BIOTRICKLING FILTER SYSTEM SPECIFICATION
LOCATION AND SIZING INFORMATION

PURPOSE: It is the intent of JEA (Jacksonville, FL) to purchase three (3) complete biological odor control system(s) to be utilized by JEA for Odor Control at:

Location 1	
Location Name:	*Shinnecock Master Pump Station*
Address:	*40 Shinnecock Road, Saint Johns, FL 32259*
Location 2	
Location Name:	*Beach Blvd Pump Station*
Address:	*11325 Beach Blvd, Jacksonville, FL 32246*
Location 3	
Location Name:	*Orange Picker Pump Station*
Address:	*2520 Orange Picker Road, Jacksonville, FL 32223*

DESIGN BASIS AND SYSTEM SIZING: The complete biotrickling filter odor control system shall be sized for the following characteristics as detailed at each location:

Location 1 – Shinnecock Master Pump Station

Parameter	Units	Min	Avg	Max	Comments
Air Flow	cfm			*900*	*Aerovent CA 12R07C blower currently installed at Shinnecock MPS and may be utilized*
H_2S Inlet	ppm	*0*	*200*	*1100*	
H_2S Removal	%	*99*	*>99*	*≥99*	*Min 99% removal / 24 hour average or less than 0.1 ppm, whichever is greater*
Min EBRT @ Max Air Flow	sec	*20*			*Empty Bed Residence Time*

Other specific design requirements or constraints related to this project are:

Item	Comments
Number of Vessels	*One (1) biotrickling filter vessel system*
Material of Construction	*Fiberglass Reinforced Plastic (FRP) Biotrickling Filter*
Diameter	*N/A*
Height	*N/A*
Vessel Color	*N/A*
Water Supply	*(x) potable or ( ) reclaimed water*
Equipment Delivery	*Less than 12 weeks from submittal approval*

Location 2 – Beach Blvd Pump Station

Parameter	Units	Min	Avg	Max	Comments
Air Flow	cfm			*600*	
H_2S Inlet	ppm	*0*	*200*	*600*	
H_2S Removal	%	*99*	*>99*	*≥99*	*Min 99% removal / 24 hour average or less than 0.1 ppm, whichever is greater*
Min EBRT @ Max Air Flow	sec	*20*			*Empty Bed Residence Time*

Other specific design requirements or constraints related to this project are:

Item	Comments
Number of Vessels	*One (1) biotrickling filter vessel system*
Material of Construction	*Fiberglass Reinforced Plastic (FRP) Biotrickling Filter*
Diameter	*N/A*
Height	*N/A*
Vessel Color	*N/A*
Water Supply	*(x) potable or ( ) reclaimed water*
Equipment Delivery	*Less than 12 weeks from submittal approval*

Location 3 – Orange Picker Pump Station

Parameter	Units	Min	Avg	Max	Comments
Air Flow	cfm			*900*	
H_2S Inlet	ppm	*0*	*200*	*600*	
H_2S Removal	%	*99*	*>99*	*≥99*	*Min 99% removal / 24 hour average or less than 0.1 ppm, whichever is greater*
Min EBRT @ Max Air Flow	sec	*20*			*Empty Bed Residence Time*

Other specific design requirements or constraints related to this project are:

Item	Comments
Number of Vessels	*One (1) biotrickling filter vessel system*
Material of Construction	*Fiberglass Reinforced Plastic (FRP) Biotrickling Filter*
Diameter	*N/A*
Height	*N/A*
Vessel Color	*N/A*
Water Supply	*(x) potable or ( ) reclaimed water*
Equipment Delivery	*Less than 12 weeks from submittal approval*

Carbon polishing unit:

Item	Comments
Number of Vessels	*One (1) carbon vessel system*
Carbon Polisher	*(x) separate unit from BTF vessel or ( ) integral part of BTF*
Material of Construction	*Same as biotrickling filter*
Diameter	*Equal or smaller than biotrickling filter*
Superficial Velocity	*45-55 fpm*
Residence Time	*≥5 seconds*
Media Type/Blend	*(70)% Type 1, (20)% Type 2, (10)% Type 3 – see Section 2.6 Part I*

QUOTES: At a minimum, all manufactures shall quote unit prices, F.O.B. destination, and information for the purchase and delivery of the complete odor control system to designated JEA location. Manufacturers must include system details with the quote, including but not limited to vessel material of construction, media type, general dimensions including media volume, and warranty information. Others are responsible for duct from the wetwell to the suction side of the blower, as well as Sch. 80 PVC piping for the water supply, nutrients and drain. Any deviations from this specification shall be fully identified and described in the quote.

RESERVED RIGHTS: JEA reserves the right to accept or reject any and/or all quotes, to waive irregularities and technicalities, and to request resubmission of quotes. JEA also reserves the right to accept all or any part of the quote and to increase or decrease quantities to meet additional or reduced requirements of JEA.

WARRANTY: The complete biological odor control system and all components shall carry a 3-year "Full Replacement Warranty" that shall begin once the unit has been started and is meeting all performance requirements. The synthetic/inert biological media and support grating shall carry a 10-year **non** pro-rated full replacement warranty. Cost of removal and replacement of media shall be by JEA.

PERFORMANCE TESTING. In the event of three (3) failed performance tests, within 30 days the manufacturer shall reimburse JEA up to 50% of the bid price of the equipment. The reimbursement amount shall be based on the highest 24-hour average removal achieved of the three (3) performance tests below 99% as follows:

H_2S Average Removal	Reimbursement Cost of Total Bid Price
≥ 99%	0%
≥ 98%	10%
≥ 97%	20%
≥ 96%	30%
≥ 95%	40%
< 95%	50%

PART 1 - GENERAL

1.1 SCOPE

A. The work specified shall include furnishing all labor, design, materials, equipment, incidentals and testing of all equipment and materials necessary to provide JEA with a completely operational Odor Control System for removal of hydrogen sulfide (H_2S) and volatile organic compounds (VOCs) from odorous air within the wastewater collection system.

B. The Biotrickling Filter Odor Control System shall consist of a biotrickling filter vessel, internal structural members, media with support grating, mist eliminator, internal piping, liquid distributors, nutrient feed and storage system, irrigation valves, recirculation pump and piping, air exhaust, fan/blower, process control system control panel, ducting, and any other equipment or accessories required to provide a complete and functioning biotrickling filter odor control system. All major system components, vessel, blower and duct shall be from the same manufacturer for single source responsibility.

C. If specified by JEA, the odor control system shall also include a carbon polisher with carbon polishing media. See Part 2.6 (Carbon Polisher) for additional information.

D. All materials, products, or devices shall be new and unused, unless indicated otherwise in proposal.

1.2 PROCESS DESCRIPTION

A. The system shall perform in accordance with the design basis. It shall be designed for continuous operation in a highly corrosive environment.

B. The biotrickling filter odor control system shall utilize a high surface synthetic/inert media to provide an optimal site for growth of microorganisms (aka: biomass). This media has a high surface/high void area for optimal treatment in a small footprint. Microorganisms that attach to the media are capable of removing H_2S and other odorous VOCs when they are contacted by these compounds in the odorous air stream. A blower conveys the odorous air from the odor source to the media at the bottom of the vessel where the air passes upward through the vessel and media. As the odorous air travels upward it comes in contact with the biomass where non-pathogenic sulfur oxidizing bacteria immobilized on the synthetic media remove H_2S and other odorous VOCs. The biotrickling filter odor control systems counter-current flow of air and water/nutrients enhances the mass transfer to the media where the biological sulfur reduction takes place degrading the odorous compounds to sulfuric acid and other soluble sulfates which are removed in the drain water. If needed, solution containing water and nutrients is conveyed from the sump onto the media via a recycle pump to maintain a healthy biological population. Neutralizing or oxidizing chemicals shall not be utilized to accomplish odor control within the biotrickling filter. If a supplemental nutrient formula is needed for the odor control system to meet the design criteria, the manufacturer shall provide a reservoir and associated dosing system.

1.3 APPROVED MANUFACTURERS

A. The biotrickling filter manufacturer shall be experienced in the design, construction and successful operation of biotrickling filter odor control systems for the removal of hydrogen

sulfide gas and other odor producing compounds from air ventilated from wastewater treatment systems. All equipment shall be furnished by a single manufacturer with single-source responsibility.

B. Systems utilizing organic, lava rock, stone, or glass media shall not be accepted.

C. Below are the approved biological odor control system design and manufacturers for this project:

1	BioAir Solutions, LLC, Voorhees, New Jersey.
2	Evoqua Water Technologies LLC, San Diego, California.
3	Heyward Florida Incorporated, Winter Park, Florida.
4	ECS Environmental Solutions, Belton, Texas.

D. If a biotrickling filter manufacturer is not a pre-approved manufacturer and would like to be included in the above list, prior to bidding on any work, at a minimum the manufacturer shall:

1. Provide manufacturer literature on biotrickling filter equipment, components and materials. A specification on the material and structural integrity of the vessel must be provided.

2. Provide a letter documenting compliance with this specification, and if necessary, state any exceptions.

3. Provide at least five (5) examples of satisfactory installations treating an average influent hydrogen sulfide concentration of greater than 600 ppm and a peak concentration greater than >1,000 ppm.

4. Provide design criteria for each of the examples, including but not limited to: air flow (cfm), hydrogen sulfide inlet design concentration (ppm), hydrogen sulfide removal (%), water usage (gpd), vessel diameter and height (feet).

5. Provide a list of references for each of the example installations with contact information including but not limited to: accurate contact information of owner (name, job title, location, phone number, email address), placed in service date, design conditions including air flow rate and hydrogen sulfide loading.

6. JEA reserves the right to request additional information.

1.4 SUBMITTALS FOR APPARENT LOW BIDDER

A. Upon notice from JEA, shop drawings and literature describing the equipment shall be submitted to JEA for evaluation and approval. Fabrication of odor control system shall not begin until JEA has given written approval and notice to proceed. If the selected

manufacturer's equipment layout, configuration, and/or piping requires changes from the bid documents, it is the responsibility of the manufacturer to clearly submit all proposed changes in the submittals at no additional cost to JEA.

B. The following items may be requested by JEA prior to approval to proceed:

1. Submittals shall include details of construction, materials of construction, model numbers, dimensions, manway locations, media material, media total depth, number of media sections, depth of media per section, vessel exterior color selection charts (if applicable), nutrient storage and feed system, recirculation pump, carbon polisher (if specified), shipping and operating weights, operating parameters, blower performance curves, blower motor (manufacturer, model, bearing type, horsepower, weight, load, efficiency, current and dimensions), process and instrumentation diagrams (wiring and interconnection diagram), electrical schematics, system layout drawings/schematics, recommended methods for handling (unloading, storing, lifting, etc.), mounting and installation instructions, and any other pertinent information that may be required for a successful odor controls system.

2. Manufacturer shall submit description of the laminate and the type of reinforcing to be used and a letter from the manufacturer stating the laminate reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application, and the resin will meet the performance requirements stated and is suitable for the service conditions specified herein and the fabrication technique proposed. Manufacturer shall also submit certification of applicable wind load design in accordance with current edition of the Florida Building Code.

3. Manufacturer shall furnish a list of recommended spare parts for each piece of equipment in the scope of supply.

4. Manufacturer shall submit calculations indicating the basis of design for the system. These must demonstrate that the equipment is structurally sound and that the system will perform as specified. Manufacturer shall submit complete design calculations for the media support system. The design calculations shall be sealed by a Registered Professional Engineer in the State of Florida.

5. Anchor and tie-down system design calculations signed and sealed by a Registered Professional Engineer in the State of Florida. Shall include, but not limited to, anchor calculations for design of fastening system to concrete pad to withstand applicable wind load criteria and other loadings discussed herein. Shall include size, embedment, and installation design criteria for anchor bolts and tie downs.

C. Manufacturer is required to submit the following items.

1. Submit certification indicating the quality control, testing, and inspection has been completed and standards specified herein have been met prior to shipment to the jobsite.

2. Manufacturer shall furnish two (2) bound copies and an electronic copy of the Operation and Maintenance instructions. The information shall be sufficient to

instruct personnel who are unfamiliar with such equipment in the operation and maintenance of the system. It shall include diagnostic procedures to be used in the event of system shutdown or malfunction.

3. Submit the performance guarantee and warranty for the system.

4. Submit results of all performance testing procedures and results.

D. Upon notice from JEA, requested submittals must be submitted within twenty (20) calendar days. All exceptions and/or deviations shall be fully identified and described.

PART 2 - PRODUCTS

2.1 GENERAL

A. The biotrickling filter shall be cylindrically shaped with upflow air passage and countercurrent liquid flow. The biotrickling filter shall include an engineered baffle to ensure 0% bypass of the air stream around any of the media bed.

B. The system shall include the equipment and controls necessary to automatically and effectively remove contaminant gases and to minimize the possibility of breakthrough due to fluctuations in gas flow or concentration.

C. The system shall be able to operate in a constant liquid recirculation mode, intermittent freshwater mode, and the ability to do both.

D. All parts for the odor control system shall be installed in strict accordance with the manufacturer's instructions and under the guidance of the manufacturer's field representative. All components shall be designed for operation in a highly corrosive environment. All exposed parts shall be suitable for direct sunlight.

E. All materials of construction including miscellaneous hardware shall be resistant to attack by the corrosive compounds present in the air stream, as well as those present in the recirculating liquid, including biodegradation by-products. Unless otherwise noted, all metallic parts shall be 316 stainless steel including nuts, bolts, and washers.

F. All special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer. The Operation and Maintenance Manual shall identify each such tool and where it is used.

G. Manufacturer is responsible for the duct from the blower to the biotrickling filter vessel, and, if applicable, from the biotrickling filter vessel to the carbon polishing system. Duct shall include required transition pieces, valves and expansion joints to connect to fan outlet and odor control equipment. Ducts shall be of sufficient diameter and designed to move air without undue pressure loss. The pressure loss of the combined odor control system and duct work shall not exceed the maximum pressure available from the blower at the specified air flow rate operating at non-overload conditions.

H. Products shall comply with National Fire Protection Association 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

2.2 PERFORMANCE REQUIREMENTS

In addition to the system requirements identified on the Location and Sizing Information page for the specific project, the biotrickling filter system shall be designed for the following operating conditions and criteria. **Systems not meeting minimum EBRT (Empty Bed Residence Time) will not be accepted.**

Minimum H_2S Removal Efficiency / 24 hr Avg.	**>99% or less than 0.1 ppm, whichever is greater**
Max. Pressure Loss Across Vessel (Biological only)	**<3.0" water column**
Max. Pressure Loss Across Vessel (Biological and Carbon)	**<6.0" water column**

2.3 BIOTRICKLING FILTER VESSEL, MEDIA, AND COMPONENTS

A. The entire biotrickling filter vessel shall be made of fiberglass reinforced plastic (FRP) material with 100 mils of chemical-resistant interior liner. The FRP shall be premium vinyl ester fiberglass resin. Resins used in laminate shall be premium corrosion-resistant, suitable for the intended service, and a fire retardant brominated bisphenol A vinylester resins to achieve a 25 or less flame spread rating in accordance with NFPA 91.

B. Selected resin shall be used for fabrication throughout the entire vessel. Use of more than one resin during fabrication is not acceptable. The resin shall not contain fillers or thixotropic agents unless otherwise specified. Vessels shall be cured in accordance with the recommendations of the resin manufacturer, including post cure temperatures and times.

C. Vessels shall be resistant to chemical attack compounds present in the application. Vessels shall also be UV resistant. Ultraviolet absorbers shall be added to the surfacing resin to improve weather/UV resistance of the vessel.

D. Vessel components shall be preassembled at the point of fabrication. Preassembly will not require all joints to be factory assembled, but all joints shall be prepared for field fabrication and square. All cut edges shall be sealed with a resin coating of the same resin as used in the fabrication. Vessel walls shall be reinforced around all openings and connections.

E. Exterior coating shall not be applied until after inspection of the laminate has been completed. No dyes, pigments, or colorants shall be used except in the exterior coat. JEA reserves the right to select the biotrickling filter vessel exterior color (if applicable). If not specified, the manufacturer shall supply their standard equipment color (white, grey or black).

F. Vessel wall thickness shall be as required by the structural design, but not be less than ¼ inch.

G. At a minimum, four (4) manways (sump, top, and bottom of packing, and top of mist eliminator) shall be provided. Manways at the top and bottom of the packing shall be at

least 24” in diameter for access to facilitate both removal and replacement of the media. They should be located away from any obstructions such as piping and ductwork. If the vessel is 6-foot in diameter or smaller, the 24” manways are not required as long as adequate access to the media is provided for removal and replacement.

H. The bottom or reservoir section shall include air inlet connection, makeup water connection, nutrient feed connection (if needed), inoculant injection connection, recirculation pump suction connection (if needed), drain, and overflow. The drain shall be positioned as close to the bottom as possible so the reservoir section can drain completely.

I. Equipment shall be furnished with concrete anchors and hold down lugs, complete with 316 stainless steel plates, bolts, nuts and washers for proper anchoring of the tank as required by the manufacturer, anticipated loads, and compliance with local code requirements.

J. Lifting lugs shall be capable of withstanding weight of the empty vessel with a minimum safety factor of 5 to 1. A minimum of three lugs shall be furnished per vessel. Lifting lugs shall be Type 316 stainless steel of FRP and attached to the vessel wall with hand lay-up laminate equal to or greater than the vessel wall thickness.

K. The structure shall comply with the current edition of the Florida Building Code including design for applicable wind loads. If necessary, hurricane straps and accessories shall be provided to securely anchor the unit to the slab.

L. Biotrickling filter shall have air inlet and outlet flanges. Flanges shall be 3/8” thick and widths will be commensurate with the scrubber dimensions. Maximum flange width will be 3”.

M. Air inlet duct between the blower and vessel shall have a 1” diameter tap and 1” ball valve for inlet air sampling. Also provide a 1” diameter tap and 1” PVC ball valve in the bottom of the duct to remove condensate in air duct at low elevations including before the blower and between the blower and vessel (if applicable). If a separate carbon polishing unit is provided a 1” diameter tap and 1” ball valve for inlet air sampling and 1” diameter tap and 1” PVC ball valve for condensate shall be provided on the transition duct.

N. Vessel shall be furnished with a vertical exhaust stack with a bolted flanged connection to the outlet. Vertical exhaust stack shall be provided with a down turned 2” diameter internal outlet air collection, transitioning to 1” diameter outside the vessel, routed down to approximately 4’ above the finished grade with a 1” ball valve for outlet air sampling. Outlet sample shall have either a ½” hole in the pipe downstream of the sample location to facilitate airflow, or shall be routed to the suction side of the blower to allow for positive flow to the sample location.

O. The Supplier shall be responsible for providing the proper media to ensure the system meets the specified performance requirements. The chemically resistant synthetic/inert media shall have a high surface area to provide an optimal site for growth of microorganisms while allowing for even airflow and water recirculation without possibility of media compaction. Media and media support system shall be suitable for continuous exposure to a dilute sulfuric acid solution with pH ranging from 1 to 3. Media should not shrink or swell with varying moisture content. The media shall be made from chemically resistant material. The system must be constructed in a manner to minimize the potential

for short circuiting of the air being treated and to enhance contact between the gas and liquid solutions. Manufacturer shall design biotrickling filter unit with engineered baffle to ensure 0% bypass of the airstream around any of the media bed.

P. Media shall be supported by media support plates, packing support plates and mid span supports suitable for supporting a bed of media plus entrained water/solution and any deposits on the media under all conditions of operation, including a flooded bed condition. Media support system shall be constructed of corrosion-resistant materials. Apply vinyl ester resin to any field cut edges of FRP media support beams or grating to prevent corrosion and degradation. Opening size shall not allow for passage of packing media in any random orientation. Manufacturer shall provide instructions for placement and removal of packing support in and out of the vessel.

Q. The vessel shall be configured with at least one fluid injection spray nozzle designed to be clog resistant. The spray nozzle shall be located to disburse the fluid evenly over the entire media surface area. Internal spray piping shall have flanged connection for easy removal without entering the vessel.

R. Mist eliminator shall be provided to prevent excess mist from being discharged from the tower exhaust. Mist eliminator shall be designed to remove 99% of all mist particles 40 microns and larger and 90% of all mist particles 10 microns and larger.

S. Vessel shall be provided with a permanently attached, stainless steel equipment identification plate. The label shall state the following in die-stamped lettering for the plate:

- Equipment identification (tag) number shown on submittals and vessel name.
- Manufacturers name and address.
- Model number and serial number.
- Date of manufacture.
- Material of construction.
- Design pressure (vacuum).
- Vessel dimensions.
- Operating weight.

2.4 CENTRIFUGAL BLOWERS

A. Blowers shall be corrosion resistant cast aluminum, welded aluminum or FRP direct drive.

B. All internal and external blower hardware shall be 316 stainless steel.

C. Motors shall be high-efficiency, 1.15 service factor, 3phase/60hz 208-230/460V. Motors shall be stainless steel wash-down/inverter duty induction type motors with sealed, lubricated bearings mounted on a corrosion resistant aluminum or stainless steel motor pedestal. No painted carbon steel bases shall be allowed. Bearings shall be heavy duty, self-aligning grease lubricated ball or roller type with a minimum 100,000 hour B-10 life. OSHA approved shaft guard shall be provided when fan wheel is not direct coupled to the motor. For motor frame sizes larger than 3HP use Severe Duty TEFC Motors.

D. Blower impeller shall be dynamically balanced prior to assembly.

E. Blower motor shall be operated by a variable frequency drive (VFD) motor controller for precise air flow control to the biotrickling filter.

F. Blower inlet/outlet shall be provided with a flex connector. The blower shall be shipped loose from the system and anchored to the concrete pad without the need for vibration isolators.

G. The pressure loss of the combined odor control system and duct work shall not exceed the maximum pressure available from the blower at the specified air flow rate operating at non-overload conditions.

H. Each fan shall be furnished with a 316 stainless steel nameplate with manufacturer's name, model number, and serial number.

2.5 INTEGRATED PROCESS CONTROL SKID

A. Components listed under this section shall be provided as a single integrated process control skid. The process control skid shall be pre-piped and pre-wired and delivered as a single unit. The skid shall be designed for a highly corrosive environment and shall be suitable for direct sunlight.

B. All piping, valves, flow meters, etc shall be mounted to the skid by the Manufacturer. The skid shall be assembled to include all appurtenances for the operation of the system.

C. System supplier shall provide any and all necessary start-up or acclimation kits required to place the system into successful operation.

D. Process Control System Panel:

1. Process control system panel(s) shall be provided to operate the blower, nutrient pump, actuator valve, recirculation pump(s), instrumentation and all other system components.

2. The process control system panel(s) shall be manufactured of marine grade aluminum, FRP or stainless steel with all stainless steel mounting hardware where necessary and rated NEMA 4X. The biotrickling filter control panel shall be provided to operate the nutrient feed pump, pressure gauge(s), actuator valve, valves, timer relays, flow meter, recirculation pump, instrumentation and all other system components in a complete packaged system for operation of the odor control system. The control system(s) shall include a VFD blower motor controller. Start/stop control shall be provided for each recycle pump, and hand-off timer control shall be provided for the nutrient pump.

3. Circuit breaker protection for all motor circuits shall be provided. A main disconnect and control transformer to 120 VAC control power shall be included.

4. Labels shall be fixed to the face of the panel in such a manner that the function of each component shall be easily ascertained. Labeled terminal strips shall be provided in order to facilitate wiring of external devices such as switches, sensors, meters, and controllers. No more than two conductors shall be located in each termination point.

5. Wiring practices shall meet standards set by the latest editions of the National Electric Code (NEC).

6. All conductors shall be labeled with wire numbers and those numbers shall correspond with those provided in a wiring and panel layout diagram. All components shall be labeled with the same symbol reference shown in the electrical wiring and instrument list.

7. Equipment shall include a ground wire #2 cu thinned to the grounded grid. It shall be exothermically welded to the grounding grid and mechanically attached to the frame with a compression terminal on the wire and bolted to the frame. Consult JEA standard grounding drawings on jea.com for additional information.

E. Spray Nozzle System:

1. The operation of the spray nozzles shall be via a recirculation pump (recirculation mode) or a motor controlled actuator valve (fresh water intermittent mode) and shall be capable of continuous, intermittent, and dual mode operation with either recirculated sump water or fresh water.

2. Recirculation pump shall be a magnetic drive pump, dynamically balanced and be capable of mounting directly to standard NEMA motors. The pump shall be totally enclosed and suitable for exposure to the elements. Motors shall be TEFC. Vertically mounted motors shall include rain guard for protection. If necessary, the recycle line shall include motorized ball valves to alternate between multiple spray headers.

3. All irrigation system piping shall be constructed of Scheduled 80 CPVC. All fittings shall be true union, solvent welded, or threaded, US standard sizes. All flange gaskets, union seals, valve seals, and other piping seals shall be fully compatible with the chemicals to be used in the regular operation, maintenance, and cleaning of the odor control system.

F. Nutrient Dosing System:

1. Supply either an external tank or integral tank built into the odor control system vessel to mix and store supplemental nutrients. Nutrients will be automatically added to the injection fluid on a periodic or continuous basis to meet performance requirements.

2. To maintain a fresh nutrient supply, nutrient storage tanks shall be sized for a minimum 7-day supply and a maximum of 14-day supply.

3. Nutrients shall be available locally, non-hazardous, and non-proprietary. Manufacturer is responsible for providing chemical composition of recommended nutrients along with non-proprietary supplier information.

4. When available, secondary plant effluent meeting supplier's standards shall be used in lieu of a nutrient feed system.

5. The nutrient dosing system shall be provided by a dedicated metering pump for the delivery of nutrient to the media bed compartment. The metering pump shall be manually adjusted for output by the operator. Nutrient system tank shall include fill, outlet, low level indicator and vent.

G. Accessories:

1. Portable pressure gauge(s) shall be provided in lieu of installed gauge(s) and differential pressure indicator as long as connections are provided to allow for measurement.

2.6 CARBON POLISHER

A. If specified on the cover sheet, manufacturer shall include a carbon polisher and carbon polishing media. Cover sheet will also specify whether carbon polisher should be combined into a single unit with the biotrickling filter or a separate unit based on site specific height and footprint limitations.

1. If the biotrickling filter and carbon system are separate units the carbon system materials of construction shall match the biotrickling filter unless otherwise noted.

2. If the biotrickling filter and carbon polishing system are separate units, all transition ducts, supports and other ancillary equipment required to provide a complete system shall be included. Duct shall be provided in between the biotrickling filter and carbon system which shall also include isolation dampers and an exhaust port and/or stack to allow the carbon system to be isolated when replacing media.

B. Equipment shall be furnished with concrete anchors and hold down lugs, complete with 316 stainless steel plates, bolts, nuts and washers for proper anchoring of the tank as required by the manufacturer.

C. The structure shall comply with the current edition of the Florida Building Code including design for applicable wind loads. If necessary, hurricane straps and accessories shall be provided to securely anchor the unit to the slab.

D. The exhaust from the carbon polishing vessel shall be equipped with a chimney cap / rain guard to protect the media from getting wet from weather events.

E. The superficial velocity through the carbon unit shall be 45-55 fpm.

F. The residence time through the carbon unit at the specified air flow rate shall be as specified on the site specified page of these specifications.

G. The biologically treated air (99% hydrogen sulfide removed) shall passes through a carbon polisher for final air polishing then discharged to atmosphere. In addition to sample ports provided before and after the biotrickling filter to monitor performance, multiple sample ports shall be provided vertically through the carbon vessel to monitor breakthrough.

H. Manways shall be provided to facilitate both removal and replacement of the carbon media. Manways shall be at least 24-inch in diameter and shall be located away from any

obstructions such as piping and ductwork. If the vessel is 6-foot in diameter or smaller, the 24" manways are not required as long as adequate access to the media is provided for removal and replacement.

I. Manufacturer is responsible for providing initial supply of carbon polishing media.

J. Media blend shall be determined by equipment supplier and JEA based on specific odors to be removed. Odors include but are not limited to hydrogen sulfide, sulfur dioxide, mercaptans, and other organic compounds. Media types include:

1. H_2S Specific Media

Mesh Size	4 x 8
Mean Particle Diameter	3.4 mm (avg.)
Moisture	8% (max as packaged)
H2S Breakthrough Capacity	0.20 (min gH_2S/cc carbon)

2. Coconut Shell Media

Mesh Size	4 x 8
CCI4 Activity	60% (min)
Iodine No	1100 (min mg/g)
Hardness	98% (min)
Ash Content	5% (max)
Moisture	5% (max as packaged)

3. Potassium Permanganate Media

Mesh Size	4 x 8
Moisture	12% (avg as packaged)
Potassium Permanganate Content	6% (min)

PART 3 – EXECUTION

3.1 SHIPPING, STORAGE AND HANDLING

A. Equipment shall be inspected for damage prior to unloading. Manufacturer shall be notified immediately upon notice of damage. Any damaged equipment shall be promptly replaced at no cost to JEA.

B. Product delivery, storage, and handling shall comply with Manufacturer's instructions and as follows:

1. All media shall be delivered in bags for ease of install.

2. Long term media storage is not acceptable.

3. All electrical and ancillary equipment shall be stored in a climate controlled building greater than 50 degrees F.

4. All parts shall be properly protected so that no damage or deterioration will occur in transit or during prolonged storage at the site.

5. All openings in equipment shall be protected against entry of foreign objects.

6. Each box, crate, and package shall be properly marked to show its contents and net weight.

C. Equipment shall be shipped on an open flat-bed trailer to facilitate offloading. A covered trailer may be utilized with prior approval providing that equipment is at or near the open end. Contact Katie Templeton (904) 665-8784 to coordinate specific delivery time and location to ensure that someone is available to assist with offloading equipment prior to delivery.

3.2 INSTALLATION

A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations. Type 316 stainless steel anchor bolts shall be furnished by the equipment supplier and set in accordance with the manufacturer's recommendations.

3.3 MANUFACTURER SERVICES

A. The manufacturer shall provide the services of a qualified service technician who shall adequately supervise the installation and testing of all equipment furnished under this contract and instruct JEA operating personnel in its proper maintenance and operation. The manufacturer shall provide service technician for at least four (4) trips no less than 8 days total for installation assistance, start-up, and post start-up inspection of the equipment. Within the first year of operation a direct employee of the manufacturer (not local representative) shall make quarterly visits after installation to ensure proper operation of the system. Emergency response requirements for the first year are a call back within 24 hours and a representative on-site within 5 business days at no cost to JEA.

B. The biotrickling filter system with other associated equipment such as the blower, piping and controls shall be field-tested.

C. Water, power and nutrients required for startup and testing will be furnished by others.

D. The startup and testing shall meet the performance guarantees described under performance requirements listed herein. All equipment shall show evidence of mechanical soundness, no evidence of liquid or gas leaks, no undue vibration and generally be structurally rigid when being tested.

E. The manufacturer representative witnessing the biotrickling filter system startup and field test shall furnish the Owner a written report certifying that the unit is operating according to specifications.

F. Coordinate startup services with the blower and VFD. The manufacturer representative of the biotrickling filter system shall provide all speed and protection settings necessary for this device.

3.4 PERFORMANCE TEST

A. The manufacturer shall provide for a direct employee (not local representative) to conduct performance testing to ensure hydrogen sulfide removal efficiency.

B. The performance test shall be conducted after sufficient acclimation time and at such time as all anticipated odorous air streams are present in the scrubber inlet.

C. The odor control system shall be tested under actual operating conditions in order to demonstrate that it will perform as required. During the test, air flow rates, recirculation rates and other controllable parameters must remain constant and be recorded.

D. The test shall last at least twenty-four (24) consecutive hours and samples shall be taken from the inlet and outlet of the scrubber system using an OdaLog portable gas detection instrument. If the equipment includes a carbon polishing unit the outlet of the system shall also be recorded during performance testing using an OdaLog. It shall be noted that performing testing is based on the biotrickling filter only. The outlet conditions of the carbon polisher shall be tested but will not be included to meet the performance testing requirements specified herein.

E. Should the system performance not meet any of the above requirements, that system shall have failed the performance test. The manufacturer shall make any additions or modifications to the system as may be necessary, at no additional cost to JEA, and the performance tests for that system shall be repeated in its entirety.

F. Manufacturer shall certify the results of the test and submit a written test certification report of the test to JEA. The conditions tested shall be documented and the parameters recorded including air flow rates, recirculation rates and pH.

G. Any additional time required to achieve successful installation and operation shall be at the expense of the manufacturer and not JEA.

H. Each performance test shall be witnessed by JEA and results submitted for review and acceptance.

I. In the event of three (3) failed performance tests, within 30 days the manufacture shall reimburse JEA up to 50% of the bid price of the equipment. The reimbursement amount shall be based on the highest 24-hour average removal achieved of the three (3) performance tests below 99% as follows:

H_2S Average Removal	Reimbursement Cost of Total Bid Price
≥ 99%	0%
≥ 98%	10%
≥ 97%	20%
≥ 96%	30%
≥ 95%	40%
< 95%	50%

J. A second performance test will be required approximately 3-months following the completion of the first performance test.

- END OF SECTION -