflection (oil canning) under full buoyant or gravity load shall be less than or equal to  $W/100$ , where W is defined as the trough width, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16".
- i. Thermal Expansion/Contraction - The troughs shall be designed to accommodate a thermally induced expansion (contraction) of 1/8" per 20 ft. length of trough over temperature range of -10°F to 100°F, without exceeding the deflection or strain limitations set forth in the preceding sections.
- j. In addition to AWWA F101-96, the design should include critical buckling load calculations for the trough cross braces or spreaders. This calculation is required to ensure that the cross braces do not approach the critical Euler column buckling load when the trough is empty and the tank is being filled, thereby placing the braces in compression.
- k. The blind or closed end of the trough is anchored to the wall with 3/8" thick FRP spacer washers to allow for thermal expansion along the length of the trough. Using the thermal excursion as specified in AWWA F101-96, maximum thermal displacements will be calculated and applied to the mounting area on the blind end to determine plate bending stresses. The plate thickness will then be calculated so that stresses do not exceed the level set forth in the AWWA spec.

### 4.6 **Materials**

- a. The trough laminate shall meet the following minimum physical and

mechanical requirements:

Table 1. Laminate Mechanical and Physical Properties

| Property          | Test        | Value                      |
|-------------------|-------------|----------------------------|
| Tensile Strength  | ASTM D-638  | 18,000 psi                 |
| Flexural Strength | ASTM D-790  | 28,000 psi                 |
| Flexural Modulus  | ASTM D-790  | 1.08 x 10 <sup>6</sup> psi |
| Barcol Hardness   | ASTM D-2853 | 40                         |
| Notched Izod      | ASTM D-256  | 13 ft-lbs/in               |
| Water Absorption  | ASTM D-570  | 0.08%                      |

- b. Resin - The resin shall be a commercial grade isophthalic polyester thermosetting resin, Corezyn COR75-AQ-010 or equivalent, which has either been evaluated in a laminate, or which has been determined to be acceptable for use in a waste treatment plant environment.
- c. Fillers: The resin shall contain no fillers. Thixotropic agents for viscosity control are acceptable. Colorants which have been determined by at least five years previous service to be acceptable for the service condition are acceptable. The standard color for the trough shall be green. Ultraviolet stabilizers are required in all trough laminates. Catalysts, accelerators and/or promoters shall be added to provide complete cure of the laminate and must meet the physical properties as indicated in Article 4.6 Table 1.
- d. Ultraviolet Resistance - Ultraviolet resistance is required in all laminates exposed to ultraviolet light, whether it be in the form of pigmentation or ultraviolet absorbers or a surface veil.
- e. Metal Reinforcement - When metal reinforcements are used, they shall be free of rust, oil and any foreign matter. They shall be completely encapsulated with a minimum of 1/8" thick laminate.
- f. Glass Mat Reinforcement - Glass mat reinforcement shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter described. Surfacing mat shall be 0.020 inches thick reinforced with a surfacing mat of Type C veil, 10 to 20 mils thick, with a silane finish and a styrene-soluble binder compatible with the resin; the glass content of this layer shall not exceed 20% by weight. Chopped strands shall be Type E glass, with silane finish and styrene-soluble binder.
- g. Woven Roving Reinforcement - The finished laminate shall include one layer of 24-ounce woven roving reinforcement over the entire trough surface.
- h. The content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to Article 4.6 Table 1.

- i. Other Reinforcement – Additional reinforcement in the form of foam or balsa sheet for high stress areas at the sides and bottom of the trough shall be completely encapsulated within the laminate. Care shall be taken to ensure that these areas of the trough laminate are not designated as attachment points or drilled for any purpose.
- j. Laminate Construction
  - 1. Inner trough surface shall be a resin rich layer 0.020 inches thick reinforced with a 10-20 mil 'C' veil surfacing mat. This resin rich layer shall contain less than 20% by weight of the reinforcement veil. A gelcoat interior surface may be provided.
  - 2. Structural layers shall consist of plies of chopped strand mat with a maximum of 2 ounces per square foot per spray-up pass. Inter-layered between two layers of mat shall be one layer of 24-ounce woven roving over the entire trough structure. Each successive pass of reinforcement shall be thoroughly wetted with resin and shall be well rolled to exclude all air pockets and bubbles prior to the application of additional reinforcement.
  - 3. Outer trough surface shall consist of a resin rich layer not less than 0.020 inches thick. The outer layer resin shall be applied after cure of the structural layer and suitably embed all reinforcing fibers.
  - 4. Finished trough shall be a minimum of 30% fiber reinforced with a minimum thickness of not less than 1/4". The laminate tolerance thickness shall be  $\pm 10\%$ .
- k. Materials used in the manufacture of the FRP troughs shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

#### 4.7 **Design and Manufacture**

- a. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth, resin rich, and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Laminations shall be dense and without voids, dry spots, cracks or crazes.
- b. The top edges of the trough shall be level and parallel with a tolerance of plus or minus 1/8" (measured when the trough is not loaded).
- c. The length of a trough section shall have a tolerance of  $\pm 1/8"$  per 10 ft. length.
- d. Horizontal stiffening flanges shall be integrally molded along the top edge of

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each trough side. These flanges shall be 1" to 3" wide, depending upon the trough configuration and shall face outward.

- e. Thickness at locations of supports such as saddles shall be at least 1-1/2 times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in Section 4.5.
- f. End flanges, where required to bolt trough sections together, and blind ends for securing to a wall, shall be a minimum of 1-1/2 times the nominal thickness of the trough.
- g. An integrally molded water stop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.
- h. Horizontal stiffeners shall be provided across the width of the trough to increase the structural rigidity of the trough system. The stiffeners shall be 1" diameter PVC pipe with an internal 1/2" stainless steel rod threaded on both ends and fastened through the trough walls on 2-foot centers[SA15].
- i. All FRP flanges shall require stainless steel backer plates to provide additional strength and distribute compressive forces from fasteners.[SA16]
- j. After fabrication, all cut edges, holes and abrasions shall be sanded smooth and sealed with a compatible resin coating to prevent the intrusion of water.

### 4.8 **Trough Supports and Hardware**

- a. Existing galvanized steel I-beam support structures shall remain in place with support structures suggested by trough manufacturer.
- b. All trough mounting hardware shall be Type 316 stainless steel and shall be supplied by the trough manufacturer.

### 4.9 **Trough Installation**

- a. CONTRACTOR shall install troughs and supports in accordance with manufacturer's instructions and approved shop drawings.
- b. Field cutting of troughs is allowed if necessary. All field cut edges and field drilled holes shall be sealed per the manufacturer's instructions.
- c. MANUFACTURER shall provide as part of the installation instructions a recommendation for sealing any interior gaps in the trough walls and floor at seams or wall attachment points.[SA17]
- d. CONTRACTOR shall ensure that troughs and supports are installed plumb and

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true, free of warp or twist, within the tolerances specified by the MANUFACTURER and as shown on the drawings.

- e. After the MANUFACTURER has approved the installation, and prior to startup, the CONTRACTOR shall clean all surfaces in accordance with the manufacturer's instructions.
- f. Weir height shall be measured prior to demolition of existing troughs and used by the ENGINEER and CONTRACTOR to determine the standard weir height for the newly installed troughs.
- g. The CONTRACTOR shall use 3M Marine Adhesive Sealant 5200 (or approved equal) between all gaskets and FRP trough components.

### 4.10 **Trough In-Line Slide Gates**

- a. Each large (24"Wx36" D) trough installed in Clarifier No. 2 shall be fitted with guides for an in-line slide gate on at the easternmost end, per the project plans (Bypass Gate Details on PL-1), to allow flow to be diverted from the channel during installation of the troughs in Clarifier No. 1. These in-line slide gates and guides shall be fabricated and installed by the MANUFACTURER.
- b. Guides shall be constructed of  $\frac{3}{4}$ "x $\frac{3}{4}$ "x $\frac{1}{4}$ " FRP angle bracket, 18" long, mounted vertically, with the top flush with the top of the trough. A 6" long guide shall be installed centered in the bottom of the trough.
- c. Slide gate shall be constructed of  $\frac{1}{4}$ " aluminum, 24"x36", with bottom corners rounded to conform to the shape of the channel. A  $\frac{1}{2}$ " rubber gasket shall be mounted on the perimeter of the gate to assist in sealing.
- d. Gates shall be designed to allow no more than 1 gal/min leakage.
- e. Any modifications of the bypass gate or guide design deemed necessary by the MANUFACTURER shall be pre-approved by the ENGINEER prior to fabrication of troughs and gates.

**ARTICLE 5- SPECIAL REQUIREMENTS – UNDERDECK EQUIPMENT TO BE  
SUPPLIED TO MSD BY BRENTWOOD INDUSTRIES**