EXHIBIT A

IRRIGATION PUMP STATION

PART 1 – GENERAL

1.01 **SUMMARY**

A. It is the intention of this specification to describe a fully operational, automatic, prefabricated pump station. Design, fabrication, testing and service shall be the sole responsibility of the pump station manufacturer. The pump station shall provide the required water volume while simultaneously maintaining a constant discharge pressure by using a prefabricated pump station with variable frequency drive (VFD) pumps for pressure regulation, under varying flow conditions up to the maximum specified capacity.

B. Contractor is to provide a complete and working pumping system. Furnish all labor, materials, supplies, equipment, tools, transportation, and perform all operations in connection with and reasonably incidental to the complete manufacturing and installation of the pumping system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein.

C. The prefabricated pump station shall have a minimum capacity and discharge pressure at skid edge as described in the technical specifications.

D. The station shall be completely wired, piped, hydraulically, electrically, and flow tested to full station capacity at factory prior to shipment to job site. Documentation of the dynamic test shall be verified by the Owner prior to pump station shipment.

E. Construction shall include a fabricated steel plate and skid assembly to support all components during shipping and to serve as the installation mounting base.

F. The intake and discharge manifold from the pump station shall terminate at or near the pump station skid edge and be provided by the pump station manufacturer.

1.02 **REFERENCE STANDARDS:**

1. ANSI- American National Standards Institute
2. ASTM- American Society for Testing and Materials
3. NEMA- National Electrical Manufacturers Association
4. IEEE- Institute of Electrical and Electronics Engineers
5. NEC- National Electrical Code
6. UL- Underwriters Laboratories, Inc.
7. Hydraulic Institute
8. American Welding Society

1.03 **PROJECT LOCATION**

The project is located**: Whittington, IL**

1.04 **CONTRACT DOCUMENTS**

A. The general nature and extent of the work and the appurtenant facilities are as shown on the Drawings under the title: **Rend Lake Golf Course**

B. Perform work within the Limit of Work line that may be indicated on the Drawings and per the discretion of the Owner.

1.05 **DRAWINGS**

A. Drawings such as utility and irrigation plans, etc., are essentially diagrammatic. Actual runs indicated on the Drawings shall be followed as closely as coordination with the work of other trades will permit.

The exact routing of such improvements and locations of equipment shall be governed by site conditions, obstructions and locations of other utilities as acceptable to the Owner.

B. In the event that discrepancies arise over dimensions, product references, omissions, or written statements, these conflicts shall be immediately brought to the Owner's attention by the Contractor. If available, this may be accomplished with the use of a "Request for Information" (RFI) form. While awaiting direction or clarification from the Owner, the Contractor shall re-direct work as necessary so as not to cause delay to the project.

C. If discrepancies arise between plans, details, specifications, addenda or any other portion of the Contract Documents, these conflicts shall be immediately brought to the Owner's attention by the Contractor. If available, this may be accomplished with the use of a "Request for Information" (RFI) form. While awaiting direction or clarification from the Owner, the Contractor shall re-direct work as necessary so as not to cause delay to the project.

D. Products, materials, labor, etc., installed or performed without proper clarification, or prior to Owner acceptance shall be the Contractor's sole responsibility and shall be removed, repaired, replaced, and/or reinstalled per the Owner's direction at no additional cost to the Owner or its agents.

1.06 MATERIALS

A. All materials and equipment used in the work herein specified shall be in new, first class condition (unless otherwise noted or scheduled), suited to the intended use.

B. Materials shall be delivered to the site and stored in original containers sheltered from the elements, but readily accessible for inspection by the Owner's Representative until installed.

C. Materials of the same general type shall be of the same make and quality throughout the work to provide uniform appearance, operation and maintenance ease.

D. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard equipment. Furnish optional or additional accessories as specified.

E. Where make of material or equipment is not specified, any product by a reputable manufacturer that conforms to the requirements of the Construction Documents may be used with the Owner's Representative's acceptance.

F. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products.

G. All equipment items shall be supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the Specified Warranty Period.

PART 2: PRODUCTS

2.01 MANFUCTURER

A. The pump station shall be as manufactured by **Watertronics, Inc.,** Hartland, Wisconsin.

B. To be considered as equal, the following information must be furnished by the contractor or manufacturer's representative:

1. A complete specification and submittal of all major components for the proposed pump station with individual pump performance verification.
2. A detailed pumping station proposal drawing complete with component location, sizes and dimensions specific to the installation.
3. A complete electrical schematic for all high and low voltage circuits showing all circuit breakers, fuses and wire sizes. All wire numbering and colors must be designated.
4. Pump station manufacturer's U.L. file number for the electrical controls and pump station.
5. A copy of the manufacturer's certificate of insurance.
6. Product support technicians shall be capable of accessing all information pertaining to the pumping equipment, e.g. electrical schematics, pump curves, program data, bill of materials, etc. The manufacturer shall have no less than two technicians on call seven days a week.
7. The pump station manufacturer shall provide factory authorized or factory direct service personnel for the set, start-up, preventative maintenance and general service of the pump system. A factory authorized or factory direct service technician must be located within one-

hundred (100) mile radius of the project site. The pump systems technician must have a minimum of 5 years' experience. The pump station manufacturer shall provide technical phone support twenty-four hours a day seven days a week.

2.02 CONTROL PANEL:

A. The pumping station electrical controls shall be mounted in a self-containing NEMA 4 enclosure fabricated from not less than 12 gauge steel. Door gasket seals shall be neoprene sponge, sufficient to protect interior components from weather and dust. The electrical panel doors shall be constructed from 12-gauge steel with integral latches.

B. All external operating devices shall be dust and weatherproof. All internal components of the enclosure shall be mounted on a removable back panel. Mounting screws for components shall not be tapped into the enclosure wall. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in any electrical control panel.

C. The control panel shall be designed, built, tested and U.L. listed by the pump station manufacturer. U.L. File Number E142155

D. A closed type cooling system shall be included to cool the enclosure and reject heat from the VFD. **Open type cooling systems allowing outside ambient air to enter the panel are not acceptable**. No water line connections shall be permitted inside of the control enclosure. VFD status and internal parameters must be viewable without the opening of the enclosure door.

2.03 MAIN SERVICE DISCONNECT

A three-pole, main station disconnect shall be contained within the NEMA 4 control enclosure. Disconnect shall be non-fused and isolate all power to the control enclosure. The station disconnect shall have an operating handle mounted in the enclosure door, mechanically interlocked to prevent entry while disconnect is in ON position.

2.04 MOTOR COMBINATION STARTERS-BREAKER

Each motor shall be protected by a MSP combination starter and breaker. Device will be UL 508 Type F. Motor starter protector and contactor are electrically and mechanically linked by means of a link module and adapter plate. All starters are suitable for usage in a group installation application according to NEC-430-53(c).

2.05 VARIABLE FREQUENCY DRIVE

A. The variable frequency drive shall be IGBT based with selectable carrier frequency up to 12 KHZ. The VFD shall include terminals for incoming power, motor output power and control terminals.

B. The VFD shall generate a sine-coded, variable voltage/ frequency, three-phase output for optimum speed control. The VFD shall incorporate power loss ride-through for a minimum of 2 seconds. VFD protective features shall include current limit, auto restart, short circuit protection, electronic motor overload protection and ground fault protection. The VFD shall have a push button programming display for easy access to operation parameters. The VFD shall be protected on the primary side by fuses of the appropriate amperage.

C. Overload capacity: 110% rated output current for one minute. Voltage Fluctuation: +10%, -15%. Sine wave PWM with full range, automatic torque boost. Frequency Control Range: 0.1 to 400Hz. Frequency Accuracy: Digital, 0.01Hz, Analog. 0.1%. Motor overload protection, Instantaneous Over current of 180% of rated output current. Over voltage at 820VDC if 460V input. Under voltage: user adjustable. Momentary Power Loss: up to 2 second ride through. Electronic Ground Fault. LED capacitor charge indicator. Input Phase loss alarm. Ambient temperature range of + 14 to 104 degrees F. Humidity of 95% non-condensing.

2.06 CONTROL TRANSFORMER

A control transformer shall provide 120-volt power to the pump station controls. The control transformer shall be protected on primary and secondary sides with appropriately sized fuses. No load other than the pump controls shall be supplied by the control transformer.

2.07 SECONDARY CONTROL CIRCUIT BREAKERS

Secondary distribution circuit breakers with appropriate ratings shall supply power to each pump starter coil circuit, the control system and to other circuits as specified.

2.08 MAIN PANEL POWER PHASE MONITOR

The incoming power shall be protected by a phase loss/low voltage system dropout relay to de-energize the pump station control circuit if a phase failure, phase reversal or low voltage condition occurs. If after attempted automatic re-starts the phase failure/low voltage alarm condition remains, the alarm must be manually reset.

2.09 CORROSION INHIBITING MODULES

Corrosion inhibiting modules shall be installed in all electrical enclosures in accordance with the manufacture's recommendations.

2.10 PROGRAMMABLE LOGIC CONTROLLER (PLC)

The pump sequence controller shall be an industrial grade PLC with diagnostic LEDs for monitoring of discrete inputs and outputs. Not less than four analog inputs and two analog outputs shall be standard for monitoring and control purposes. The PLC shall contain two independently addressable ethernet ports for monitoring and programming. The PLC shall contain one serial port for monitoring or control of other serial devices. The PLC shall contain an EEPROM for permanent program storage. The PLC shall contain non-volatile memory for storage of critical configuration data.

2.11 AUTOMATIC PRESSURE REGULATION BASED ON VARIABLE FLOW

The pump station controls shall be capable of changing the regulated downstream pressure while in operation, based on discharge flow or discrete input as called out by the technical specifications. The pump station controls shall also be capable of up to six, user adjustable pressure regulation set points based on discharge flow or one additional set point based on a discrete input. In addition to adjustment of downstream pressure, the controls shall be capable of up six pressure regulation algorithms to insure accurate pressure regulation regardless of regulated pressure, discharge flow or connected pump combination.

2.12 VFD BACKUP PRESSURE REGULATION

A. Pump station manufacturer shall provide a line item option for a redundant pressure regulation device in the event the single specified VFD unit faults or fails. Redundant pressure regulating device can be hydraulic pressure regulation per individual pump or VFD per individual pump. The back-up mode shall automatically regulate pressure in the event the main VFD fails. There must be no more than a 10-minute loss of irrigation in any VFD failure. The VFD back–up pressure regulation mode must provide full station design flow as indicated in the technical specifications.

B. Utilizing the pressure relief valve is **not** an acceptable pressure regulation back up device.
Acceptable Methods include**:**
   - Hydraulic Control Valve per pump
   - VFD Per Pump **(BTU analysis with corresponding cooling feature required)**

C. Design detail, valve / cooling equipment submittals and BTU analysis (VFD option) are required to be included with bid documents.

2.13 USER DEFINED PRESSURE SET-POINT BASED ON FLOW ZONES

The operator shall be capable of changing the regulated downstream pressure based on discharge flow or discrete input as called out by the technical specifications. The pump station controls shall also be capable of up to six, user adjustable pressure regulation set points based on discharge flow or one additional set point based on a discrete input. In addition to adjustment of downstream pressure, the controls shall be capable of up six pressure regulation algorithms to insure accurate pressure regulation regardless of regulated pressure, discharge flow or connected pump combination.

2.14 LEAD PUMP SELECTION

Lead selection of equal horsepower pumps shall be accomplished by total accumulated pump running time. The pump with the lowest accumulated running time shall be the next pump started in the sequence. Alternating logic for selection of lead pump shall not be accepted.

2.15 ALARMS

Controls shall shut down the pump station in the event of the following alarm conditions. The controls shall attempt to restart the system after alarm shutdown or loss of power. After a user adjustable number of attempts to re-pressurize the system, the controls will go into hard shut down and remain there until manually reset.

1. Low discharge pressure cutout. Pressure remains 20 PSI below regulate set point for set time delay.
2. High discharge pressure cutout. Pressure remains 11 PSI above regulate set point for set time delay.
3. Phase/ voltage cutout. High or low voltage, loss of phase, or phase reversal.
4. Low inlet pressure cutout. Pressure remains below set point for set time delay.
5. Starter fail cutout. Output to starter is not met with corresponding running input for set time delay. Indicates overload, phase imbalance or control fuse.
6. VFD fault and VFD bypass status.

2.16 OPERATOR INTERFACE

A. The controls will utilize an industrial programmable logic controller (PLC) with 10” color touchscreen, a HOA switch for each of the main motors, an emergency stop button, and a reset button. The user will be able to monitor, adjust, and control all the station parameters from the touchscreen. The PLC will include custom programming and screens that allow the user to monitor/log and adjust operation parameters.

B. Operator interface shall be a full color display touchscreen unit mounted in the enclosure door. Operator interface shall be used for logical display of all pump station functions. The operator interface shall have a IP 65 rated Water-Resistant Front Panel. The operator interface shall be touch sensitive with intuitive on-screen user instruction for ease of operator use. The operator interface shall be no less than 1024 x 600 pixel resolution, with viewing area measuring not less than 10.0" diagonal. User memory for storing critical pump operation data shall have no less than 1GB of storage capacity.

C. The operator interface shall allow the user to view and modify all pertinent operation parameters. The operator interface shall incorporate password protection for modification of critical pump station parameters. The operator interface capabilities shall include but are not limited to the following:

- Overview screen showing pump system configuration. Screen shall show:
  - If each individual pump is enabled or disabled.
  - The number of hours on each pump.
  - Station full flow and pressure design criteria
- System screen with information on current regulation pressure, setpoint, regulation pressure, System status, restarts remaining, VFD reference speed, pressure regulation method (VFD or EBV modes) and adjust settings button. Adjust settings button will allow changing parameters etc. after entering password.
- Settings menu to allow changes to pressure regulation settings, pipe saver mode, VFD manual mode, analog calibration, flow calibration, program or register settings.
- Flow screen will display pressure in PSI, flow in GPM and total gallons pumped in thousands of gallons. Separate display for total gallons pumped since last reset.

- Alarm status with time stamping, display of pump station conditions at shutdown and restart. Alarms will be displayed in red when activated and a separate listing will be displayed in green when the alarm is reset. Alarms will be logged to a compact flash disk allowing the service technician to upload data to a spreadsheet type program.
- Full control of and capability of monitoring, adjusting and viewing any options present such as water level, inlet strainer, wye strainer, filtration, chemical injection, or liquid tank levels. Adjustment of automatic/manual pressure regulation set points.
- Graphing capability for up to one full year detailing flow rate and pressure. Graphing function shall give option to graph and plot a point every minute. The graph function will be selectable by day, month and year as well as the time of desired graph. All data will be logged to a compact flash disk allowing the service technician to upload data to a spreadsheet type program.

D. The touchscreen will be connected to a Watertronics supplied Ethernet switch. The wireless switch will communicate via a customer Ethernet communications network to the internet. The wireless router/switch will allow Watertronics control engineers to remotely monitor and modify the system in real time to insure satisfactory operation.

2.17 REMOTE ACCESS INTERFACE [TOUCH SCREEN EMULATOR]

- The station shall contain an integrated local WiFi router that allows for connections to node control via HTML5. The station shall contain a node controlling computer system. The HMI interface will be integrated directly to the node control system and accessed via QR code on the control panel.
    - The HMI interface will allow for direct monitoring and control from the station.
    - The PLC has an embedded web server that serves up the same user interface that is on the physical HMI in the panel.
    - Using the router's Wi-Fi, any Wi-Fi client with an HTML5 capable browser can connect, navigate, login and make configuration/calibration adjustments.
    - Multiple clients can be connected simultaneously and navigate independently from each other and independently from the physical HMI in the panel.
- Factory Direct Access Available
    - Monitoring
    - Troubleshooting
    - Programming Updates

2.18 WATERVISION CLOUD BASED REMOTE MONITORING AND CONTROL SOFTWARE FOR PERSONAL COMPUTER, TABLET, AND SMART PHONE

The pump control system shall incorporate a remote monitoring and control system (Watervision Cloud) that is accessible from any HTML5 enabled device.

A. Connectivity

1. Pump controls: The pump controls shall be connected to the internet via a RTU (Remote Telemetry Unit) that shall transmit the pump station parameters to a secure central data collection point, from which they can be retrieved. The RTU shall communicate directly to the pump control PLC through an ethernet port. The RTU shall poll the pump station controls continuously and transmit to the secure central data collection center only on a change of state. The RTU shall be connected to the internet via a cellular or Ethernet as called out in the technical specification.
2. Web enabled device: The web enabled device for remote monitoring and control of the pump system shall require a HTML5 enabled browser.

B. Secure data storage

- Historic and cloud-based data shall be stored on secured, scalable, distributed infrastructures.
- The data storage infrastructure shall have the highest levels of security. Within the infrastructure the data shall be encrypted and compressed inside of a secure database.

- Physical security and distribution shall be managed by an external provider that specializes in cloud-based computing. This allows for the prevention of multiple sorts of bad actor intrusions, such as viruses and others.
- Historic and backup data is backed up daily and moved to separate, secure storage to facilitate disaster recovery.

C. Features

The remote monitoring and control system shall be accessed by a secure login and password. A user hierarchy shall provide varying levels of access as defined by the system administrator. Upon successful login, the user shall be able to monitor their pump system and any attached ancillary devices on a single overview screen. Additional pump monitoring and control features shall be accessed through links from the overview screen. Specific features of this system shall include, but not be limited to:

- Pump station disable
- Alarm reset
- Status of 15 Main Pumps and a Sustain Pump
  - Ready, Running, Hours, Capacity, Frequency, Current, HOA State
- Individual Pump disable for all 15 Main Pumps plus Sustain Pump
- Discharge Pressure Information (Setpoint, current Pressure, Low-Pressure & High-Pressure Alarm SP)
- Flow information (Current Flow, Flow of all enabled pumps, Flow of all pumps, Flow of all running pumps)
- Inlet Pressure Information (Current Pressure, Low-and High-Pressure Alarm SP)
- Water Level Information (Current Level, Low-and High-Level Alarm SP)
- Current regulating Frequency Status
- Current Power Status
- Status for up to 6 Water sources (Ready, Running, Water Level, Flow, Volume)
- Control and Configuration for up to 6 Water sources (Enable/Disable, Override, Water Level SP, Window to start source)
- Discharge strainer status
- Discharge Filter Status (Ready, Flushing, Upstream Pressure, Downstream Pressure, Differential Pressure, Different Pressure SP)
- Inlet Strainer Status (Ready, Running)
- Status for up to 4chemical injection pumps (Ready, Running, Tank Level, Frequency)
- Control for up to 4 chemical injection pumps (Tank Level SP, Enable/Disable)
- Up to 5 Time of use Lockout Groups for Pump lockout control including Sustain Pump
- Water Management for a daily and/or monthly volume exceeded shutdown
- Cabinet Temperature Monitoring
- Water Report for individual Pump station or complete customer account
- Energy Report for individual Pump station or complete customer account
- Alarm notification through text messaging or email
- Ad Hoc Trend to diagnose pump station and monitor additional pump station status variables

2.19 PRESSURE TRANSDUCER

A solid-state pressure transducer shall provide a noise free, linear output proportional to discharge pressure. Transducer shall be solid-state, strain gauge type with integral voltage regulation and output accuracy not less than 0.25%. The transducer shall be constructed of stainless steel and rated for the discharge pressure of the pump station as called out in the technical specifications.

2.20 FILTRATION SYSTEM

A. The pump station shall be equipped with a filtration system to assure a clean water supply to the irrigation system. The filtration shall consist of individual barrels containing removable filter elements. The number of barrels, the specific filter model number and filter screen micron rating shall

be called out in the technical specification. Each removable filter element shall consist of a course screen in series with a fine screen. The fine screen shall be flushed periodically to remove accumulated debris.

B. Flushing initiation shall be a timed interval, user adjustable, and a pressure drop across the screen, also user adjustable. Flushing control shall be governed by the pump station PLC. Separate flushing controls shall not be accepted.

C. Flushing action shall be initiated by an electronically actuated butterfly valve. The Electric Butterfly Valve (EBV) is impervious to dirty water vs. a hydraulic diaphragm valve susceptible to damage due to the filtered particles being flushed. Using a hydraulic diaphragm valve as the filter flush valve is **not acceptable.** To assure tolerance to dirty water, electric butterfly valve shall open/close at a programmed rate to eliminate excessive pressure drop or pressure spike.

D. Operation: Water shall flow into the **316 stainless steel** filter body and through the 316 stainless steel filtering screen from the inside out allowing blocked contaminates to accumulate on the inside surface of the filtering screen. Differential pressure across the filtering screen shall be continuously monitored as the filter cake builds on the inside of the filtering screen. The differential pressure across screen shall be monitored using a pressure transducer upstream and downstream of the filter assembly. Using a differential pressure switch is **not acceptable**. The pump station control logic shall have the capability of graphically tracking the pressure across the filter for troubleshooting purpose locally at the pump station through the touch screen operator interface device and through the remote monitoring and control software. When the differential pressure reaches an adjustable threshold (recommended at 7 psi), a flush cycle shall be initiated by the opening of the electric butterfly valve. The opening of the flush valve drops the pressure inside the drive chamber allowing flow to reverse through the suction scanner nozzles. The suction scanner nozzles transfer this reduced pressure at the nozzle location onto the inside of the filtering screen surface. This reduced pressure on the inside of the filtering screen creates a reversed flow through the filtering screen, pulling the containments off the screen, back through the suction scanner nozzles and out the flush valve. Once the nozzles have traversed and cleaned the entire screen surface, the flush valve shall close stopping the flush cycle.

E. The drive mechanism of the filter shall **not** consist of electric motor, or limit switches to return the drive mechanism to its start position. The drive mechanism shall allow the suction scanner nozzles to traverse across the screen and return to their start position, and if required, to continue this cycle indefinitely without interrupting the flush flow. A hydraulic motor directly attached to the suction scanner shall drive the suction scanner.

F. The filter screen element shall be **316 stainless steel** with micron opening size called out for in the technical specification. The filter housing and cover shall be manufactured from **316 stainless steel** and shall be manufactured to ASME standards but not stamped unless called for in the technical specification.

2.21 MAGNETIC FLOW SENSOR

A. The pump station shall have a flow sensor installed, which shall be utilized to control the pump station and display instantaneous flow rate along with total gallons pumped through the touch screen operator interface device mounted on the control panel door. The flow meter shall be electromagnetic design comprising of two major components, a flow tube and a signal converter housing with display. The flow meter signal converter shall produce a pulse output signal in linear proportion to flow rate. Flow meter shall read flows from 0-30 fps, with a worst-case inaccuracy of +/- 2% of reading when flowrate is at or below 10% of the meter maximum rated flowrate. Flow meter shall be sized so that maximum system flow lies between 15 and 24 fps through the meter. The meter shall incorporate a straight-thru flow design with no moving parts and minimal pressure loss, low maintenance and high accuracy. Meter shall be installed according to manufacturer's recommendations. The flow tube shall be an ANSI B16.5 Class 150# flanged in sizes 4" thru 12" (no 5" size). Wetted liner shall be Neoprene rubber. Liner shall extend beyond the ends of the flow tube and over the flanged faces. The meter shall be calibrated during the pump station full run performance testing while at the factory prior to shipment using a calibrated master meter.

B. Flow Measurement:

1. Accuracy: 10% to 100% of max flow = $\pm$1% of reading. Cutoff to 10% of max flow = $\pm$2% of reading.

2. Measuring frequency:
Battery power: 1/15 Hz, External power: automatically proceeds with full-speed measurement, with frequency up to 5.5 Hz. Range: 0.3 fps – 30 fps.

C. Battery Power
Battery Life: 3-5 years, Battery Level Indicator: Supported, Battery Replacement: Supported

D. External Power
Voltage Range: 8 – 32VDC, Auto Switch to External Power: Supported, External Power Indicator: Yes

E. User Interface
1. Buttons: Support 1 -2 buttons (reed switch)
2. Display Contents
Flow rate, Total, Battery life, Low battery warning, Empty pipe warning, Reverse flow direction indication
3. Display Digits: Rate - 7 digits, Total – 9 digits
4. Rate Units: Gallon/minute, Liter/minute, Liter/second, Cubic feet/minute, Cubic meter/hour, Million gallon/day
5. Total Units: Gallons x 1000, Acre Inches, Acre Feet, Liters X 1000
6. Unit Settings: Set according to customer requirement before shipment
7. Unit Switching: Switchable by defined user button (reed switch)

F. Output: Frequency (opt. iso., dry contact) – with external power, max frequency 1000 Hz., Pulse (opt. iso., dry contact), Communications – supported with related hardware

G. Working Conditions: Temperature Operating: 14° F – 131° F, Storage: -40° F – 140° F, Pressure: 290 PSI, Conductivity of Medium: 20uS/cm

H. Installation Method: ANSI 150# Flanged

I. Protection Rating: Tamper proof IP68 signal converter housing

2.22 SKID WIRING

A. Skid wiring shall conform to National Electrical Code Standards. All wiring from control panels to motors shall be in metal reinforced, water tight, flexible conduit with copper conductors rated not less than 600 volts and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductor. Flexible conduit runs shall not exceed six feet in length. A grounding cable sized to National Electrical Code requirements shall be included in the flexible conduit. There shall be no splices between the motor starters and the motor connection boxes.

B. Wiring to flow sensors, and pressure transducer shall be multi-conductor, shielded cable suitable for Class II low voltage controls. Wiring to motor operated valves, (option available for VFD stations), shall be in flexible conduit with TFFN #18 gauge copper conductors rated not less than 600 volts.

2.23 JUNCTION BOXES

All off skid devices requiring control interface shall be terminated in a junction box. This junction box shall be located at the skid edge nearest the installation point of the off skid device. Chemical and monitoring systems shall be terminated in a NEMA 4 junction box located on the exterior of the main controls enclosure to allow user connection.

2.24 PUMP ASSEMBLIES

A. Vertical Turbine Irrigation Pump

Bowl assembly including suction case, intermediate bowls and discharge bowls shall be of ***ductile iron.*** The impellers shall be of ***304 Stainless Steel*** , statically balanced. Impellers shall be adjusted vertically by means of an adjusting nut located at the top of the driver. Each pump shaft is to be turned, ground and polished stainless steel having a chromium content of not less than 12%. It shall be supported by bearings above and below each impeller. The size of each shaft shall be appropriate to transmit the horsepower required by the pump.

Each turbine pump inlet strainer shall be corrosive resistant basket type with an area not less than four times the pump suction bell inlet area.

The discharge column pipe shall be A53 Grade B schedule 40 and furnished in interchangeable 10' sections with threaded couplings. The line shafts shall be ground and polished 416 stainless steel, and shall be coupled with steel couplings, have left hand threads, which tighten during operation. Drop-in type shaft centering spiders shall be provided at each column coupling at maximum 10' spacing. The section of shaft passing through the stuffing box shall be stainless steel having a chromium content of not less than 12%.

Turbine Pumps shall have polymer bearings and all stainless steel hardware.

B. Discharge Head

Each pump shall be supplied with a DUCTILE IRON discharge head having a grooved discharge connection. The top diameter of the discharge head shall match the motor base to distribute the load uniformly. The minimum operating pressure of each discharge head shall be no less than 30% higher than the maximum output pressure of the pump. The DUCTILE IRON discharge head will have a tinsel strength of 65,000 PSI.

C. Mechanical Seal

Each turbine pump discharge head shall contain a mechanical seal assembly located where the line shaft protrudes through the discharge head. The mechanical seal assembly shall consist of a main housing, shaft sleeve assembly, locking and drive collars. The shaft sleeve shall be machined from 416 stainless steel. The locking and driving collars shall be machined from 7075 aluminum. Integral to the seal housing, a permanently lubricated ball bearing shall be mounted, located out of the pumping media. The mechanical seal shall be resistant to corrosion and abrasives, totally self lubricating, and rated for no less than 300 PSI. The seal assembly shall require no bypass tubes or related devices to provide cooling or lubrication.

2.25 MAIN MOTOR WINDING CONDENSATE HEATER

Each pump motor will be supplied with a 120-volt space heater in the motor windings to prevent condensation during non-use times. The heaters will be deactivated while the motors are running.

2.26 PRESSURE MAINTENANCE PUMP MOTOR

The pressure maintenance pump shall be equipped with a 3600 RPM, high efficiency submersible motor. The pressure maintenance pump shall perform as specified by the Technical Specifications.

2.27 SKID, PIPING, VALVES, GAUGES, & MECHANICAL EQUIPMENT

A. **Base Construction:** Pump station skid shall be formed from a single sheet of 3/8" steel, continuous welded and smooth ground at all corners resulting in a seamless, one-piece structure with rounded edges and corners. Two 3" holes shall be located at each corner of the skid, on the sidewall, for the purpose of lifting the pump station. The skid shall be strategically reinforced underneath with structural channel iron to support pumps, manifolds, control enclosures and periphery. The skid shall be drilled and tapped for mounting of pumps, manifolds, tanks, relief valves and other equipment. All tolerances shall be sufficient to permit direct bolting of pump station components to skid. No slotted holes shall be permitted in the pump station skid and no nuts or bolt heads shall be permitted on the underside of the skid. The pump station skid shall cover the wet well completely, without the need for a separate wet well cover plate. The pump station skid shall incorporate an integral wet well access hatch measuring not less than 16 inches by 24 inches. The access hatch door shall be both hinged and removable. For safety purposes, the wet well hatch access handle shall not protrude above the skid surface. The skid shall be primed and painted per enclosed specification on both top and bottom. **All skid and piping fabrication shall be performed by American Welding Society certified welders only.**

B. **Fabricated Piping:** All fabricated piping shall conform to ASTM specifications A53 for Grade B welded or seamless pipe. Discharge piping 8" and above shall be a minimum of Schedule 10. Discharge piping 6" and smaller shall be Schedule 40. All welded flanges shall be forged steel slip-on or weld neck type. All welded fittings shall be seamless, conforming to ASTM Specification A234, with pressure rating not less than 150 psi.

C. **Drains:** Drains are to be provided from any possible low point in the system and are to be equipped with 3/8 A or 1/4" brass valves. Drains shall include, but are not limited to, the following:
   - Drain for each pump discharge check valve
   - Drain in discharge manifold upstream of station discharge isolation valve.
   - A wash down 3/4" brass hose bib on the discharge manifold, upstream of the main station isolation valve.

D. **Pump Check Valve:** Pump check valves shall be bolted directly to the pump discharge heads and sized per the technical data sheet. Valve bodies shall be cast from ASTM-126C cast-iron or better and shall be free from blowholes, sand holes, and other impurities. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Internals shall be machined bronze disc, seat, and stem guide. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI. Valves 4" and smaller to be pressure rated for 250 PSI, 6" to 10" to be pressure rated to 150 PSI. Valves 12" and larger check valves to be globe style with 150-PSI rating iron bodied with bronze trim.

E. **Isolation Valve:** Each pump shall be isolated by means of a grooved valve after the check valve and before the discharge manifold. The discharge manifold shall also have a grooved isolation valve at the skid edge (6" and less). Isolation valves shall be butterfly type with gear operators for valves 8" and larger, rated for 200 PSI WOG working pressure. Trim shall include stainless steel stem, bronze or nickel coated iron streamlined disk with full faced resilient seat design to eliminate need for flange gaskets.

F. **Pressure Relief Valve:** A pressure relief valve shall be installed on the discharge piping downstream of the pressure regulating valves. The valve shall be sized to bypass sufficient water back to the water source to avoid the discharge pressure from exceeding the maximum programmed pressure set point by more than 10 PSI.

G. **System Air Release:** Individual pump column air shall be purged prior to entering the pump station inlet and / or discharge manifold. Separation reservoirs or tanks with air/ water balance controls shall not be accepted.

H. **Pressure Gauge:** A pressure gauge shall be located on the discharge and inlet manifolds to indicate the regulated pressure. Pressure gauge shall be 304 stainless steel case and bezel construction. Gauge shall be 4" diameter, liquid filled. Pressure sensing connection shall be 1/4" NPT lower gauge connection.

I. **Lake Level Controls:** The irrigation reservoir shall be continuously monitored by an electronic pressure transducer, which will send a 4-20ma signal to the PLC. The reservoir level will be read on the Touchscreen operator interface and displayed in inches. The user shall be able to control the remote signal activation level by making the desired adjustments on the screen. When low (set point) level has been maintained for the pre-set period, a 120 VAC signal shall be sent to a dry contact relay in the pump station panel to activate the start signal for a fill pump or valve. Upon a rise in the reservoir level the signal will stop and the relay will drop out to stop the filling operation. Lake level wire terminal connections will be located in a J-box on the control panel exterior.

J. **Pipe Support Stand:** Furnish manufactured steel pipe support stand as shown on the drawings and details. Support must be capable of supporting the weights. dead load and be adjustable within the range shown on the pump piping detail.**Access Hatch:** Provide hatch as a hinged component of the pump-mounting skid for access to wet well.

K. **Painting:** Painting of the entire unit shall consist of a multi-step coating system including metal preparation, a rust prohibitive epoxy prime coat and a two part ultraviolet insensitive polyurethane finish having a total dry film thickness of not less than 5 mils. Each coat will be applied and baked for one half hour at 165 degrees F. All pump station components including skid, manifolds, isolation and relief valves, grooved clamps and supports shall be painted potable water blue. All electrical enclosures and accessory panels and tanks shall be appliance white

L. **Other Components:**

- Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, and any other items indicated on the drawings.
- Other Materials: Provide other materials or equipment shown on the drawings or installation details to be part of the pumping system, even though such items may not have been referenced in these specifications.
- All nuts, bolts, washers, and fasteners shall be zinc or cadmium plated for corrosion resistance.

N. **Station Heater**

The pump station manufacturer will provide a thermostatically controlled heater. The heater will be powered from the station control panel and be mounted on a swing arm attached to the panel top.

2.28 POWER ZONE 5KVA

The pump station manufacturer shall provide an auxiliary power supply pre-wired and mounted on the skid. It should be capable of delivering 120-volt OR 220-volt single-phase power, with KVA and breaker ratings and quantity as called out in the technical data sheets.

2.29 FERTIGATION RUN RELAY

The pump station manufacturer shall provide a run relay, which shall provide a start/stop signal for customer supplied fertigation pump. The run relay shall allow the fertigation pump to run only after 100 GPM station flow rate. The station GPM setting to activate or de-activate the fertigation pump shall be field adjustable through the operator interface. The run relay wire terminal connection will be located in a J-box on the control panel exterior.

2.30 ELECTRONIC BUTTERFLY VALVE BACK-UP PRUSSURE REGULATION ON MAIN PUMPS ONLY

A. Pump station manufacturer shall provide an automatic by-pass back-up mode for constant pressure regulation in the event of VFD failure. The back-up mode shall automatically function on the fly during an event of a VFD failure, without loss of irrigation. The VFD back–up mode must provide constant pressure at variable flow without causing line surge. Utilizing the pressure relief valve is **not** an acceptable automatic back up mode due to its inability to provide surge free constant pressure regulation at variable flow demand. The automatic VFD by-pass mode shall be either controlled hydraulically through a pressure-regulating valve per pump or EBV (electronic butterfly valve(s).

B. The pump station discharge pressure shall be regulated to provide surge-free constant pressure as programmed via the control panel operator interface. Discharge pressure shall be regulated by an Electronic Butterfly Valve, consisting of the following:

1. Gradual entry of water from the EBV pump into the discharge manifold to allow for complete purging of pump column air and elimination of surges.
2. Maintain programmed downstream pressure regardless of discharge flow.
3. Up to six, user adjustable PID control settings to ensure accurate pressure regulation at all flows, programmed pressure, or connected pump combination.
4. Adjustable pressure ramp-up and ramp-down to assure surge free pressure regulation.
5. After a drop in pressure, gradually increase system pressure over a user adjustable period of time to eliminate surging.
6. Rate of change of pressure control to anticipate and eliminate rapid pressure changes caused by changing system demand.

C. Adjustment of regulated downstream pressure shall be accomplished though the control panel operator interface. Individual pressure regulating valves shall be butterfly type with electric motor gear actuation. The maximum allowable pressure drop across the butterfly valve at full pump capacity shall not exceed one PSI. The Butterfly Valve shall be rated for not less than 285 PSI.

2.31 COMPOSITE PUMP STATION ELNCLOSURE

A. The pump station shall be totally enclosed by a modular type enclosure that is constructed of non-corrosive composite materials.

B. The composite enclosure shall completely enclose the pump station mounting base and be flush with pump station pad.

C. The pump station enclosure shall consist of the following:

Side panels, two sets of double doors and pitched roof panels formed from fiberglass reinforced composite material. This material will be a 32-lb density closed cell fiberglass reinforced polyurethane panel having the following physical properties.

Material Properties	**.05”**	**.75”**	**1.0”**
Tensile Parallel: strength	6,220 psi	4,298 psi	3,837 psi
Tensile Perpendicular: strength	186 psi	274 psi	343 psi
Shear: Strength	530 psi	641 psi	685 psi
Shear: Modulus	3,750 psi	5,376 psi	6,243 psi
Compression: Strength @ 2.5% strain	366 psi	454 psi	339 psi
Compression: Modulus	14,700 psi	18,154 psi	13,627 psi
Flex: Strength	6,813 psi	5,372 psi	5,669psi
Flex: Modulus	311,180 psi	217,520 psi	278,440 psi
Static Bending: Strength	6,813 psi	5,563 psi	6,422 psi
Static Bending: Modulus	378,770 psi	279,310 psi	286,450 psi
R-Value:	1.22F(ft^2)h/Btu	1.92F(ft^2)h/Btu	2.24F(ft^2)h/Btu
Coefficient of Linear Expansion:	1.33 X 10^-5 in/in/F	1.33 X 10^-5 in/in/F	1.33 X 10^-5 in/in/F
Mold/Fungi Test:	Passed Rating of 0	Passed Rating of 0	Passed Rating of 0

Corner posts, center posts and header beams shall be formed from structural composite profiles having UL 94 VO Flame Resistance Properties. The chart below is a typical listing of mechanical properties of the structural profiles utilized within the composite enclosures.

Mechanical Properties	**Unit**	**Value**
Tensile Strength	Psi	12,500
Tensile Modulus	Psi X 10^6	1.2
Flexural Strength	Psi	25,000
Flexural Modulus	Psi X 10^6	1.1
Compressive Strength - flatwise	Psi	34,000
Compressive Strength - edgewise	Psi	29,500
Shear Strength	Psi	13,000
IZOD Impact Strength	Ft.-lb./in.	9.6
Water absorption in 24 hrs	% by weight	.2
Specific Gravity		1.8

A header beam shall run from corner post to corner post on all sides of the enclosure. The header beam shall be chemically fused to the corner posts and center posts utilizing a Methacrylate structural adhesive. The composite framework is then attached to the skid utilizing the supplied mechanical hold-downs.

Each side panel shall have either a corner or center post on each side. Corner and center posts hold side panels in place from behind. Header beams hold side panels in place at the top and front.

D. The entire roof shall be removable without disturbing the remainder of the building. The roof panels shall sit on top of and bolt to the header beams. Bolts shall be spaced no farther than 20" apart around the lower flange of each roof panel. Removal of these bolts shall be the only obstacle to removing the entire roof. Two lifting points will be attached to the roof assembly for ease of removal. When two roof panels are joined together the mated pair is easily removed with a lifting strap and a boom. Removing the roof panels allows full access to pumps and motors from above. The structure and roof shall have a snow load rating of not less than 110 p.s.f.

E. One incandescent light fixture shall be mounted at least 54" above the floor. The fixture will be suitable for wet locations and a cage will protect the light bulb. The switch will also be suitable for wet locations and be mounted at the edge of the door giving access to the control cabinet. All wire will be protected inside ½" sealtite flexible conduit.

F. A fan shall be incorporated into one fixed side panel. The fan motor shaft shall be placed at least 48" above the top of the pump station skid. The fan shall have protective screening completely surrounding the blades and self-opening shutters on the outside of the panel. The fan shall be at least 18" in diameter and move at least 2800 cfm. The fan shall draw air from within the enclosure. A self-opening louvered panel shall be placed in a fixed side panel as far from the fan as possible. This louvered panel shall serve as air intake into the enclosure. An industrial thermostat will activate the fan.

G. Painting shall consist of a multi-step coating system including composite preparation for use of a two part ultraviolet insensitive Aliphatic Urethane finish having a total dry film thickness of not less than 5 mils. All exposed enclosure components including side panels, doors, roof panels, posts, headers, and mounting brackets shall be painted medium green or Sandstone.

2.32 BACKUP MODE ON VFD

Pump station manufacturer shall provide an automatic by-pass back-up mode for constant pressure regulation in the event of VFD failure. The back-up mode shall automatically function on the fly during an event of a VFD failure, without loss of irrigation. The VFD back–up mode must provide constant pressure at variable flow without causing line surge. Utilizing the pressure relief valve is not an acceptable automatic back up mode due to its inability to provide surge free constant pressure regulation at variable flow demand. The automatic VFD by-pass mode shall be either controlled hydraulically through a pressure-regulating valve per pump or EBV (electronic butterfly valve(s).

PART 3: EXECUTION

3.1 INSPECTIONS AND REVIEWS

Site Inspections:

1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Contracting Officer Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

3.2 EXCAVATION AND BACKFILLING

Contractor to install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer Representative.

3.3 PUMP STATION OFF LOADING & SETTING

Off-loading & setting of the pump station is the responsibility of the **contractor,** unless specifically called out elsewhere in the specification. **Crane** to off-load and set the pump station on the concrete slab is to be provided by **contractor**.

3.4 SITE PREPARATION DRAWINGS

Site preparation drawings shall be furnished by the manufacturer within two weeks after receipt of order. Drawings shall indicate pump station alignment, discharge piping size and electrical services required from local contractor. The owner shall return one set of drawings marked approved or corrected within one week of receipt.

3.5 PUMP STATION START UP

Technical start up shall be furnished by either the pump station manufacturer or a qualified Watertronics certified service agency. Location and mounting details shall be furnished by the pump station manufacturer. Electrical connection, by purchaser, shall consist of a single conduit from Owner's disconnect to the pump station main disconnect. Additional purchaser responsibility shall include confirming correct motor rotation and securing local inspection/approval.

3.6 TECHNICAL START UP

Pump station technical start-up. Procedures should include:

1. Station start-up and pressurization
2. Pressure, flow, automatic shut-down and programming adjustments
3. Monitoring of irrigation cycle when possible. Technician will instruct operations personnel as to the operation, adjustment and maintenance of the pump station.
4. Monitoring of automatic filter and filter pressure differential adjustments. Manual and automatic filter flush cycle.

3.7 PROJECT RECORD DRAWINGS

A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.

B. Record pumping system alterations. Record work installed differently than shown on the construction drawings. Record accurate reference dimensions.

C. Prior to project completion label each sheet of the project drawings (redlines) as "Record Drawing" and turn over to Contracting Officer Representative for delivery to Engineer. Completion of the Record Drawings is a prerequisite for Final Inspection.

3.8 TESTING

A. The pump station manufacturer shall conduct and document a complete factory dynamic test of the pump station prior to shipment. Pump station shall be tested throughout the entire operating range at the net discharge pressure called for in the technical specifications.

B. Watertronics Dynamic Pump Test:
   1. Station full flow
   2. Station discharge pressure
   3. Individual pump pressure
   4. Individual pump flow
   5. Pump RPMs
   6. Pump curve (flow vs. TDH)

7. Motor Voltage
8. Motor frequency
9. Motor Phase
10. Motor Full Load Amps
11. Motor amps at service factor (1.15)
12. Motor Efficiency
13. Vertical Motor vibration Standard Testing (V1, V2, H1, H2, A1, PH1, PH2)
14. Power factor
15. The test shall be documented for verification by the consulting engineer or owners' representative prior to delivery upon request.

3.9 WARRANTY

The manufacturer shall warrant the pumping station to be free of defects and product malfunctions for a period of two years from date of startup or 27 months after shipment, whichever occurs first. Failures caused by, lighting strikes, power surges, vandalism, flooding, operator abuse, or acts of God are excluded from warranty coverage. All warranties implied or otherwise shall not exceed those warranties extended by major or sub-component suppliers. Parts only warranty is not acceptable.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

Pumping System Maintenance:

1. Prior to Final Inspection, provide a one-day training session to operating personnel on proper operation and maintenance of the pumping system. Training session should be for a period of not less than 8-hours and cover aspects of maintaining, operating and repairing the new pumping system.
2. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
    a. Catalog cut sheets for pumping system.
    b. Manufacturer’s Operation and Maintenance manuals including complete documentation for programming and recommended settings and adjustments.
    c. Manufacturer’s Technical Service Bulletins.
    d. Manufacturer’s Warranty Documentation.
    e. Manufacturer’s guide for troubleshooting operational problems.
    f. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
    g. Predictive schedule for component replacement.
    h. Listing of technical support contacts.
3. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.

3.11 OPERATION AND MAINTENANCE MANUAL

Operation and Maintenance manuals shall be furnished at time of startup and initial training. Owner will also receive training specific to this station as specified.

3.12 CLEANUP

A. Upon completion of work, Contractor to remove from the site all machinery, tools, excess materials, and rubbish.
B. Clean all surfaces and touch up scratches on pumping system or piping with factory paint to match original.

[End of Part 3]

PART 4: TECHNICAL SPECIFICATIONS

Pumping System Model # VTVE-7C-60X3/5ST-480-3-1800-120
Total Design Criteria: Quantity of Pumps: 4
Design Flow: 1800 GPM @ 120 PSI Station Discharge

Third Party Listing

Starting Equipment	U.L. Listed as and Industrial Control Device
Controls	U.L. Listed as and Industrial Control Assembly
VFD Controls	U.L. Listed as and Industrial Control Assembly

Total Design Criteria

Zone	**Flow (GPM)**	**Pressure (PSI)**
1	1800	120

Pump Station Incoming Power Requirement

DEVICE	**AMP**		**KVA**	**Voltage**	**Phase**	**Hertz**
Lead Pump (60 HP)/VFD	68			480	3	60
Lag Pumps (60 HP)X2	68					
Sustain Pump (5 HP)	8					
Control Power	3					
Accessories	21					
Total Full load Amps	236					

Pump Station Main Disconnect Rating

Fused	**Amps**	**Volts**
Control Panel	400	480

Operator Interface

Color	**10" Raspberry Pi Touchscreen**	**Touchscreen**	**Memory Card**
YES	Yes	-	YES

Variable Frequency Drive

Operating Temperature	0 to 50ºC (32º -150ºF)
Humidity	Non-Condensing
Minimum Efficiency	98% (full load, base speed)
Frequency Rating	100% continuous drive rating, Intermittent 111% Drive rating for one minute

Safeties

Safety	**Setting**
Incoming Phase Failure and Low Voltage and Phase Reversal	10% +/-
Individual Power Phase Failure and Low Voltage	10% +/-
Low Discharge Pressure Shut down	25 PSI Below Setpoint
High Discharge Pressure Shutdown	15 PSI Above Setpoint

Low Water Level Shutdown	2’ Above Pump Suction

Motor and Pump Data

		PMP	Pump #1	Pump #2	Pump #3			
Motor HP		**5**	**60**	**60**	**60**			
Motor Starting Code G, Class F Insulation								
Motor/Pump RPM		**3600**	**1800**	**1800**	**1800**			
Motor Service Factor		**1.15**	**1.15**	**1.15**	**1.15**			
Motor Efficiency		**74%**	**95%**	**95%**	**95%**			
Motor Power Factor		**81%**	**87.2%**	**87.2%**	**87.2%**			
Motor Type		**SUB**	**VHS**	**VHS**	**VHS**			
Motor Disconnect Volts		**480**	**480**	**480**	**480**			
Motor Full Load Amps		**8**	**68**	**68**	**68**			
Motor Locked Rotor Amps		**53.4**	**424**	**424**	**424**			
Motor O.L. Rating, Amps		**8.9**						
Motor Starter Type		**XL**	**VFD/XL**	**VFD/XL**	**VFD/XL**			
Motor Space Heater		**N/A**	**Yes**	**Yes**	**Yes**			
Motor De-rate For Altitude		**N/A**	**N/A**	**N/A**	**N/A**			
Motor CFM Requirements		**N/A**	**1020**	**1020**	**1020**			
Total Station CFM Req’d					**3060**			
Pump GPM		**40**	**600**	**600**	**600**			
Pump TDH		**308**	**318**	**318**	**318**			
Pump Efficiency at Design		**65%**	**83.9%**	**83.9%**	**83.9%**			
Pump Shut Off Head, FT		**430**	**449**	**449**	**449**			
Pump Column Pipe ID		**2"**	**6”**	**6”**	**6”**			
Pump Column Material		**Steel**	**Steel**	**Steel**	**Steel**			
Pump Shaft Material		**17-4 PH SS**	**Stainless Steel**	**Stainless Steel**	**Stainless Steel**			
Pump Impeller Material		**Noryl**	**Stainless Steel**	**Stainless Steel**	**Stainless Steel**			
Pump Bowl Material		**AISI 304SS**	**Cast Iron**	**Cast Iron**	**Cast Iron**			
Pump Discharge Size		**2"**	**6”**	**6”**	**6”**			
Pump Check Valve Size		**2"**	**6”**	**6”**	**6”**			
Check Valve Rating, PSI		**200**	**200**	**200**	**200**			
Check Valve Drop at Capacity, PSI		**.75**	**1.5**	**1.5**	**1.5**			
Pump Isolation Valve Size		**2"**	**5”**	**5”**	**5”**			
Isolation Valve Rating, PSI		**200**	**200**	**200**	**200**			
Electronic Butterfly Valve		**N/A**	**5”**	**5”**	**5”**			
Station Relief Valve Size					**4”**			

Sequence of Operation.
The system will Start or Stop based on the differential pressure setpoint.

Non-Irrigation times: The pressure maintenance pump (PM) should cycle ON and OFF to maintain irrigation setpoint system pressure. Pressure maintenance pump (PM) should turn OFF when main irrigation pumps Start.

Irrigation times: When the pressure maintenance pump cannot maintain the system pressure, the VFD on the main pump station will start the first main pump and gradually ramp the pressure up to desired irrigation system pressure. The start pressure of the VFD pump should be a differential below the setpoint. The pump speed will be modulated to hold a constant station pressure regardless of the flow. As the flow rate of the system increases and the VFD on the main pump can no longer maintain the system pressure at pump maximum speed, the next sequential pump should start on station VFD and first pump should accordingly reduce its speed and modulate. As the flow keep increasing, the pumps should sequentially be started until all the pumps are running to satisfy the system flow at the setpoint pressure.

When the irrigation demand of flow start to decrease, pumps should be sequentially turned off until a single VFD driven pump is operating.

When no flow demand is required the station pumps should turned OFF.

An algorithm should be written and included with the pump station for reducing the VFD pump speed as the next sequential pump is started so that no pressure surges are generated during the transition between pumps (even with across the line starting). If the operator/customer prefer to switch the VFD from pump to pump for sequential starting, he should be able to select this option with the HMI.

Pump Stuffing Box Style

Type	Mechanical Seal	Packing
	X	

Station Discharge Information

Zone	Isolation Valve	Meter Run Size	Flow Meter Type	Z Pipe	TOL's
1	8"	8”	Electromagnetic	N/A	3 @ 3/4"

Filtration

Manufacturer	Size	Quantity	Model	Micron
Valve & Filter	10"	1	V1500	300

Remote Interface Software & Alarm Notification

Watervision Web Based Remote Monitoring	Cellular	X

Special Remote Monitoring

Custom Views	Wet Well Level Monitoring & Multiple Fill Control
Custom Views	Fertigation Monitoring & Control

Pump Station Enclosure

Access Doors	Ventilation Fan/Louvers	Interior Lighting	Exterior Mounted Service Disconnect	Exterior Mounted Communication J-Box	Color Green or Sandstone
X	X	X	X	N/A	Sandstone

Main Electrical Enclosure Lighting

Interior	X	Exterior	N/A

Power Zone

Size (KVA)	Output Voltage	Circuit Breakers Amps-Quantity
5	120	15-4

Fertigation System Interface

Run Relay	X	**Optical Isolator**	X

Remote Recharge System Interface

Level Sensor Type	Quantity	Voltage
Level Transducer	1	Dry Contact

Pump Station Heater

Size (KW)	Voltage
5	460

Site Conditions & Intake Screen

Wet Well Depth	To Be Determined
Wet Well Diameter	60"

[End of Specification]