SECTION 11825
FINAL SETTLING TANK MECHANISM

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, material, and equipment to design, fabricate, furnish, and install final settling tank mechanisms T-9 and T-10.

B. All work performed under this Section shall comply with all approved trade practices and manufacturer's recommendations.

C. Manufacturer shall be WesTech, Clearstream or Ovivo.

D. The Manufacturer shall be same Manufacturer for both the clarifiers supplied under this section and Section 11826.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Scaled dimensional drawings of all components.

b. Information to verify compliance with all specified requirements.

c. Written certification that the proposed drive meets AGMA standards.

d. General arrangement of the drive unit verifying AGMA torque, overload protection system, housing and gear materials, and horsepower.

e. Complete test procedure for torque testing the collector mechanism for the AGMA torque specified.

f. Complete assembly drawing of the collector components giving the type of materials and dimensions.

g. Complete sludge transport calculations substantiating the rake blade design, rake tip speed, and floor slope.

h. Complete process calculations substantiating the sizing of the center column and ports, EDI and outlets, and outer feedwell. These calculations shall be based on parameters from the manufacturers operating experience. These parameters shall be verified by data presented from successful operating installations. Side by side comparison testing of EDI and feedwell design from existing operating

clarifiers that have spiral rake blades and are products of the manufacturer shall be presented with the calculations.

2. Information for the Record:

   a. Operation and Maintenance Manual information.

1.03 QUALITY ASSURANCE

A. The equipment manufacturer shall have not less than ten successful installations of the type of drive and sludge mechanism specified on final clarifiers at least 40 feet in diameter at not less than ten different municipal wastewater treatment plants within the United States. All such installations shall have been in service for at least 2 years.

1.04 WARRANTY

A. A written supplier's warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of ten (10) years from start up or 126 months from time of equipment shipment, whichever comes first. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts (i.e. squeegees, skimmer wipers, motors, coatings, etc.).

PART 2 PRODUCTS

2.01 GENERAL DESCRIPTION

A. There shall be furnished and installed equipment for (2) spiral blade drive clarifier(s). The equipment shall include a center drive unit and torque control, stationary center influent column, energy dissipating inlet (EDI), center feedwell, rotating drive cage, rake arms with spiral blades, anchor bolts, scum skimmer, scum box, effluent weir, scum baffle, and all other appurtenances required or shown on the drawings.

2.02 STRUCTURAL MEMBERS

A. Structural steel shall conform to ASTM A36. All steel parts shall have a minimum thickness of 1/4-inch Connections shall be shop welded or field bolted. Field welding will not be permitted, except for the bridge splice and skimmer connections. All welding shall conform to American Welding Society Standard AWS D1.1. All steel structural components shall be designed so that stresses developed do not exceed allowable stresses, as defined by current AISC standards when designed for the AGMA rated torque.

B. All individual members of trusses shall be treated as compression members for calculation of slenderness ratios. Panel lengths and member sizes shall be selected such that slenderness ratios do not exceed 200:1 for compression and 240:1 for tension. For strength, the controlling member force shall be used to determine member size.

Maximum deflection in a span under the combined dead loads and design live loads shall not exceed L/360.

2.03 DRIVE MECHANISM

A. The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values listed herein. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L 10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

1. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.

2. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.

3. Any and all welding on the drive unit shall be done using E70XX weld rod.

B. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. Support base for the drive shall be of welded steel to assure rigidity. Dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58 62 Rc and protected by a neoprene seal. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. The main gear to pinion gear mesh shall be oil lubricated. An oil sight glass, fill pipe, and drain shall be provided for the reservoir. Lubrication fittings shall be readily accessible.

C. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v belts, and shall be keyed to the pinion.

The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high-

speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.

2. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.

3. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

D. The motor shall be totally enclosed, ball bearing type, of ample power for starting and continuously operating the mechanism without overloading. The motor shall conform to Section 11050 and be suitable for operation on 460 volt, 3 phase, 60 Hertz power.

E. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

F. A space heater shall be provided in the overload housing for condensate control. 120 volt connecting wiring and controls shall be furnished by the Contractor.

G. A visual torque dial indicator shall be provided and oriented so it may be read from the walkway.

H. The microswitches shall be factory set to: 1) sound an alarm when the load on the mechanism reaches 100 percent of the AGMA rated torque capacity of the drive; and 2) stop the motor when the load reaches 120 percent of the AGMA rated torque capacity. The alarm shall be provided by the equipment manufacturer.

I. A shear pin device, set for 130 percent of the AGMA rated torque shall be furnished.

J. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29 x 106 psi. The center cage shall be fastened to and supported from the gear casing. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and

protected by elastomer seals. Felt seals that allow the entrance of moisture from outside the drive (i.e. rain water, condensate, etc.) will not be allowed.

K. A heat trace tape and controls shall be provided to prevent freezing of the condensate pipe by the mechanism manufacturer. 120 volt connecting wiring shall be furnished by the Contractor. The controls shall include a push to test light in a NEMA 4X control box.

2.04 CENTER PIER

A. A stationary cylindrical steel influent column of 1/4" minimum wall thickness shall be provided. One end shall have a support flange for bolting to the tank floor over the influent line, with a similar flange at the top for supporting the drive unit and walkway. The structure and anchor bolts shall provide adequate support for the entire mechanism dead load plus live loads and torque with an adequate factor of safety to eliminate excessive deflection or vibration. Suitable openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the energy dissipating inlet.

B. Prior to the center column being grouted in place, the drive unit shall be installed, positioned, and leveled.

2.05 INFLUENT FEEDWELL FLOCCULATION BAFFLES

A. A rotating circular energy dissipating inlet with bottom shall be supported by the cage and be designed to diffuse the liquid into the feedwell in an impinged flow direction without excessive disturbance or formation of vertical velocity currents. The EDI shall be designed to positively prevent sludge from depositing within the EDI and shall include bottom drain holes.

B. The diameter, depth, and detention time of the EDI shall be included in the submittal with the design calculations and shall show proper process application as evidenced by the required successful operating installations.

C. The rotating EDI shall be designed with a full bottom extending to within 1 inch of the center column. It shall include an upper rim angle for stiffness. Multiple, discharge ports shall be provided to induce impinged flow. The gates shall have a fixed bottom to prevent vertical currents as the flow exits the EDI.

D. The EDI shall be made of not less than 3/16-inch-thick steel plate with necessary stiffening angles.

E. The flocculating feedwell shall be located outside of the EDI to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.

F. The supports for the feedwell shall be located either above the liquid extending from the cage or bridge, or on the rake arms. Submerged supports from the rake arms shall be designed so as to minimize horizontal flow disruption.

G. No feedwell support or feedwell spliced connection shall be contained within the annular space formed between the feedwell and EDI. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge. The diameter, depth, detention time, and exit velocities shall match the process application calculations as evidenced by the required successful operating installations.

H. The feedwell shall be made of not less than 3/16-inch-thick steel plate with necessary stiffening angles.

2.06 CENTER CAGE, TRUSS, AND SLUDGE RAKE ARMS

A. The center cage shall be of steel box truss construction. It shall be provided with connections for the two sludge rake arms and feedwell supports if required. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The cage and each arm shall be designed to withstand 150 percent of the design running torque of the drive without over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.

B. The mechanism shall include two long sludge rake arms of steel truss construction with spiral steel scraper blades.

C. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

D. Blades shall properly convey settled sludge to the sludge withdrawal.

E. The arms shall be adjustable at the cage to assure an even grout thickness over the tank bottom.

F. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not re-suspend settled sludge.

G. The tank floor slope and sludge withdrawal pit design shall be verified by the clarifier equipment manufacturer.

2.07 ACCESS BRIDGE, AND HANDRAILING

A. The existing walkway and platform with handrails shall be supported by the drive unit and influent column at the center and the tank wall at its outer end.

B. The clarifier supplier shall field measure the bridge and it’s components prior to shop drawing submittals to ensure all connections to their mechanism are compatible with the existing bridge. The connections shall be designed by the clarifier manufacturer and all steel components necessary shall be supplied and installed. The minimum thickness shall be one quarter inch.

C. It may be necessary to raise the elevation of the existing bridge and platform to accommodate the new equipment. Clarifier manufacturer is responsible for providing new supports for the bridge and platform to the existing clarifier wall and stairs if the elevation of the platform is raised. **(Addendum 1, Issued 01/06/20)**.

2.08 SURFACE SKIMMER

A. The clarifier manufacturer shall furnish two skimming devices as part of each mechanism. The skimming mechanism shall be arranged to sweep the surface scum between the feedwell and scum baffle into a full radius scum trough cantilevered from the tank wall.

B. Each skimmer arm shall be supported by a suitably designed truss, tube, or pipe assembly connected to the center cage and cantilevered over the scum trough. Tie rods shall be properly located to allow adjustment of the skimmer arm as well as to hold the skimmer in horizontal alignment. Each skimmer arm shall be equipped with a 1/4 inch 50-60 durometer neoprene wiper blade extending the full width of the scum trough. Steel back-up bars shall be fastened to the back of the wiper with stainless steel fasteners.

C. A submerged portion of the wiper shall form a C-cup shape to trap and carry surface scum and water up the beach ramp and deposit the contents into the trough. The C-cup assembly shall be fully submerged to minimize scum from escaping underneath the wiper as the scum is transported to the scum trough.

D. The full radius trough shall be supported from the tank wall and fabricated from 1/4 inch steel plate and structural steel angles to form a trough. The scum trough shall span the distance between the feedwell and the scum baffle. The trough and supports shall be designed for a 200-hundred-pound point load at the feedwell end of the trough in addition to all dead loads and shall not deflect more than 2 inch in an empty tank. The feedwell end of the trough shall be 6 inches deep and slope down to the wall end with a 6 inch Schedule 40 stub pipe. A flexible coupling shall be provided for connection from the 6 inch Schedule 40 stub pipe to the scum withdrawal piping in the tank wall. The front side of the trough shall include a minimum 12 inch wide ramp for removal of scum. The scum is trapped as the wiper meets the ramp and is conveyed up the ramp to be dumped into the scum trough for disposal. The feedwell end of the trough shall have a vertical steel plate extending 1 foot out in front of the ramp to help trap the scum as the skimmer approaches the ramp and to prevent the scum from flowing around the outside edge of the trough. Fabrication of the scum trough shall be true and free from any warpage.

E. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and

closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.

2.09 SURFACE PREPARATION PAINTING

A. All surfaces shall be prepared in accordance with Section 01350.

B. The Contractor shall have the option of field painting or galvanizing all supplied steel components.

2.10 ANCHOR BOLTS

A. All equipment anchor bolts shall be stainless steel. The equipment manufacturer shall furnish a steel template and grout shield to accurately locate the center pier anchors and to allow grouting beneath the pier and manifold seal plate.

2.11 CONTROL PANEL

A. A complete control panel shall be furnished for the clarifier operation. Panel will accept three phase 480VAC, and include the following:

1. NEMA 4X SS enclosure with disconnect handle.
2. Main circuit breaker and control power transformer sized for controls and overload housing and panel heater.
3. Motor starter and overloads.
4. HAND-OFF-AUTO switch, green running light, amber torque warning light, amber torque overload light, torque reset pushbutton, alarm horn and strobe light, and alarm acknowledge/silence pushbutton, and panel heater with thermostat. Indicator lights shall be LED push-to-test type.
5. Typical panel internals including but not limited to breakers, fuses, relays, terminals, wireway, cable and wire markers, ground bar, etc.
6. For interface to existing plant SCADA the control panel shall accept start signal, and provide dry contacts for motor running, HOA status, and torque warning.

2.12 DENSITY CURRENT BAFFLES

A. Clarifiers T-9 and T-10 shall be furnished with a density current baffle at the tank periphery below the effluent weir designed to deflect density currents away from the weir. The baffle shall be constructed of minimum 1/4" thick fiberglass sheets supported on triangular aluminum or fiberglass supports which are anchored to the tank wall. The baffle shall slope downward toward the tank center at a minimum 45 degree angle to prevent build-up of sludge deposits. Vent holes shall be provided to allow trapped gases to escape.

B. Density current Baffles shall comply with ANSI/AWWA Standards as applicable for wastewater treatment, size and mounting location shall be determined by clarifier configuration to maximize solids retention and withstand buoyant forces.

PART 3 EXECUTION

3.01 ACCEPTANCE TEST

A. The sludge collector mechanism shall be field tested, after erection, and in the presence of the Engineer to confirm and verify the structural and mechanical compliance to the torque requirements specified by loading each collector mechanism with 100 percent and 120 percent of AGMA rated torque specified. This field test shall include checking the operation of warning and drive shutdown circuitry.

B. The manufacturer shall submit complete test procedures to the Engineer for approval. Testing shall be accomplished with the machine in operation. Loads shall be applied to the mechanisms' truss arms through cables or other means, anchored to the tank floor or wall. Load shall be applied by means of a hydraulic cylinder or springs or any means which allows the machine to rotate for a peripheral distance of at least 3 feet under load.

C. All labor, materials, and test apparatus necessary for conducting the above test shall be furnished by the Contractor at no additional cost to the Owner.

3.02 INSPECTION, STARTUP, AND TRAINING

A. The Contractor shall furnish a factory-trained representative of the manufacturer to perform inspection, start-up, and training services. The manufacturer's representative shall be experienced in the installation, startup, operation and maintenance of the equipment.

B. The representative shall check the installation prior to floor grouting. The representative shall certify that the equipment is ready for the procedure and shall train the Contractor on the proper procedures installing the floor grouting.

C. Once the tank is ready to startup, the representative shall check the installation and supervise final adjustments and initial startup of the equipment. Special attention shall be directed to checking the installation of the seals at the manifold. He shall check for the proper clearances between the sludge mechanism and all areas of the grouted floor. He shall certify that the installation is correct and that the equipment has operated satisfactorily. Within two weeks of the startup inspection, the manufacturer shall submit to the Engineer a written report detailing the representative’s inspection and including the written certification that the installation is correct and is operating correctly.

D. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment. The Owner may videotape the training.

PART 4 SPECIAL PROVISIONS

4.01 DESIGN CRITERIA

A. The hydraulics for the final settling tank shall be designed to handle:

	Minimum	Average	Maximum
Effluent Flow (mgd)	0.5	1.5	3.16
Return Flow (mgd)	0.5	1.0	1.5
Mixed Liquor Flow (mgd)	1.00	3.0	4.66
Center Pier Diameter	16 inch		
Influent Well Size	13-15 feet in diameter by 5 feet depth		

B. Drive.

Motor Horsepower	1.0 hp
AGMA Rated Continuous Torque	~~8,000~~ 14,700 feet-pounds
AGMA Rated Peak Torque	~~16,000~~ 29,000 feet-pounds
Speed	8.5-12ft/min

(Addendum 1, Issued 01/06/20)

C. Tank Dimensions.

1. See Drawings for final clarifier layout and dimensions.

4.02 DBS DRIVE ~~ALTERNATICE~~ ALTERNATIVE BID ITEM (ADDENDUM 1, ISSUED 01/06/20)

A. General: The drive mechanism shall consist of an electric motor, primary hydraulic reduction unit, and an enclosed final reduction unit consisting of a pinion and an internal tooth gear.

B. Primary Hydraulic Reduction Unit: The primary hydrostatic reduction unit shall drive the intermediate gear reducer.

1. The primary reduction unit shall consist of a hydraulic gear pump and a hydraulic motor.

2. The primary reduction unit shall have an integral hydraulic manifold that shall incorporate a hydraulic pressure relied calve to give protection against overload, flow control calve, a dual function cartridge cavity for uni-directional or bidirectional operation, a 4-20 mA transducer port, a pressure gauge port, and a hydraulic filter port.

3. A minimum service factor of 3.0 shall be applied to the catalog rating of any commercial hydraulic component.

4. All hydraulic components shall be enclosed in a steel housing of sufficient size to contain the minimum volume of 6 gallons of hydraulic fluid. The housing shall serve as the reservoir for the hydraulic oil.

5. Internal oil circulation in the event of any hydraulic pump or motor seal leakage.

6. A disposable "spin-on" type hydraulic filter shall be provided to filter the hydraulic oil.

7. Hydraulic pump drive shaft must be vertical to permit vertical mounting of electric motor.

8. Individual hydraulic control components plumbed together with pipe or hose fittings shall not be allowed.

C. Intermediate Gear Reducer: The intermediate gear reducer shall be mounted on the top of the final reduction unit and properly registered to maintain accurate centers for the final reduction gearing.

1. The intermediate reduction unit shall have sufficient bearing capacity to fully the pinion gear without a lower support bearing.

2. The L_{10} life of the intermediate gearbox bearings shall be in excess of 100,000 hours at 16,000 ft. lbs. operating torque.

3. The Service Factor shall be greater than 2.5.

4. The intermediate reducer shall be AGMA rated for 10 million cycles, when drive is operating at continuous output torque of 16,000 ft. lbs.

D. Final Reduction Unit:

1. The final reduction housing shall be manufactured from A36 steel plate. All welds shall conform to applicable specifications of the AWS. After welding, all mounting and mating surfaces shall be machined to insure proper fit and alignment of the drive pinion and mating gear. The base plate on which the gear and bearing is mounted shall be flat within 0.008". The steel plate to which the intermediate pinion drive gearbox is mounted shall be a minimum of 1.5" thick.

2. The final reduction housing shall employ a fluid hermetic seal and a Neoprene seal between the housing and the main gear driven rotating member to prevent passage of air or water into the final reduction housing.

3. The final reduction unit internal tooth gear shall be machined to AGMA grade 6 or higher. Gear teeth shall have a core hardness of 250 to 300 BHN, and be induction hardened to 55Rc. The main gear set shall be rated per AGMA Standard 2001-C95 for 20 years at a continuous torque load of at least 40,000 ft. lbs. Gear pitch diameter shall be a minimum of 30".

4. The main gear support bearings shall have an L_{10} life in excess of 100 years.

5. The final reduction unit pinion shall be made of heat-treated alloy steel and shall be mounted on the output shaft of the intermediate reduction gearbox. The gear teeth shall be induction hardened to 55 to 60 Rc.

E. Electric Motor: The drive motor shall be Mill & Chemical Duty TEFC, 1.15 Service Factor, Class F insulation.

F. Overload Device: The overload protection device shall have two independent switches, which may energize an alarm circuit when the load on the mechanism approaches overload and pen the motor circuit when and excessive overload occurs. The switches shall be enclosed in NEMA 4x HOUSING. Overload device shall have a 6" diameter stainless-steel torque gauge indicating torque load on drive unit in ft. lbs. Overload alarm, and overload cut off torque settings shall be factory preset per customer specifications.

G. The entire drive unit shall be designed for a maximum duty torque of at least 32,000 ft. lbs., and the final reduction unit main gear set shall be designed for a momentary peak torque of at 94,000 ft. lbs. All calculations of gear & bearing life shall be made in accordance with the latest AGMA and AFBM standards.

H. All lubrication shall be of the totally enclosed grease or oil bath design.

I. The drive mechanism shall be manufactured by DBS Manufacturing, Model D30-AF.

END OF SECTION