APPENDIX D

IRRIGATION SYSTEM MATERIAL AND INSTALLATION SPECIFICATIONS

TO BE INSTALLED AT

Butternut Creek Golf Course

Blairsville, Georgia

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SPECIFICATION OUTLINE

Category	Description
Bid	**LABOR ONLY / Contractor to Purchase Concrete as needed for Thrust Blocks & Controllers with forming materials.**
Hole Closing / Minimize Play Disruptions	1-2 holes at a time to be coordinated with the superintendent and pro shop
Sprinkler Spacing	TORO INF 55 & 54 / 35', 55', 65'(60-65 psi) , 75' - 85'(80 psi), **V-I-H Electric**
Quick Couplers	Greens (21), Tees (0)
Control System Level	Toro Lynx with T-Map (Existing)
Satellites	Toro E OSMAC
Communication	Wireless
Sprinkler Wiring	Individual Wire per Sprinkler, Individual Sprinkler Control One spare wires to green valve and One to furthest tee head
Power Sources/Wire	(2) Locations, Golf Maintenance Building & Main Pump Station / 120V Power / Power Conditioner
Grounding	ASIC Standard Rod, Plate, Enhancement Material
Pedestals	Plastic Green
Mainline Routing	HDPE / Independent
Mainline Gate Valves	AVK Series with Fusible Ends
Lateral Valve / Taps	Looped Lateral Style Configuration / HDPE Sidewall Branch Saddle / Electro-fusion Saddle
Fittings	LASCO Service Tees, Butt, Socket/ Electro Fusion Fittings, All Swing Joints Arms to be 1-1/2", HDPE DR11
Swing Joints	Toro Unitized Swing Joints-ACME,1-1/2" Inlet and Arm, Match top 90deg.to Sprinkler Outlet
Joint Restraints	N/A
Vibratory Plow / Replace Sod on Trenches or Disturbed Areas	Yes, Plow Mainline & Lateral lines 4" & 2" / Yes
Existing Irrigation Equipment	Contractor to remove existing heads, swing joints, and electric valves. Equipment to be returned to the golf course superintendent. Areas disrupted during removal of equipment must be properly graded and re-sodded.
Pump Stations	New 1,000 GPM pump station to be installed in the existing wet well by Owners. This should be compete prior to the irrigation installation. The Contractor is to connect to the new 12' HDPE Down Pipe. The slab, building

	& electrical power sources by Owners.
Pump House / Power Service	To be provided by the Owner
Mainline Direction Change / Taps	(HDPE) Butt & Socket Fusion Tees / Sidewall Branch Saddle / Electro-fusion
Sprinkler Setting	At Grade Upon installation, re-set after (2) month settling
Boring	Road – 0 / Creek 2 - 8"
Bridge Crossings	N/A
Handheld Radio	YES (Existing)
Handheld I Pad PC	No (0)
Staking	By CONSULTANT through Owner
Yardage Markers	By CONSULTANT through Owner
Programming/Computer Graphic	By CONSULTANT through Owner
GPS As-built	By CONSULTANT through Owner
Options	
Filtration	No, make port provisions
Weather Station	Yes
Soil Sensors	No

SECTION 1 - GENERAL CONDITIONS & SCOPE OF WORK

1. Objective

It is the objective of the plans, details and specifications to ensure:

a. Workmanship and Quality

The assembly of the irrigation system for the project will be achieved in an efficient and satisfactory manner, and in accordance with the highest workmanlike standards established for irrigation system installation in order to ensure the highest quality installation, operation and efficiency upon completion.

b. Complete Installation

The finished system shall be complete in every respect and shall be ready for operation to the satisfaction of the OWNER. Accordingly, the requirements of these specifications and accompanying plans and details shall be considered as part of the contract. The chosen CONTRACTOR will follow the specifications, plans and details with due perseverance.

2. Definitions

The following references shall be represented as:

CONTRACTOR – TBD
OWNER/MANAGEMENT – UNION COUNTY RECREAION
CONSULTANT – AQUA TURF INTERNATIONAL

3. Location and Scope of Work

The site location for the project is in **Blairsville, Georgia**.

The CONTRACTOR shall install an automatic underground irrigation system as indicated on the drawings and as hereafter specified. This includes all materials, labor, tools, permits, appliances and taxes and all other costs necessary and appropriate. No deviation from these specifications, the accompanying drawings, the contract, or other general conditions is authorized. No such deviation shall be made unless written authorization signed by the OWNER, or his duly appointed representative, has been obtained in advance. Any labor, machinery, tools and permits specifically identified either on the drawings or in the specifications that are required for or can be reasonably anticipated for completion of the irrigation system shall be furnished by the CONTRACTOR at no additional cost to the OWNER. The CONTRACTOR shall be specifically responsible for the coordination and proper integration of the work with all trades involved in the project.

a. Water Source

The water source for this project at the time of the design is a pond utilizing its surface water. It is fed by a Butternut Creek that bisects the property running from Northeast toward Southwest. Water sources can change between the design and construction. The contractor is responsible for insuring that all materials installed meet any code requirement for the water to be used in the system at the time of installation.

b. Special Circumstances

THE CONTRACTOR WILL KEEP THE EXISTING SYSTEM PRESSURIZED TO MAINTAIN THE ABILITY TO IRRIGATE THE HOLE BY EITHER THE OLD OR NEW SYSTEM. NO HOLE SHALL BE DOWN FOR MORE THAN 48 HOURS. ANY ADDITIONAL ISOLATION REQUIRED TO MEET THESE REQUIREMENTS WILL BE AT NO ADDITIONAL COST TO THE OWNER.

- **Bids are due to be submitted by TBD, 2017.**
- **Construction is to commence on TBD, 2017.**
- **All work should be completed by TBD, 2017.**

- This is a Labor only project. Materials are to be provided by the owner.
- The contractor will have responsibility of the irrigation materials once they are removed from the storage inventory that will be maintained and secured by the golf course staff.
- Material Storage will be at the designed area located adjacent to the golf course maintenance building.
- A new pump station will be installed prior to construction.
- At the new pump station, the Contractor shall connect to the new 12" Down Pipe and continue thereafter with the irrigation installation.
- The existing pump station building & wet well will have improvements and modifications to be done by the owners.
- The owner will be responsible for any of the necessary electrical power service connections and or modifications.
- The contractors are to remove all existing irrigation components (Sprinklers, Valves, Quick Couplers, and Controllers) and return them to the superintendent.

c. Scheduling

A work schedule shall be submitted by the CONTRACTOR to the OWNER prior to the commencement of any work showing the approximate dates the various items of work will begin and end. This will help to ensure proper cash flow on the project.

Construction is to commence on approximately the week of TBD. All work should be completed by TBD.

d. Contractor Experience

HDPE

The contractor shall have successfully installed high density polyethylene pipe in golf/turf irrigation projects. References will be required. These reference(s) must provide a satisfactory response or the experience will not be accepted.

If a contractor or his employees have not previously successfully installed HDPE pipe for golf/turf irrigation projects, he will not be allowed to bid on the project.

The irrigation installers will be required to have a qualified fusion technician from the pipe and or fitting suppliers to review and demonstrate the recommended installation procedures. The technician must have been trained and have fusion certification. The training must have been completed within the past twelve months. A designated person or persons will be trained by the technician. The training will include the following:

1. Compatible fusion
2. Butt fusion
3. Socket fusion
4. Electro-fusion
5. Side wall fusion
6. Attachment of mechanical saddles
7. Hands on operation of fusion equipment
8. Equipment manufacture's guidelines
9. HDPE pipe, fittings manufacture's recommended procedures

Contractor Equipment Qualifications

If the contractor owns butt fusion equipment, the equipment must be serviced prior to use for this project. The machine must be environmental friendly and satisfactory working order. The hydraulic system must be leak free. The pressure gauge must be checked for accuracy and the thermometer checked. Regular checks must be made for proper drag and temperature operations of the equipment throughout the project

If a butt fusion machine is rented, it must be rented from company that has a fusion machine service center or centers certified by the butt fusion machine manufacturer. The machine must arrive with certification that the pressure gauge and heater thermometer were accurate when shipped. Regular checks must be made for proper drag and temperature operations of the equipment throughout the project

The extent of the CONTRACTOR experience shall be indicated in the Section 4.0 of the Bid Documents.

4. Drawings

a. Additional Drawings

Each GENERAL & IRRIGATION CONTRACTOR will be provided plans and specifications in digital format from a file delivery system or our website. If applicable, username and password will be provided by CONSULTANT. Color plots and specifications are available from ATI for $250 plus shipping. The CONTRACTOR may reproduce the drawings for their use.

b. Verification of Dimensions

The drawings show the extent and general arrangement of the irrigation system. Due to the scale of the drawings, it may not be possible to indicate all offsets, fittings and accessories that may be required. Before proceeding with the work, the CONTRACTOR shall visit the premises and carefully check and verify all dimensions and shall report all variations from those indicated on the plans to the OWNER and CONSULTANT. In addition, the CONTRACTOR shall carefully investigate the structural and site conditions and become thoroughly familiar with all details of the work and working conditions.

c. Precedence of Drawings

The irrigation design is essentially diagrammatic with size and location of the equipment drawn to scale whenever possible. CONTRACTOR shall make use of all data in the contract documents and shall verify this information at construction site. CONTRACTOR shall furnish and install all work called for on the drawings whether or not specifically mentioned in the specifications.

5. Guarantee

The workmanship included under the contract shall be guaranteed for twelve (12) months by the CONTRACTOR from the final date of acceptance by the OWNER. Materials and products furnished under this contract shall also be guaranteed by the CONTRACTOR for a minimum of twelve (12) months from final approval. The CONTRACTOR shall furnish to the OWNER all written warranties provided by the manufacturer or distributors of any equipment or materials installed under this contract. In the event of malfunction within the time specified above, all necessary repairs and/or replacements shall be made expediently by the CONTRACTOR, at no additional cost to the OWNER. The OWNER retains the right to make emergency repairs without relieving the guarantee obligations of the CONTRACTOR. The OWNER has the responsibility to maintain the irrigation system in proper working order during the warranty period. In the event the CONTRACTOR does not respond to the OWNER'S request for repair work under this guarantee within a period of seventy-two (72) hours, the OWNER may make such repairs as he deems necessary at the full expense of the CONTRACTOR.

Any settling of back-filled trenches that may occur during the guarantee period, shall be repaired by the CONTRACTOR at no additional cost to the OWNER, including the complete restoration of all damaged planting, paving or other improvements of any kind.

6. Permits and Code

The entire irrigation system shall be installed in complete compliance with all applicable local and state laws, ordinances and established codes. The CONTRACTOR shall at his sole cost and expense and without increase in the contract price, comply with all laws, rules, ordinances, and regulations of all governing bodies having jurisdiction over the work; obtain all necessary permits and licenses therefore, pay all manufacturer's taxes, use taxes, processing taxes, all federal and state taxes, insurance and contributions for Social Security and Unemployment Compensation. The CONTRACTOR shall, upon request, furnish evidence that all such obligations have been fulfilled in full. Any additional work or furnishing of materials required due to inspection by the authorities of jurisdiction shall be furnished at no additional cost to the OWNER.

Installation shall be as required by the National Standard Plumbing Code (NAPHCC), National Electric Code (NEC) and as specified elsewhere in the specifications. If the CONTRACTOR observes that the drawings and specifications are at variance or in conflict with existing ordinances, regulations, or codes, he shall promptly notify the CONSULTANT in writing. Any necessary changes shall be as authorized in writing by the CONSULTANT. If the contractor performs any work knowing it to be contrary to such laws, ordinances, etc. and without notice to the CONSULTANT, he shall bear all resulting costs, including but not limited to the change and correction thereof, so as to comply. Permits and licenses of a temporary nature necessary for the commencement of work shall be secured and paid for by the CONTRACTOR. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified.

7. Damages

If the CONTRACTOR or OWNER should suffer damage in any manner due to any wrongful act or neglect of the other party or of anyone in his employ, whether as his employee, agent or sub-contractor and such damage is not adequately covered by insurance, he shall be reimbursed

by the other party for such damage. Any claim for damage shall be made in writing to the party liable within a reasonable time of the observance of such damage and not later than the time of final payment. All claims for damage are subject to negotiation and in no way shall hold up progress of the work or of progress payments.

a. Damages Caused by Delays

Should the CONTRACTOR default in the performance of his work causing delays to the project, he shall be liable for any and all loss and damages including liquidated damages sustained by the OWNER. The CONTRACTOR shall not be liable under this paragraph if such default is caused by labor strikes or lockouts, acts of God, or other reasons beyond the control of the CONTRACTOR. Notice of such occurrence should be given in writing immediately by the CONTRACTOR to the OWNER.

b. Recourse by OWNER

The OWNER retains the right, after giving seventy-two (72) hours written notice to the CONTRACTOR, to provide any such labor and materials in the event that the CONTRACTOR at any time:

1. Discontinues or does not provide a full time on-site **Supervisor** (The name of the supervisor must be included in Section 4.0 of the Bid Documents) dedicated to this project "ONLY". Mandatory 5 days a week of supervision during installation, excluding; holidays, illness, vacation or personnel trauma.
2. Fails to supply a sufficient number of properly skilled workmen.
3. Becomes adjudicated as bankrupt, files an arrangement proceeding, commits any acts of insolvency or makes an assignment for benefit of creditors without the consent of the OWNER.
4. Fails to make prompt payment to material suppliers or laborers.
5. Fails, in any respect, to properly and in a timely fashion diligently execute the work covered by this contract.
6. Becomes delinquent in respect to payments or contributions required for health and welfare, pension, or other employee benefit programs or trusts.
7. Stops work due to a court order or public authority for a period exceeding 30 calendar days.
8. Persistently disregards codes, regulations and laws including safety laws.
9. Is unable to obtain materials due to poor credit.

In the event of any of the above occurrences, the OWNER reserves the right to terminate the CONTRACTOR'S right to proceed with the work. The OWNER shall have the right in that event to enter upon the premises of the project and take possession of all materials, tools and appliances thereof. The OWNER may employ any other person or persons to finish the work and provide materials thereof for the purpose of completing the work under this contract.

In such case, the CONTRACTOR shall not be entitled to any further payment under this contract until the work undertaken by the OWNER is complete. If the unpaid balance to be paid under this contract does not exceed the expenses incurred by the OWNER in completing the CONTRACTOR'S work, the remaining balance will be paid to the CONTRACTOR by the OWNER. If the OWNER'S expenses exceed the unpaid balance, the CONTRACTOR shall promptly pay the OWNER the amount by which such expenses exceed the unpaid balance.

The expense for finishing the work by the OWNER, and the damages incurred by the OWNER by reason of CONTRACTOR default, shall be charged to the CONTRACTOR; and appliances and equipment taken possession of used to secure payment thereof.

c. Damage to Other Work

If, in the opinion of the OWNER, a failure, malfunction or in-operation of the system or a portion thereof results in erosion, loss of turf, or other damage to the golf course during construction, the cost of correction, repair or replanting necessary to return the damaged area to an acceptable condition shall be paid by the CONTRACTOR.

8. Insurance

Public Liability and Property Damage Insurance

The CONTRACTOR shall at his own expense, prior to commencement of any work, acquire Public Liability and Property Damage Insurance. He shall furnish a Certificate of Insurance to the OWNER with an insurance carrier satisfactory to the OWNER, with limits specified, and a thirty (30) day cancellation clause prior to commencement of work.
The insurance policy or policies shall be satisfactory to protect the CONTRACTOR and the OWNER against loss from liability imposed by the law from damages on account of bodily injury, including death resulting from, suffered or alleged to have been suffered, by any person or persons other than employees, resulting directly or indirectly from the performance or execution of this contract, or any sub-contract there under, and also to protect the CONTRACTOR and the OWNER against loss from liability imposed by law for damage to any property, caused directly or indirectly by the performance or execution of this contract or any sub-contract there under.

The insurance policy shall also cover accidents arising out of the use and operation of automobiles and trucks. The insurance policy or policies shall include an endorsement naming the OWNER as an additional insured under the policy or policies. The policies shall also

provide that should the policy be canceled or reduced in coverage afforded there under before the expiration thereof, the issuing company will mail written notice of not less than thirty days prior to such cancellation or reduction to the OWNER.

All public Liability and Property Damage Insurance shall be maintained by the CONTRACTOR in full force and effect during the entire period of performance under this contract. The amounts of coverage shall not be less than:

A. Workman's Compensation - Statutory Limits,
B. Commercial General Liability
    1. Occurrence - $1,000,000
    2. Product and Completed Operations - $1,000,000
    3. Personal and Advertising - $1,000,000
    4. General Aggregate - $2,000,000
C. Automobile and Vehicle Liability
    1. Combined Single Limit - $1,000,000

The CONTRACTOR shall also provide and maintain sufficient insurance coverage to cover the cost of all materials and equipment provided by him and stored on the site that shall be used or installed on this project. Said insurance shall provide compensation for loss due to fire, theft or vandalism.

9. Payments and Compensation

On or before the 26th of the month during construction, the CONTRACTOR shall submit an invoice for all work completed during that monthly period approved by the OWNER'S REPRESENTATIVE on a standard AIA contract.. The request for payment should be submitted on an approved payment request form, for work performed and materials and supplies purchased, delivered and suitably stored on the job site and/or built into the work through the twenty-fifth (25) of the month. The CONTRACTOR shall submit with each pay request, two sets of updated "As-Staked" Drawings with the latest information pertaining to the work for which pay is requested. Failure to submit interim drawings will result in withholding of payment until such drawings have been received.

A 10% retention will be held by the OWNER on labor only. The payment will be in the amount of 90% of the invoiced amount. The 10% reduction will be paid thirty (30) days after final acceptance of the system subject to:

A. The complete checkout of the system has been completed and,
B. The CONTRACTOR has corrected any trench settlement, re-set sprinklers and valve boxes, performed clean-up and corrected any and all malfunctions.
C. CONTRACTOR shall present OWNER with waiver of lien in form and substance satisfactory to OWNER and with such other instruments as may be reasonably required by OWNER in order to effectively waive mechanic's and material's liens, in compliance with the laws of the State of Florida. The CONTRACTOR will hold the OWNER harmless from any liens, indebtedness or liabilities to sub-contractors or other parties hired by the CONTRACTOR.
D. The CONTRACTOR shall supply the Sales Tax Certificate included in the Bid Documents.

The OWNER'S REPRESENTATIVE shall review each request for payment submitted and shall make payments of all items approved less retainage as set out above on or before the tenth (10) day of the following month.

The OWNER may authorize payments for materials delivered to the site and stored, but not installed. The CONTRACTOR must furnish with his request for payment, material releases indicating that said equipment has been paid for in full, a statement indicating the same is free from all liens and encumbrances and will be utilized in the work covered in this contract, and a material list verifying inventory at the storage location if applicable.

No payment for material or equipment shall in any way relieve the CONTRACTOR of his responsibility to obtain and provide material at his expense or release the CONTRACTOR from any obligations of this contract. All storage and handling costs are the responsibility of the CONTRACTOR.

The final payment to the CONTRACTOR shall constitute a waiver of all claims by the OWNER except those resulting from:

A. Terms of warranties required by the contract,
B. Faulty or defective work appearing after completion,
C. Failure of work to meet the requirements of the contract,
D. Unsettled liens.

The acceptance of final payment by the CONTRACTOR constitutes a waiver of all claims by same except those previously made in writing and identified by the CONTRACTOR as unsettled at the time of the final application for payment.

The CONTRACTOR shall supply the OWNER with copies of all lien releases pertinent to the project prior to the making of final payment.

10. Additions and Deletions

The CONTRACTOR agrees to make any and all changes or deviations from the original plans and specifications, when requested. Any additions or deletions will be based on the unit prices provided on the Unit Price List.

The CONTRACTOR may be asked to submit a lump sum price for major additions or deletions to the project. The terms of such changes should be understood and agreed upon in writing by the OWNER and CONTRACTOR prior to commencement of work. Additional work or deviations performed without written authorization will not be subject to reimbursement. Items not covered by the unit prices shall be submitted by the CONTRACTOR as an itemized invoice covering all labor for the additional work. A reasonable percentage to cover overhead and profit shall be added to the CONTRACTOR'S cost. Deletions of the work will be handled using the same procedure.

If, during final inspection, unacceptable or incomplete conditions exist and such conditions are not corrected within the prescribed time and the OWNER undertakes to correct said conditions or corrections, the contract cost will be reduced by an amount reasonable to cover the cost of making the corrections or incomplete conditions. If the work consists of items for which unit prices have been designated, these unit prices shall be used. In all other cases, the actual cost of labor with a reasonable percentage added for overhead, will be the method to determine reduction of compensation.

The OWNER, through his OWNER'S REPRESENTATIVE, and without invalidating the contract, may order additional work or alterations to the original contract, adding to or deleting from the original work. All such additions or deletions shall be requested in writing and the contract sum shall be adjusted accordingly in conformance with the unit costs as bid by the CONTRACTOR and accepted by the OWNER. All such work shall be completed under the conditions of the contract except that any claim for extension of time caused by additions shall be adjusted at the time of ordering such change. Minor changes in the work that do not involve extra cost and are not inconsistent with the purpose of the work can be ordered by the OWNER'S REPRESENTATIVE and no claim for an addition to the contract sum will be considered.

SECTION 2 - CONSTRUCTION GUIDELINES

1. General Conditions

Installation of the irrigation system shall proceed in the following general manner:

a. CONTRACTOR must submit an anticipated construction schedule prior to installation to be approved by CONSULTANT.
b. OWNER will all purchase the material.
c. CONTRACTOR responsible for assisting in ordering of material, handling, storage, all quantities, and security.
d. The pump station – Install new pump station and wet well
e. Delivery, installation or upgrade of central computer.
f. Flagging of sprinklers by the CONSULTANT.
g. GPS and AS-Builts by the CONSULTANT.
h. Programming of the irrigation computer by the CONSULTANT.
i. Installation of mainline pipe, fittings, valves, and power wire will begin as determined by the construction team.
j. Installation of lateral pipe, wire, fittings, swing joints and isolation valves upon completion of flushing of connecting mainline sections.
k. All pipe installed 2" thru 6" shall utilize the trenchless plow method everywhere that is feasible.
l. All pipe installed 8" and larger shall utilize the open cut trenched method.
m. The CONTRACTOR will remove and repair damaged areas on all existing below & above ground irrigation components.
n. CONTRACTOR is responsible for backfill and compaction of mainline and lateral trenches where applicable.
o. Installation of field satellites.
p. Installation of sprinklers to grade after flushing lateral lines.
q. Cleanup and final back-filling of trenches. Cart path repair.
r. Weekly submittal of contractor annotated and revised "Revised As-Staked Drawings" to the CONSULTANT indicating pipe size and station numbers and verifying all components.
s. GROUNDING tested (by: Material Distributor's Representative), modified if necessary by CONTRACTOR.
t. Coordination of Final As-built Drawing between the CONTRACTOR and CONSULTANT.
u. Re-setting of sprinklers, valves boxes, etc. to grade after grassing and a minimum 2- month settling period if needed.
v. HDPE distributor must make two site visits to the site during construction to inspect CONTRACTOR workmanship.

2. **Contractor's Understanding**

By submitting a bid proposal, it is understood and agreed by the CONTRACTOR that he has, by careful examination of the site, satisfied himself as to the nature and location of the work, the conformity of the ground, the character, quality and quantity of materials to be used, the character of the equipment and facilities incidental to the completion of the work, the general and local conditions, and other matters that may in any way affect the work under this contract. The contract shall not be affected or modified nor shall any of its terms or obligations be affected or modified by verbal agreement or conversation with any officer, agent, or employees of the OWNER, either before, during, or after the execution of this contract.

3. **Safety**

The CONTRACTOR shall follow all standard construction methods and complete all aspects of work in a professional manner. All methods should comply with current OSHA standards. The CONTRACTOR shall provide for proper worker safety at all times.

4. **Supervision and Workmanship**

a. **Supervisor**

The CONTRACTOR shall keep on the project, during its progress, a qualified supervisor and any necessary assistants, all satisfactory to the OWNER and CONSULTANT. The supervisor shall represent the CONTRACTOR, in his absence, and all directions given to him shall be as binding as if given to the CONTRACTOR. The irrigation supervisor shall be approved by the CONSULTANT and the approved supervisor will be maintained throughout the job unless prior approved by the CONSULTANT. The name of the supervisor must be included in Section 4.0 of the Bid Documents.

a. **Workmanship**

Every facet of the work described herein shall be executed in strict accordance with the contract documents in the most workmanlike and substantial manner. All workmanship shall be the best of its kind. All materials, equipment and labor shall be furnished in ample quantities to facilitate the proper and expeditious execution of the work. All materials shall be new, except such materials as may be expressly provided in the contract documents to be otherwise.

5. **Existing Facilities and Structures**

The plans may show the location and nature of existing facilities, structures and utilities. However, neither the OWNER nor CONSULTANT assumes any responsibility for the correctness or completeness of this information. The CONTRACTOR shall request such information from the OWNER, appropriate agency or utility, sufficiently in advance of construction to preclude damage to the same.

The CONTRACTOR shall exercise the utmost of care in protecting all existing buildings, equipment, piping, pipe coverings, utilities, roads, sidewalks, landscaping or other structures of any kind. The CONTRACTOR shall be liable for any damage to any of the OWNER'S property.

Any damage from leaks in the piping system being installed by the CONTRACTOR or his agents, employees, or sub-contractors during the course of his work, whether through negligence or otherwise, shall be replaced or repaired by the CONTRACTOR at his own expense in a manner satisfactory to the CONSULTANT. Such repair or replacement shall be a condition precedent to the OWNER'S obligation to make final payment under the contract.

The CONTRACTOR shall perform all cutting, patching and fitting of his work required to match to the work of others or existing piping, structures or utilities either shown on the plans, implied in the specifications or necessary to complete the installation and to make the parts of his work whole.

The CONTRACTOR shall take all necessary and reasonable precautions to prevent any damage to existing trees, foliage, plant material, wetlands, native areas, archeological areas or other property of the OWNER. Any such areas disturbed by the CONTRACTOR, his employees, agents or sub-contractors shall be restored to their original condition by, and at the CONTRACTOR'S expense. No native or environmentally sensitive areas shall be disturbed in the slightest degree. The CONTRACTOR must impress his organization with this sense of importance and responsibility to preserve the delicate nature of such areas. Hunting, exploring, camping, recreation or other activities not related to the performance of work by the CONTRACTOR is prohibited on the OWNER'S property. Employees in violation of this request shall be subject to dismissal.

6. Materials

All materials to be supplied by the CONTRACTOR shall be new, and the best procurable without defects, and as required by the plans, specifications and special provisions. All equipment shall be supported by local service organizations. All materials shall be suitable for the pressures and temperatures to be encountered. Any materials or equipment found to be defective or not as specified shall be removed from the site by the CONTRACTOR, and proper materials shall be installed by the CONTRACTOR at the expense of the CONTRACTOR.

The vendor for the materials shall be listed in the submittal section of the bid.

All materials to be supplied by the OWNER shall be new, and the best procurable without defects, and as required by the plans, specifications and special provisions. All equipment shall be supported by local service organizations. All materials shall be suitable for the pressures and temperatures to be encountered. Any materials or equipment found to be defective or not as specified shall be removed from the site by the OWNER, and proper materials shall be installed by the CONTRACTOR at the expense of the OWNER.

a. Submittals

Contractor shall submit with his bid a list of materials to include the vendors and models to be installed for HDPE Bids. (*As applicable: Pipe, wire, fittings, valves, sprinklers, swing joints, quick couplers, satellites, air relief valves, drain valves*)

b. Approval

No material shall be installed before on-site inspection and approval of the material by the CONSULTANT or the OWNER'S REPRESENTATIVE.

c. Delivery

The CONTRACTOR shall coordinate the delivery of all materials and equipment to avoid delay of the project. The CONTRACTOR is responsible for providing any and all means including equipment, labor, etc. for the complete delivery and proper unloading of all materials from suppliers. **This is also applicable for Labor Only projects.**

d. Substitutions

All materials and installation shall be as specified and approved by the CONSULTANT or OWNER'S REPRESENTATIVE. If materials have no reference of "or accepted equivalent", contractor shall bid on specified materials. No changes to plans or specifications will be made prior to bidding unless contractors have received a written addendum.

e. **Storage**

The OWNER shall provide a specified location in which all materials to be used on the project shall be stored when not in use. Provision of the land is for the purpose of keeping the property neat and orderly and in no way waives any requirements of the CONTRACTOR to protect his equipment and materials from damage by the elements or from theft or vandalism. Facilities of adequate size and water-tight, with floors raised above ground level, shall be provided for all types of materials that are liable to damage from exposure to weather. Other materials shall be stored on blocks off the ground.

Materials shall be located as to allow easy access for inspection and identification. All materials shall be carefully stacked and stored on the grounds, and all work shall be performed in strict conformity with local laws regarding the same. The storage location shall be supplied with adequate security to the satisfaction of the CONSULTANT, in order to protect the materials stored therein. The OWNER or CONSULTANT may enter the material storage area for inspection, inventory, or any other purpose as he deems necessary. Any material that has become damaged, weathered, deteriorated or otherwise become unfit for use shall not be used in the project.

Upon completion of all work, or when directed by the CONSULTANT or OWNER'S REPRESENTATIVE, the CONTRACTOR shall remove the storage facility promptly from the construction site.

f. **Materials Furnished by the OWNER**

The OWNER is to provide all materials for the project pending review of the bids. The OWNER will provide all electrical power disconnects at the pump station for the project at locations as noted on the plans. The OWNER shall make all connections and provide labor and materials to make connections to the irrigation system control system power wiring from the OWNER supplied disconnect panels. Where necessary, the OWNER will provide and install all power conditioners/voltage regulating/stabilizer units at required electrical supply points. All power conditioners/voltage regulating/stabilizer units or connections to the meters/hook-ups/disconnects at any location shall be made by a licensed electrical contractor per all applicable codes.

g. **Additional Equipment**

(4) sets of complete sprinkler tools and (4) quick coupler keys with swivel hose ells. (4) Sprinklers of each model installed on the project. All other additions and deletions determined by unit pricing.

h. **Handling**

The CONTRACTOR shall be responsible for correct procedures in loading, unloading, stacking, transporting and handling all materials to be used in the system. The CONTRACTOR shall avoid rough handling that could affect the useful life of

equipment. Pipe and other materials shall be handled in accordance with the manufacturer's recommendations on loading, unloading and storage.

7. Maintenance of Existing System

The existing system shall be replaced and shall be abandoned. The existing controllers, electric valves, and sprinkler heads on the course will be salvaged and returned to the club.

8. Clean-Up

The CONTRACTOR shall remove waste materials from the site during the entire term of the project, as is necessary to maintain the premises in a clean and orderly fashion. This includes debris from the existing irrigation system exposed during the new system installation. Upon completion of the work, the CONTRACTOR shall promptly remove from the site all temporary structures, field office, debris and waste incidental to his operation and shall clean and prepare all fixtures and surfaces relative to the contract. Failure to perform a clean-up function within seventy-two (72) hours of notification by the OWNER may result in this work performed by others in a manner he deems expedient. The cost therein shall be charged to the CONTRACTOR and deducted from moneys due under this contract.

9. Programming and Training

The irrigation computer shall be completely programmed to include all database entries such as station numbers, sprinkler type, radius and flow. The flow management of the software will be programmed to ensure the most efficient operation to include pump capacity and mainline hydraulic flow zones. The irrigation schedules and programs will be created. The as-built digital file will be converted into the appropriate .shp files and the database information will be combined with the mapping software for the selected irrigation manufacturer. Programming for the computer central system is to be provided by the CONSULTANT (Aqua Turf International) and is to be paid by the OWWNER.

The CONSULTANT will coordinate the loading of the data and map in the irrigation computer as well as superintendent training with the local distributor.

SECTION 3 - STAKING AND CONSTRUCTION RECORDS

1. General

The flagging of the irrigation components will be performed by the CONSULTANT to determine the locations of the mainline, sprinklers, valves, quick couplers and satellites prior to installation.

The CONTRACTOR may be required to make field adjustments from the initial design in order to effectively irrigate the course as a result of adjustments before or during construction. These minor adjustments will not be compensated. However, significant changes in quantities or routings will be compensated as per the Unit Prices.

The CONTRACTOR may change the pipe routing or depth of trench in order to compensate for rock or other obstacles with the prior approval of the CONSULTANT or OWNER'S REPRESENTATIVE. Field changes of this minor extent will in no way affect the contract price except where changes alter the quantity of materials or increase the depth of trench and backfill required. The routing of the pipe should otherwise generally follow the irrigation plan. Any changes require the prior approval of the CONSULTANT.

2. Flagging and Staking

Flagging services are to be provided by the CONSULTANT (Aqua Turf International) and are to be paid by the OWNER. The CONSULTANT will conduct up to (8) site visits for a pre-construction meeting to review the irrigation plan and staking procedure, flagging of all irrigation components, material and installation inspections and a final walk through. The CONSULTANT will initially review the entire sprinkler layout and strategy with the CONTRACTOR.

A minimum of (5) day's advance notice shall be given that holes are ready. If less than (5) days notice is given, the CONTRACTOR may be required to pay an expedition fee and travel expenses to be negotiated with the CONSULTANT. If additional visits are required due to the CONTRACTOR, the CONTRACTOR will be billed $950 per day plus travel expenses.

The locations of the sprinklers and valves on the plans are essentially diagrammatic. In no instance shall the spacing of sprinklers exceed the distances as shown on the drawings. All flags for staking will be provided by the CONSULTANT.

The flags will be immediately replaced by the CONTRACTOR with a ¾" x 3' PVC stake, marking paint or approved equal and clearly marked in order to clearly designate the equipment to be installed at each location. Stakes/hubs shall be placed accurately and components shall be located within one (1) foot of the indicated/flagged position. Any offset from the base position shall be clearly indicated to insure accurate installation. The CONTRACTOR shall maintain this staking, and have the CONSULTANT replace any disturbed stakes to the correct position (at the CONTRACTOR'S expense), until the equipment is installed and indicated by the contractor on the revised "As-Staked Drawings."

During construction, files will be distributed via a link to our company YouSendIt file delivery system. http://www.yousendit.com/ . For directions and download information using the YouSendIt file delivery system, follow the on screen directions.

Approximately two days after completion of each staking visit, the CONSULTANT shall provide the CONTRACTOR a set of reproducible "As Staked Drawings" via the YouSendIt file delivery system. Any shipping of the drawings as requested by the contractor will be paid by the CONTRACTOR. The drawings will include the sprinkler locations with station numbers. The CONTRACTOR shall immediately verify the drawings in comparison to the staking and immediately notify the CONSULTANT of any variances. These as-staked drawings shall be the basis for the Final Construction Record Drawings. ATI shall be notified by the CONTRACTOR if the station numbers are changed from those supplied by ATI. The next staking visit will not be made until the previous station numbers are verified. The purpose for this is to allow for accurate and expeditious as-built development as well as programming of the central computer by ATI. If the station numbers are changed without notification to ATI prior to programming the CONTRACOR will be billed $95 per hour for the time required to revise the as-built drawing and irrigation program.

3. Construction Record Drawings

The GPS As-Built is to be provided by the CONSULTANT (Aqua Turf International) and is to be paid by the OWNER. The CONSULTANT shall account for all irrigation components to include sprinklers, valves, pipe routing, pipe size, wire routing, wire size, wire splices, satellites and quick couplers installed on the project. This will be accomplished using sub-meter accuracy GPS survey equipment in combination with timely and accurate field notes. The As-Builts shall be drafted using AutoCAD 2012 or equal and shall be backup up to be filed by the CONSULTANT. The CONTRACTOR shall stake all in-ground main lines, irrigation fittings, wire splices, valves, capped lateral lines, plugged service tees, and other buried components with a ¾" x 3' PVC stake or approved equal to provide for GPS mapping by the CONSULTANT. The CONTRACTOR shall maintain this staking, and replace any disturbed stakes to the correct position until the as-built is finalized.

The CONTRACTOR shall neatly maintain updated irrigation "as-built" field notes. The notes for each hole shall be provided to the CONSULTANT within (1) week after installation of the hole. The CONTRACTOR shall maintain a copy of the field notes for their records. Information included on the irrigation field notes shall include, but is not limited to:

a. Person responsible for drawings and date of preparation.
b. Pipe routing and size, mainline fitting angles.
c. Indication of all sprinkler types and nozzles.
d. Location of all water sources and electrical supply points.
e. Station and satellite assignment of sprinklers.
f. Wire trench locations, wire splices and wire size.

g. Measurements to all valves and wire splices.
h. Notes of any unique installation conditions or equipment.

The CONTRACTOR shall keep a qualified person on the job during the entire project to update and coordinate the on-going "as-built drawing".

The CONSULTANT will provide drawings of the final "as-built" of the irrigation system from these notes and the GPS data. The irrigation as-built data will be provided to the OWNER by ATI in a .dwg format. The data will be provided on a single sheet at 1"=100' scale, Color CAD rendered ready for wall mounting. As-built will also be supplied in 42" x 30" color plots at 1"=200' and 1"=100', and 11"x 17" color laminated hole x hole bounded for field books. Additional books can be supplied at $250 each.

4. Improper Location of Equipment

If at any time prior to final acceptance of the irrigation system it is found that the CONTRACTOR has improperly located equipment, he shall remove the improperly located equipment and install such equipment in the locations satisfactory to the CONSULTANT. The relocation of the improperly located equipment shall be at the CONTRACTOR'S expense.

SECTION 4 - EXCAVATION

1. Excavation

Prior to trenching all mainlines & laterals the CONTRACTOR will mark lines on the turf showing the layout of pipe. The existing sod shall be cut and placed to the side for replacement over the backfilled trench by CONTRACTOR. The sod shall be immediately replaced to avoid desiccation and shall be watered as needed until replaced to insure viability by OWNER. Irrigation of the sod after it is laid is the responsibility of the OWNER once the hole or area is approved by OWNER'S REPRESENTATIVE. If water is not available from the existing irrigation system the CONTRACTOR is responsible to provide a water truck to irrigate the sod.

HDPE Pipe shall be installed per manufactures' recommendations. This includes the bedding of the pipe in the bottom of the trench.

All trenches shall be neatly aligned with trench bottoms as level as possible. Trenches shall be of adequate width to allow installation of wires as detailed in the drawings.

During excavation existing pipe may be encountered. Any pipe that is encountered during trenching shall be removed outside the width of the trench prior to installation of the new piping.

Irrigation mainline pipe shall have a minimum of thirty (30") and a maximum of thirty-six inches (36") of cover on the pipe. All lateral lines shall have a minimum of eighteen inches (18") and a maximum of twenty-four inches (24") of cover on the pipe. The bottom of the trench shall be free of rocks, clods, debris and other sharp edges.

The CONTRACTOR shall exercise reasonable care to avoid causing damage to any and all underground utilities or structures. The OWNER shall advise the CONTRACTOR of any underground utilities or structures of which he is aware. Utility locating services shall be called upon to pinpoint the location of any underground utilities on the site of the project. It is the responsibility of the CONTRACTOR to assure that this procedure is carried out.

Trenching shall be avoided within the drip lines of existing trees. The CONTRACTOR shall provide proper root pruning to meet arboricultural standards or as directed by the OWNER or CONSULTANT. No trenching shall be done within twelve (12") inches of proposed or existing streets, walks, drives or structures unless prior approval has been received in writing from the OWNER or CONSULTANT.

2. **Rock Excavation**

All excavation shall be classified as "ROCK". No additional compensation for rock trenching. CONTRACTOR shall be responsible for the disposal of the unsuitable materials removed from the trench and the acquiring of additional backfill materials. CONTRACTOR shall be responsible for hauled away onsite of unsuitable material to designated locations marked on the plan or as directed by the OWNER or OWNER'S REPRESENTATIVE.

All rock trenching and hauled off material cost shall be included in the CONTRACTOR'S lump sum price.

3. **Backfill**

Irrigation contractor shall thoroughly compact all trenches in lifts not to exceed twelve inches (12") with a Vermeer trench compaction machine or equivalent and the last layer shall tie smoothly into existing grade. Final acceptance of trench backfill shall rest with OWNER'S REPRESENTATIVE or CONSULTANT. Backfill material shall be free of rocks or other material potentially harmful to the pipe. All excavated materials that in the opinion of the CONSULTANT or OWNER are suitable for backfill, base or cover material shall be kept separate from the general excavation material. Acceptable bedding material, fill dirt, pea gravel or sand shall be used to extend six inches (6") above the pipe. Acceptable bedding material, around swing joints, fittings and sprinklers shall be sand. The remainder of the backfill shall contain no lumps or rocks larger than three inches (3"), except the top six (6") inches that shall be free of rocks over one inch (1"). All material not suitable for backfill or reuse shall be disposed of by the CONTRACTOR and hauled away onsite to designated locations marked on the plan or as directed by the ARCHITECT or OWNER'S REPRESENTATIVE.

Bedding of Pipe in Rock Excavation Areas

It shall be necessary to bed the pipe and wire in sand to cover exposed rock or other hazardous soil conditions. In this instance, the CONTRACTOR shall excavate the trench an additional three inches (3") in depth and then provide a minimum of three inches (3") of coarse clean sand or suitable clean backfill material for bedding of the pipe. All bedding material cost shall be included in the CONTRACTOR'S lump sum price if applicable.

4. **Street Bridge Crossings**

If applicable, the CONTRACTOR will arrange and pay for any directional boring as needed across existing streets or waterways. The CONTRACTOR will be required to install all wire through sleeves. Materials used for road and bridge crossings shall meet or exceed the following specifications and detail drawings and must be prior approved by the CONSULTANT.

5. **Cart Paths**

The cart paths are to be repaired by the irrigation contractor during the course renovation. The current cart paths are asphalt. Cold patch can be utilized.

SECTION 5 - PIPING AND CONNECTIONS

1. **Handling**

The CONTRACTOR shall exhibit extreme care and caution at all times in the handling, loading and unloading, storing and installation of all pipe, fittings and related components. Pipe shall be delivered to the project shipped on equipment proper for shipping HDPE products and to meet industry standards. Any pipe damaged in any way shall be discarded and removed from the site immediately to avoid future use.

Pipe shall be transported around the project on a trailer or vehicle with a bed long enough to allow the complete length of pipe to be supported. The bed and supports or braces of the trailer shall be covered so that no sharp edges can damage the pipe in any way. **Transporting of pipe by means of a back-hoe with forks will not be allowed.**

2. **Mainline and Lateral Pipe Materials and Installation**

Water Pipe shall be HDPE in color (Black).

a. **Pipe Materials**

All piping on the project of a similar type shall be of one manufacturer and installed as called for in the specifications and as called for by the manufacturer. All pipe shall be as indicated on the drawings and meet the following criteria:

Mainline - HDPE PE4710 - SDR 13.5 (161psi WPR)
Laterals - HDPE PE4710 - SDR 13.5 (161psi WPR)
Road Bores - HDPE PE4710 - SDR 13.5 (161psi WPR)
Bridges - HDPE PE4710 - SDR 13.5 (161psi WPR)
Road & Bridge Crossing Electrical: 2" - Conduit "Grey" ***"Marked for Electric"***
Class 200 SW Sleeve PVC

b. **HDPE Pipe Materials**

Pipe shall be manufactured from a PE PE4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-05 with a cell classification of PE 445474C or higher. Pipe shall be manufactured to the dimensions and requirements of ASTM F714. All 1 ½" pipe and below shall be SDR 11 (202psi WPR). All 2" pipe shall be SDR 13.5 (161psi WPR). All 4" pipe and above shall be SDR 13.5 (161psi WPR) The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All HDPE pipe shall be in straight 40' lengths OR (1.5", 2", 3" and 4" HDPE pipe can be in coils if CONTRACTOR straighten and re-rounds pipe with a Line Tamer Machine.

The distributor of the HDPE pipe and fittings must comply with the following requirements:

1. The distributor must be capable of supplying both the pipe and fittings.
2. The distributor must be capable of manufacturing special fittings within its own manufacturing facility.
3. The supplier must have the capability to train the contractor's employees in butt fusion, electro-fusion and socket fusion of HDPE pipe and fittings.

4. The supplier must be capable of providing a "Hot Line "phone number to assist in fusion and fusion equipment questions.
5. The supplier must be capable of providing a trained representative on site upon the request of the contractor, owner or consultant to address any problems that are encountered during the installation.
6. The supplier must be capable to rent, sell and service fusion equipment.
7. The supplier must furnish a written 5 year limited Warranty for HDPE pipe and fittings Golf and Turf Irrigation Applications.

c. HDPE Pipe Installation

The polyethylene pipe shall be joined into continuous lengths. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 425 (+/- 15) degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The fusion equipment used shall be manufactured by approved manufacturing or approved equal. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. Thrust blocks will not be required with the fused HDPE pipe. Electro-fusion shall be used as shown on the plans and details or where Butt fusion cannot be used.

All main line pipe joints are to be butt fused using McElroy fusion equipment or approved equal. Each butt fusion unit shall be equipped with a datalogger. The CONTRACTOR shall label each butt fused joint so as it will be recorded on the datalogger. The datalogger shall record temperature, fusion pressure, with a graphic representation of the fusion cycle and shall be part of the quality control records. The datalogger information shall be downloaded weekly and given to the CONSULTANT or OWNERS REPRESENTATIVE for quality control records.

The CONTRACTOR **and** his fusion machine operator shall complete a training school on the use of all fusion equipment to be used on the project, butt fusion and electro-fusion or show proof of previous attendance within the last calendar year. The training will also include approved mechanical saddles and connections. This training will be taught by a qualified fusion trainer at the jobsite. The contractor shall furnish a copy of the completion certificate to the CONSULTANT or OWNERS REPRESENTATIVE.

Prior to HDPE pipe being installed in the trench, after the CONTRACTOR has begun butt fusion of the pipe, the irrigation consultant and/or the owners representative reserve the right to select at random two butt fusion joints (with a minimum of 18" of pipe on each side of the joint). These samples shall be sent to the HDPE supplier or manufacturer for hydrostatic testing at the CONTRACTOR'S expense. The testing procedure shall be to Factory Mutual Standards. In no case will the failure be in the butt fusion joint. The test will be recorded and sent to the CONTRACTOR and CONSULTANT. Upon failure of any butt fusion weld; CONTRACTOR will be required to cut and re-weld all questionable butt fusion joints as directed by the CONSULTANT at no cost to the OWNER.

d. Warranty

Seller warrants that, for a period of five years from the date of shipment it will replace any section of HDPE pipe product that is defective in materials or workmanship, provided that

Buyer, upon discovery of a defect, promptly notifies Seller of the defect and, as instructed by Seller at such time, either returns the product to Seller for inspection or allows Seller to inspect at the place of installation. If Seller determines the product to be defective, Seller will provide new product of the same specification and same quantity as the defective product and Seller will bear the expense of freight to deliver the replacement product to the jobsite. Contractor warrants that, for a period of five years from the date of installation, it will re-fuse or repair a fusion connection that is defective in workmanship, provided that Buyer, upon discovery of a defect, promptly notifies Contractor of the defect and, allows the Contractor to inspect at the place of installation. If it is determined the fused connection to be defective, Contractor will re-fuse or repair the connection at the jobsite. Contractor does not warrant the product itself, only the fused connection

e. Sleeves, Bridge and Stream Crossings

When the irrigation pipe or wire must be installed across a paved road, the CONTRACTOR shall contact and obtain the necessary permission of the agency or persons having jurisdiction. The CONTRACTOR shall install pipe and sleeved wire sleeves across the area in accordance with the governing agency's guidelines. A sleeve of sufficient size to pass the electrical conduit wire sleeves shall be installed with separate sleeves for all 115/220 V.A.C. and 24-volt control wiring installed. Ductile iron pipe may be used in lieu of sleeves for water pipe at road crossings. Any method employed, however, must satisfy the governing agency's requirements. The CONTRACTOR shall pay for all costs incurred including permits and road surface replacement or repair if pavement is removed or damaged by this operation.

HDPE Expansion Joint Coupling & Above Ground Pipeline Anchor:

Note: CONTRACTOR to follow all Manufacture recommendations on the use of expansion joint couplings and above ground pipeline anchor at all times.

The above ground anchor fitting is commonly used to manage HDPE pipe from thermal expansion and contraction. The fitting is fused into the pipe-line, and a metal band (C-Clamp) is secured over the anchor fitting in the middle, and securely bolted to an I-beam, support bracket, or embedded into a concrete block up-to the spring-line with C-clamp over the pipe crown and bolted to the block . The metal band attaches the pipeline to the anchoring point; the OD rings prevent the pipeline from moving in expansion or contraction in either direction. The width of the center groove can be made as wide as required so as to get sufficient grip on the HDPE pipe for the thermal excursions expected.

Wire sleeves of sufficient size consisting of PVC electrical conduit with enough separate sleeves to provide for separation of 115/220 V.A.C. and 24 volt wiring shall be provided and individually supported or securely strapped for support if needed.

f. HDPE Fusion

1. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground, whenever possible. The joining method shall be the butt fusion and or socket fusion method and shall be performed in strict accordance with the pipe supplier's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe supplier, including, but not limited to, temperature requirements of 425 +/- 15 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 +/- 15 psi for hydraulic . The fusion equipment used shall be manufactured by McElroy Manufacturing, or

equal. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.

2. Electrofusion or socket fusion (500°F +/-25 may be used where the butt fusion method cannot be used. Electrofusion couplings and fittings shall be PE 4710 with a minimum cell classification of PE 445474C. Electro-fusion couplings or fittings shall have a manufacturing standard of ASTM F1055. Couplings and fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.
3. Mechanical connection to other types of pipe shall be made by one of the following methods:
   a. Flange, using HDPE flange adapter with HDPE stubs, ductile iron back up ring, and zinc-plated bolt pack. All bolts to be installed to manufacturer's torque specifications.
   b. Mechanical joint, using HDPE Mechanical Joint (MJ) adapter kit with HDPE stubs.
   c. Bell MJ adapter with kit (4"- 24")
4. INSPECTION: Inspect the pipe for defects before installation and fusion. Pipe shall not exhibit scratches or gouges greater than Defective, damaged or unsound pipe will be rejected.
   TESTING if pressure testing is required testing shall be done hydrostatically.
5. All fused taps on HDPE pipe shall be made using Electrofusion branch saddles with 2" IPS HDPE outlet or sidewall branch saddles. The pressure rating shall be equal to or greater than 100 PSI Central Plastics PE 4710 or approved equal.

g. <u>Mainline HDPE Pipe 4" - 16" Installation</u>

All HDPE pipe shall be installed per the following:

1. CONTRACTOR shall plow 4" - 6" pipe with proper equipment and soil conditions. (Not Required) Open cut trenching can also be utilized.
2. Pipe shall be installed in accordance with ASAE S376.
3. Irrigation mainline pipe shall have a minimum of thirty (30") and a maximum of thirty-six inches (36") of cover on the pipe. Variations in cover are allowed to overcome obstructions or separations from existing utilities.
4. Any repairs to the main line during construction shall require the use of HDPE fittings.
5. Extreme care shall be taken at all times to prevent contamination of the pipe with debris and dirt during storage, transport and installation. The open ends of the pipe shall be sealed at all times when installation is not in progress.
6. Piping shall be flushed completely <u>prior to</u> connection to lateral lines.
7. All mainline trenches shall be sod cut and replaced, backfilled and compacted as specified.
8. CONTRACTOR to install a 16" manifold with two outlets and valves to be prefabricated on or offsite.

i. <u>Lateral Pipe Installation 2" & 4"(Trenchless)</u>

Lateral pipe to be installed by trenchless methods. All lateral pipes to be installed by trenchless methods shall be installed per the following requirements:

1. 2"-4" plowing depth shall be a minimum of eighteen inches (18") and a maximum of (24") maintained from the top of the pipe to the surface of the trench. (Not Required) Open cut trenching can also be utilized.
2. 1½" plowing depth shall be a minimum of sixteen inches (16") and a maximum of (22") maintained from the top of the pipe to the surface of the trench.

3. Bottom of the trench shall be free from sharp debris and rocks.
4. Installation of pipe shall be installed in accordance with ASAE S376.
5. Backfill will be compacted from 90%-95% compaction.
6. Piping shall be flushed completely prior to installation of sprinklers.
7. Extreme care shall be taken at all times to prevent contamination of the pipe with debris and dirt during storage, transport and installation. The open ends of the pipe shall be sealed at all times when installation is not in progress.

3. Fittings and Valves (HDPE System)

All fittings shall be HDPE DR11. Fittings and valves shall be line sized as called for in the plans unless stated elsewhere in the plans or specifications. Fittings and valves shall be used that are compatible with the pipe utilized on the project. All fittings and valves of a similar style and type shall be purchased from the same manufacturer.

Fittings

All fittings shall meet the following requirements

1. All sprinklers shall be mounted **on LASCO PVC 364-251,** 2" x 1½" Tap't Saddle w/ACME Threads and 1-½" swing joints. The swing joint shall be adapted at the swing joint outlet to match the size of the sprinkler inlet. Or approved Equal.
2. All rotors shall be installed on 12" standard lay length LASCO, factory assembled, adjustable swing joints as indicated on the details. Swing joints shall utilize PR315 or Schedule 80 components and contractor shall follow manufacturer's installation recommendations.
3. All rotors shall be installed on 12" standard lay length, factory assembled, adjustable swing joints as indicated on the details. Swing joints shall utilize PR315 or Schedule 80 components and contractor shall follow manufacturer's installation recommendations.
4. All swing joints must come with a minimum 5 year warranty. NOTE: Toro and Rain Bird swing joints are accepted only with a five year warranty for both swing joins and sprinklers.
5. All golf sprinkler swing joint and sprinkler threads shall be ACME.

HDPE Fittings

1. Butt Fusion Fittings - Fittings shall be PE4710 HDPE, Cell Classification of 445474C as determined by ASTM D3350-02. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be manufactured using a Data Logger. Reference to the Data Logger Quality Control records should be referenced from an indented stamp in each fusion bead of each fitting. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings 8" and smaller shall be molded. All fittings above 8" shall be fabricated and must meet or exceed the.
2. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 4710 resin with a minimum cell classification of PE 445474C. Flange adapters and Mechanical Joint Adapters shall have the same pressure rating as the pipe unless otherwise specified on the plans.
3. All fused taps on HDPE pipe shall be made using "fused connection" socket or electro-fusion service saddles as shown on the plans and details. They shall be PE4710

HDPE, Cell Classification of 445474C as determined by ASTM D3350-02, shall have a manufacturing standard of ASTM F1055, and must meet or exceed the pressure rating of the pipe.

4. Where required "fused connection", socket or electro-fusion couplings will be used as shown on the plans and details. They shall be PE 4710, Cell Classification of 445474C as determined by ASTM D3350-02, shall have a manufacturing standard of ASTM F 1055, and must meet or exceed the pressure rating of the pipe.
5. HDPE IPS dead end cap DR11 (1.5" – 8").
6. Compatible fusion shall be meet at all times.
7. All drill bits used for drilling HPDE pipe shall be a Poly-Click Series, Composite Core Bit applied by an electric drill. Miyanaga: PCC32C 1 ¼" Hole Saw, PCC28C 1 ½" Hole Saw, PCSKS Hole Saw Shank (Short or Long Shank), PCCCDS Hole Saw Drill Bit.

Mainline Isolation Valves
Main Line isolation valves 4" and larger shall be line sized American Valve AVK Series #66 for use with HDPE DR 13.5 fusible ends, as manufactured by American Valve Company. **Or approved Equal.** They shall be PE 3408/ PE4710 and have a 2" operating nut. Assembly shall be installed in a 12" x 18" Square valve box with a 4" PVC sleeve around valve skirt.

Lateral Isolation Valves
Lateral Line isolation valves 4" shall be line sized American Valve AVK Series #66 for use with HDPE DR 13.5 fusible ends, as manufactured by American Valve Company. **Or approved Equal.** They shall be PE 3408/ PE4710 and have a 2" operating nut. Assembly shall be installed in a 10" round valve box with a 4" PVC sleeve around valve skirt.

Drain Valves
Drain Line valves 2" shall be American Valve AVK Series #66 for use with Female Threaded Ends or DR 13.5 fusible ends, as manufactured by American Valve Company. **Or approved Equal.** They shall be PE 3408/ PE4710 and have a 2" operating nut. Assembly shall be installed in a 10" round valve box with a 4" PVC sleeve around valve skirt.

Air Release Valves
A 2" Plastic Bermad 02-ARC-P or equivalent air release valve shall be installed on any high inflection points in long runs (100' or greater) of piping without sprinkler head outlets. The relative location is indicated on the irrigation plans, but should be field adjusted to the highest point. The valves shall be mounted on a two inch (2") electro-fusion service saddle by mainline size followed by a 2" PVC SCH80 nipple, length required to service the assembly, a two inch (2"), AVK Series #66 for use with Female Threaded Ends or HDPE DR 13.5 fusible ends, a two 2" x 4" SCH80 nipple terminating at the air release valve. **Or approved Equal.** This assembly shall be installed in a 14" by 23" minimum valve box with lid mounted at grade level to allow for access and maintenance.

Landscape Tie-In Valves
- All existing landscape points of connection as located on the plans shall be installed as follows:

The relative location is indicated on the irrigation plans, but should be field adjusted to the desired drain or flush points. The valves shall be mounted on a two inch (2") electro-fusion service saddle by mainline size followed by a 2" PVC SCH80 nipple, length required to service the assembly, a two inch (2") AVK Series #66 for use with Female Threaded Ends or HDPE DR 13.5 fusible ends, a two 2" x 4" SCH80 nipple terminating at the electric valve. **Or approved Equal.** This assembly shall be installed in a 12" by 18" minimum valve box with lid mounted at grade level to allow for access and maintenance.

Valve Boxes (Heavy Duty)
The CONTRACTOR shall install all gate valves, isolation valves, remote control valves, drain valves, air relief valves, ground rods, electrical splices, etc. in high impact plastic valve boxes per the details on the plans to provide easy access to the installed component. Valve boxes shall be manufactured by Ametek, Brooks, Carson, or approved equal, and be of the following size:

All Valve Boxes (Heavy Duty)
Mainline Valves - 12" x 18" Square, Marked "Irrigation"
Lateral Valves - 10" Round, Marked "Irrigation"
Automatic Valves – 12" x 18" Rectangular, Marked "Irrigation"
Ground Rods & Quick Couplers- 6" Circular, Marked "Irrigation"
Elec. Splices – 12" x 18" Rectangular, Marked "Electrical", locking lid
Air Release – 14" x 23" Rectangular (minimum), Marked "Irrigation"

Valve boxes shall be installed with the appropriate extensions per the manufacturer to bring the valve box level with existing grade. Pea gravel shall be installed in the floor of each automatic valve box. Valve box lids in turf areas shall be green and those in native soil, bark or mulch shall be tan.

4. Flushing

Extreme care shall be used at all times during flushing and pressurization. Mainlines shall be flushed as each section is added to the system and a gate valve installed. Lateral lines should not be connected to the mainline prior to flushing of the mainline. Laterals must be flushed prior to installation and operation of the sprinklers. Any flushing through the sprinklers may result in the replacement of the sprinkler subjected to flushing with a new sprinkler and the CONTRACTOR will be responsible for all labor and materials necessary in the replacement.

5. Inspection

The CONSULTANT and OWNER reserve the right and access to inspections of the installation whenever necessary. The CONTRACTOR shall provide any labor and equipment required to

successfully test and inspect the work. Inspections include, but may not be limited to, the following:

A. Inspection of materials to be used on the project,
B. General inspection of installation by the CONSULTANT and OWNER'S REPRESENTATIVE,

C. Proper sprinkler location, coverage patterns and performance,
D. Leakage test of the piping system and all valves,
E. Inspection for trench settlement, proper grading and compaction of trenches, sprinklers, valve boxes and all components upon completion of the installation,
F. Inspection for satisfactory repair, as a result of installation, of any damage to asphalt surfaces, blacktop, roadways, landscape, etc.,
G. Testing of the automatic operation of all irrigation equipment.

6. HDPE Pipe Testing

The mainline and lateral piping system is to be fused to withstand Bend Back testing as determined by ASTM F2620-06. Testing shall occur at a minimum once per operator, per diameter, per week. At any time a new operator is fusing pipe, a Bend Back test is required. At any time during the fusion process the CONSULTANT or OWNER's REPRESENTATIVE has the right at any time to have a Back Bend test administered at their discretion. Fusing Operator must document with a silver/metallic Sharpie marker, each test specimen by marking date of fusion, operator's full name, diameter of pipe tested and must mark as "pass or fail" and store in one place for proof of compliance. Back Bend test procedures as followed but may not be limited to:

Butt Fusion Qualification:

a. Prepare a sample joint. Sample lengths should be at least 6" or 15 times the minimum wall thickness.
b. Observe the fusion process and verify the recommended procedure for butt fusion is being followed.
c. Visually inspect the sample joint for quality.
d. Allow the joint to cool completely (minimum of one hour).
e. The sample should be cut lengthwise into at least three longitudinal strip with a minimum of 1" or 1.5 times the wall thickness in width.
f. Visually inspect the cut joint for any indications of voids, gaps, misalignment or surfaces that have not been properly bonded.
g. Bend each sample at the weld with the inside of the pipe facing out until the ends touch. The inside bend radius should be less than the minimum wall thickness of the pipe. In order to successfully complete the bend back, a vise may be needed. For thick wall pipe, a hydraulic assist may be required.
h. The sample must be free of cracks and separations within the weld location. If failure does occur at the weld in any of the samples, then the fusion procedure should be reviewed and corrected. After correction, another sample weld should be made per the new procedure and re-tested.
i. All fusions will be "manually data logged". Every fusion technician shall use a silver/metallic Sharpie marker and print the following information on each fusion; Full name of fusion technician, date and time of day.

Saddle Fusion Qualification:

a. Prepare at least two sample joints. The main pipe length should be a minimum of 2' or seven times the maximum saddle fitting base dimension, whichever is greater.
b. Observe the fusion process and verify the recommended procedure for saddle fusion is being followed.
c. Visually inspect the sample joint for quality.

d. Allow the joint to cool completely (minimum of one hour). The main should not be tapped for this qualification process.
e. Cut the joint lengthwise along the main pipe and through the saddle fitting.
f. Visually inspect the joint for any voids, gaps, misalignment or surfaces that have not been properly bonded.
g. Bend each test strip 180 degree with the inside facing out.
h. The fusion joint must be free of cracks, voids, gaps and separations.
i. Test the other sample joint by impact against the saddle fitting. The failure must occur by either tearing the fitting, bending the fitting at least 45degrees or by removing a section of the pipe. Failure at the fusion is not acceptable. This test is a federal requirement for qualification of fusion procedures, but is not a requirement for individual qualification. If failure does occur at the weld in any of the samples, then the fusion procedure should be reviewed and corrected. After correction, another sample weld should be made per the new procedure and re-tested.
j. All fusions will be "manually data logged". Every fusion technician shall use a silver/ metallic Sharpie marker and print the following information on each fusion; Full name of fusion technician, date and time of day.

7. Balance and Adjustment

The CONTRACTOR shall balance and adjust the various components of the sprinkler system so that the over-all operation of the system is most efficient. This includes a synchronization of the controllers, adjustments to pressure regulators, pressure relief valves, part circle sprinkler heads and individual station adjustments on the controllers. The CONTRACTOR may request the MANUFACTURER or OWNER'S REPRESENTATIVE to assist in the balancing and adjustment of the system as it relates to its function and operation.

8. Notice of Completion

When the CONTRACTOR is satisfied that the system is operating properly, that it is balanced and adjusted and that all work and clean up is completed, he shall issue the notice of completion to the CONSULTANT. The notice of completion shall include the request for final inspection with date and time given. The inspection shall occur upon final completion of the installation but prior to the re-setting of the sprinklers after the settling process.

9. Final Inspection with OWNER'S REPRESENTATIVE

The CONSULTANT will respond to the notice of completion by the CONTRACTOR and shall appear at the given time for a tour of the project with the purpose of making it the final inspection. Any inconsistencies in regard to the specifications shall be noted by the CONSULTANT and OWNER'S REPRESENTATIVE and a written copy of correction shall be given the CONTRACTOR.

SECTION 6 - SPRINKLERS AND IRRIGATION VALVES

1. Sprinklers

The installation of sprinklers shall include the furnishing of all equipment and components necessary to completely install the sprinkler and shall include, but not be limited to, excavation and backfill, swing joint risers assembly, sprinklers, wire and restoration to grade in accordance with these plans and specifications.

a. Large Turf Sprinkler Materials

Sprinklers shall be of the types, nozzles and sizes indicated on the plans and capable of producing the radius of throw, flow, pressure and any other designations as indicated on the drawings. Sprinklers shall meet the following requirements:

A. All V-I-H sprinklers shall be electric actuation.
B. Pressure regulated with a pre-set pressure of **65-80 PSI MAX**.
C. Cases shall be constructed of high impact molded plastic.
D. Sprinkler internal and valve shall be serviceable through the top of the sprinkler.
E. Carry a minimum **five (5) year** unconditional warranty.
F. ACME inlet threads are required on V-I-H sprinklers.
G. Manufacturer may be required to supply a replacement nozzle for each sprinkler at no additional charge.
H. Nickel Plated Model or saltwater rotor.
I. Acceptable models:

Legend	Toro 65/80 PSI	
85' Spacing Full Circle V-I-H-H	INF 55-57	**80 PSI**
75' Spacing Full Circle V-I-H-H	INF 55-55	**80 PSI**
65' Spacing Full Circle V-I-H-H	INF 55-53	**65 PSI**
55' Spacing Full Circle V-I-H-H	INF 55-51	**65 PSI**
35' Spacing Full Circle V-I-H-H	INF 55-51	**65 PSI**

(Mainless Nozzle Config. Requires the low-flow stator 102-6929)

85' Spacing Part Circle V-I-H-H	INF 55-57	**80 PSI**
75' Spacing Part Circle V-I-H-H	INF 55-55	**80 PSI**
65' Spacing Part Circle V-I-H-H	INF 55-53	**65 PSI**
55' Spacing Part Circle V-I-H-H	INF 55-51	**65 PSI**
35' Spacing Part Circle V-I-H-H	INF 55-51	**65 PSI**

(Mainless Nozzle Config. Requires the low-flow stator 102-6929)

b. Sprinkler Installation

The OWNER will remove all existing sprinklers on the site during construction. Part circle sprinklers staked along cart paths shall be installed at a 1' offset from the pavement. The CONTRACTOR must coordinate the location of the finished pavement to insure that the sprinklers are located within 1' of the pavement.

Sprinklers shall be installed at grade upon initial installation. Two (2) months after completion of the installation, the CONTRACTOR will be required to return to the project and reset any sprinklers that have settled. All sprinklers shall be backfilled and hand tamped to 95% compaction to avoid future settling. Swing joint installation shall be consistent throughout the project with the sprinklers laying away from the green and to

the right side of the pipe. Extreme care shall be taken to prohibit trash from entering the piping and swing joints during installation of the sprinklers. Sprinklers in areas of excessive slope shall be adjusted level for maximum sprinkler performance without exposing the sprinkler case to damage from mowers or other equipment. The CONTRACTOR shall install a small coil of tubing at each valve-in-head sprinkler to allow for maintenance. A wire shall be run from the satellite to each sprinkler. Three (3) spare wires shall be installed to the quick coupler at each tee and green. The location of the spare wires shall be marked on the contractor's field notes and "as-built". The CONTRACTOR shall be responsible for all adjustments necessary to insure the proper coverage and operation. All adjustable part circle sprinklers shall also be properly adjusted by the CONTRACTOR prior to final checkout of the system. All sprinklers having adjustable pin nozzles shall have such pin adjusted for proper distribution prior to planting and final checkout of the system.

2. **Quick Coupling Valves**

Quick coupling valves shall be installed at each green, and where indicated on the plans for tees, rough and bunker areas and meet the following requirements:

A. One-piece brass construction with 1" inlet thread minimum.
B. Install utilizing a LEEMCO **Or Approved Equal** stabilizing anchor.
C. All quick couplers installed in rough, native or landscape areas shall also be installed with a 24v- hot and common wire to the satellite in that control zone.

Material supplier shall supply four (4) quick coupler valve keys compatible with the valves installed. All keys shall be fitted with hose swivels to accommodate one-inch (1-1/2") hose.

3. **Automatic Control Valves**

Electric automatic valves (if applicable) and as located and sized per the plans shall be installed to meet the following requirements:

A. One piece plastic construction,
B. Provide pressure regulation if available
C. Debris resistant
D. Acceptable Models:
   Toro – P220-27-08

SECTION 7 - AUTOMATIC CONTROL AND ELECTRICAL

1. Central Computer (Existing)

- The central control system shall be a wireless Toro Site-Pro with T-Map with all necessary antennas shall be installed at the maintenance building.

The irrigation computer shall be installed prior to commencement of **project**. The irrigation central controller shall be a IBM compatible computer based package of the latest model as specified by the irrigation software manufacturer and shall include the CPU, software, printer, monitor, modem, cables, antennas, irrigation interface units, surge suppression, programming and training manuals as specified herein and any other items necessary to insure complete operation of the irrigation system. Central controller shall be fully compatible with the satellite controllers used in the system.

A hand held wireless portable radio system for irrigation control must be installed to include all antennas, surge suppression devices, cabling and (4) hand held radios. All frequencies required for any radio equipment are the responsibility of the CONTRACTOR. The CONTRACTOR shall coordinate a site survey with the irrigation material supplier to perform a site survey, preferably prior to submitting a bid. In either instance, any additional antennas required to make each satellite fully functional to the central computer located at the maintenance building will be the responsibility of the OWNER.

One (1) I Pad PC remote irrigation system manager must be included.

The CONTRACTOR shall be responsible for the installation of all central computer components in coordination with the distributor and certify communication to all field components. Location of the central controller shall be in the maintenance building and installed per the following specifications and any manufacturer's recommendations

a. Irrigation Software

Irrigation system software shall be of the latest release version and include a 5-year complete warranty and service program. The manufacturer shall agree to provide any software releases for a period of twelve (12) months following **final acceptance** of the system by the OWNER.

b. Irrigation Computer

The irrigation computer shall be latest model approved by the irrigation manufacturer and meet the following minimum requirements:
Central Computer (Existing)

2. Field Satellite Controllers

The field satellite controllers shall be wireless and compatible with the central computer. The concrete pads, satellites shall be installed per the manufacturer's recommendations. Controllers shall be as located and installed as shown on the plans and details. Each satellite shall be installed to allow for expansion of (4) stations per hole per location. Each satellite shall be fully surge protected as specified in the plans and details or as recommended by the

manufacturer for 120 / 240VAC power. Satellites shall be supplied with the following features:

A. Housed in a heavy-duty temperature and chemical resistant high impact plastic pedestals.
B. UL Listed.
C. Electric actuation
D. Removable access panels for ease of installation and maintenance.
E. Include all necessary cabling and connections. Capable of providing a minimum of 24 stations.
F. Acceptable Models:
Toro – E OSMAC

3. **Weather Station**
Wireless Weather Station as provided in material takeoff.

4. **Wiring**
The CONTRACTOR shall insure that all wiring shall be in accordance with all local codes and manufacturer's specifications. Wiring shall be as manufactured by PAIGE electric or approved equal. Upon receiving materials, all wire shall be inspected by the OWNER'S REPRESENTATIVE prior to installation. The OWNER will provide all properly sized and fused electrical disconnects and panels for the irrigation system. The CONTRACTOR shall provide all wiring, conduit, labor, equipment and any other items necessary to connect field wiring to these power sources.

All wiring, where feasible, shall be installed in a continuous manner without splicing. Any splices that must occur other than in satellites pedestals shall be located in plastic valve boxes with locking covers and marked as "Electrical" per the details in the plans. All splices shall be located on the revised "As-Staked Drawings." Wire shall be checked immediately upon installation for resistance and continuity. Grounding shall be completed simultaneously with

the satellite installation. All grounding shall be installed in accordance with the plans, specifications and manufacturer's specifications prior to connection of the 240VAC power to the satellites.

a. **Power Wire Materials**
All power cables are type Tray Cable to be UL listed for direct burial, and rated at 600 volts approved for underground direct burial and meet the following requirements:
1. The cable shall include three conductors, which are to be colored per wire industry standard or numbered as 1, 2, and 3.
2. The size of the "hot" and "common" conductors are to be as shown on the irrigation plans, and the size of the "ground" conductor as required by the National Electrical Code, or larger.
3. The inner copper conductors shall are to be covered with high dielectric PVC and Nylon. The outer jacket will be black PVC and is to be sunlight resistant.
4. All wire shall be furnished in 2,500 ft. reels where possible, or 1,000 ft. reels as a minimum.
5. All power wire shall be supplied by the same manufacturer.

6. Approved power cable shall be Paige Electric Co., LP specification number P7266D for 10 AWG and smaller and specification number P7267D for 8 AWG and larger or equal.

b. Power Wire Installation

The CONTRACTOR shall install all 240 VAC power wire as per the installation specifications of the irrigation control system manufacturer as well as the plans, specifications and to meet the follow requirements:

1. All wiring shall be installed in accordance with all applicable electric codes.
2. All wire shall be installed in 2" conduit with pull boxes installed at a minimum of 300' or at changes in pipe direction **(only if applicable per building code).**
3. Any mainline trench that does not include power wire should have a blue 24-volt tracer wire installed to the nearest satellite. Blue should not be used for any other purpose. No mainline trench should be installed without a wire available for tracing.
4. Wiring shall be installed in mainline trenches adjacent to and two (2") inches below the top of piping.
5. Install with a minimum of twenty-six inch (26") cover.
6. All field satellites are to be grounded in accordance with all local code and the manufacturer's recommendations.
7. All splices shall be made with Scothcast epoxy splice kits #82-A, #82-A1, #82-A2, #82-A3, or wye splice #82-B1, #90-B1, or approved equal.
8. All above ground wiring shall be installed in conduit per applicable codes.

c. 24-Volt Wire

Wires connecting the remote control valves to the irrigation controller are single conductors, type PE. Its construction incorporates a solid copper conductor and polyethylene (PE) insulation with a minimum thickness of 0.045 inches. The wires shall be UL listed for direct burial in irrigation systems and be rated at a minimum of 30 VAC. Approved wire is Paige Electric Co., LP specification number P7079D or equal. All common wires shall be sized as #12 and all hot wire as #14
All 24-volt wire splices and connections to sprinkler wires shall be made in DBR/Y watertight connectors. Wires shall be affixed with numbered labels in the satellite. One (1) spare hot and One (1) common should be supplied to the green and furthest tee head for each hole. The spare wires should also be differentiated by color. Blue should only be used for mainline tracer wires.

A separate wire shall be run from each sprinkler to the satellite. All sprinklers shall be wired for individual operation. If pairing of sprinklers is deemed to be required by the OWNER, all approach, tee, and green sprinklers may be wired for individual operation. Adjacent part circle sprinklers other than greens or tees may be paired if they are set at the same arc. Pair sprinklers on separate pipelines where possible. Pairing of sprinkler wires where approved shall be done in the satellite and not in the field. Each wire shall be clearly numbered with an adhesive label in the pedestal for easy identification.

5. Grounding

All satellite power sources, the central controller and irrigation satellite locations shall be grounded to meet the manufacturers' specifications.

It is the responsibility of the CONTRACTOR to provide surge protection for all electrical equipment installed by him in relation to the irrigation contract. Said protection shall include but not necessarily be limited to the items described above and in the following paragraphs. The CONTRACTOR shall place a good grounding conductor system at each automatic controller (or control group) location to meet the ASIC grounding standards in the detail drawings and in the specifications below.
The installed grounding system should have a reading of no more than 10 ohms resistance to the ground in which it is placed. Resistance to the grounding electrode shall be measured by using a MEGGER direct reading Earth Resistance Testing instrument as manufactured by James G. Biddle Co. of Plymouth Meeting, Pennsylvania or a similar type of measuring instrument.

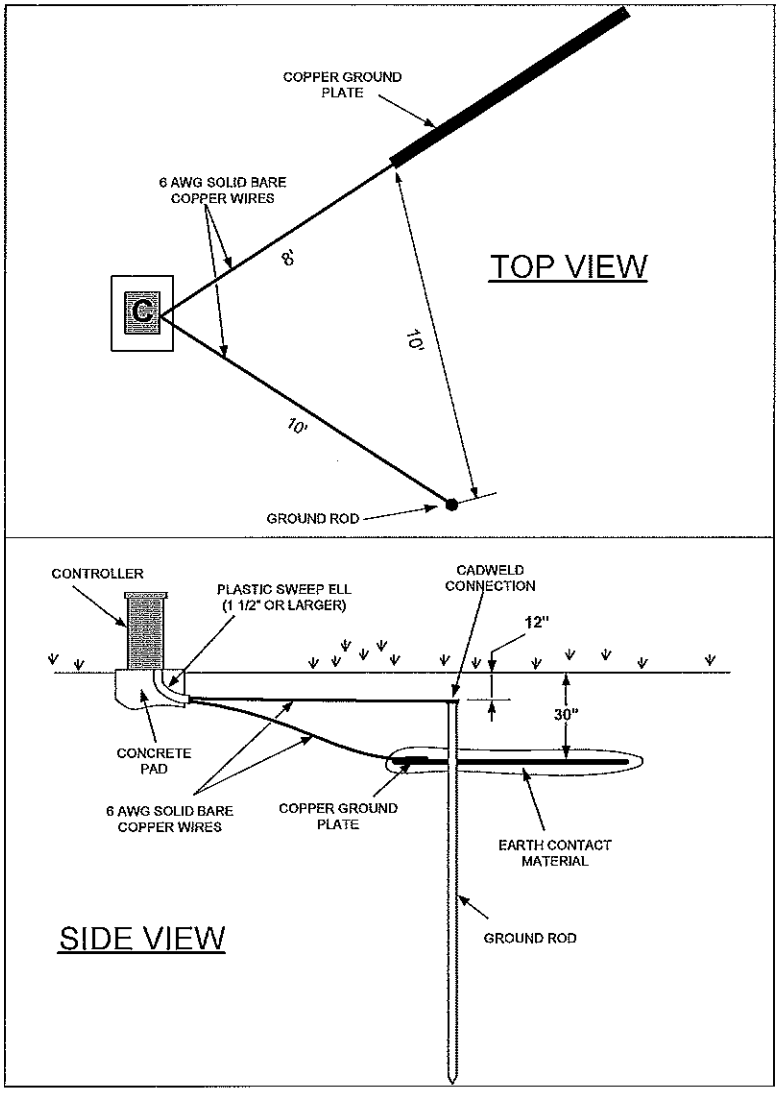
NOTE:

- 0- 5 Ohms—Excellent Grounding Protection
- 5 - 10 Ohms—Good Grounding Protection
- Above 10 ohms—Resistance is considered a poor ground and steps must be taken to improve the grounding conditions.

The CONTRACTOR shall have the right to seek assistance from the manufacturer or its local representative in the testing of any grounds. A minimum of 10 ohms resistance to ground is to be achieved. The CONTRACTOR shall install all grounding equipment described above and as described in the control system manufacturer's literature in an attempt to reach this level. Where specified methods do not reach required levels, the CONTRACTOR may be asked to install additional grounding equipment as dictated by local conditions. The CONTRACTOR will be compensated for this additional wiring and equipment installation as negotiated by the CONSULTANT for the OWNER.

a. EARTH GROUNDING

It is the responsibility of the installer to connect all electronic irrigation equipment for which he is responsible to earth ground in accordance with Article 250 of the National Electrical Code (NEC.) Grounding components will include the items described in the following paragraphs, at a minimum. Use grounding electrodes that are UL listed or manufactured to meet the minimum requirements of Article 250-52 of the 1999 NEC. At the very minimum, the grounding circuit will include a copper clad steel ground rod, a solid copper ground plate and 100 pounds of PowerSet® earth contact material, as defined below and per the following detail.



Ground rods are to have a minimum diameter of 5/8" and a minimum length of 10 feet. These are to be driven into the ground in a vertical position or an oblique angle not to exceed 45 degrees at a location 10 feet from the electronic equipment, the ground plate, or the wires and cables connected to said equipment, as shown in the detail above. The rod is to be stamped with the UL logo, Paige Electric part number 182007 or equal. A 6 AWG solid bare copper wire (about 12 feet long) shall be connected to the ground rod by the installer using a Cadweld Plus Control Unit welding kit, Paige Electric part number 1820037 or equal. This wire shall be connected to the electronic equipment ground lug as shown in the detail above.The copper

grounding plate assemblies must meet the minimum requirements of Article 250-52(d) of the 1999 NEC, Paige Electric part number 182199L or equal. They are to be made of a copper alloy intended for grounding applications and will have minimum dimensions of 4" x 96" x 0.0625". A 25-foot continuous length (no splices allowed unless using exothermic welding process) of 6 AWG solid bare copper wire is to be attached to the plate by the manufacturer using an approved welding process. This wire is to be connected to the electronic equipment ground lug as shown in the detail of page 1. The ground plate is to be installed to a minimum depth of 30", or below the frost line if it is lower than 30", at a location 8 feet from the electronic equipment and underground wires and cables. Two 50-pound bags of PowerSet®,

Paige Electric part number 1820058 or equal, earth contact material must be spread so that it surrounds the copper plate evenly along its length within a 6" wide trench. Salts, fertilizers, bentonite clay, cement, coke, carbon, and other chemicals are not to be used to improve soil conductivity because these materials are corrosive and will cause the copper electrodes to erode and become less effective with time.

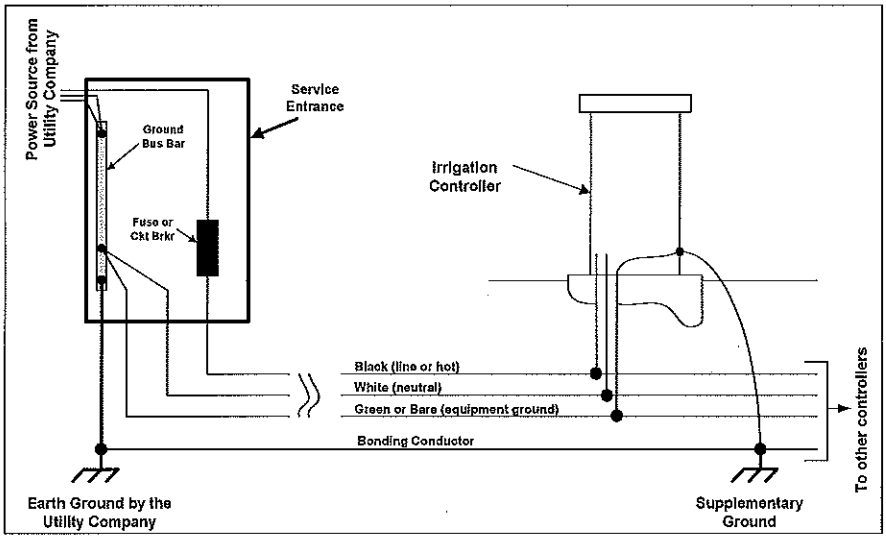
Install all grounding circuit components in straight lines. When necessary to make bends, do not make sharp turns. To prevent the electrode-discharged energy from re-entering the underground wires and cables, all electrodes shall be installed away from said wires and cables. The spacing between any two electrodes shall be so that they don't compete for the same soil.

The earth-to-ground resistance of this circuit is to be measured using a Megger®, or other similar instrument, and the reading is to be no more than 10 ohms. If the resistance is more than 10 ohms, additional ground plates and PowerSet® are to be installed in the direction of an irrigated area at a distance of 10', 12', 14', etc. It is required that the soil surrounding copper electrodes be kept at a minimum moisture level of 15% at all times by dedicating an irrigation station at each controller location. The irrigated area should include a circle with a 10-foot radius around the ground rod and a rectangle measuring 1-foot X 24-feet around the plate.

All underground circuit connections are to be made using an exothermic welding process by utilizing products such as the Cadweld "Plus" color coated container kits. Solder or "One Shot" shall not be allowed to make connections. In order to ensure proper ignition of the "Plus System", the Cadweld Color Coated Containers must be utilized by the size identification ring color chart used by Cadweld "Plus" grounding applications. The 6 AWG bare copper wires are to be installed in as straight a line as possible, and if it is necessary to make a turn or a bend it shall be done in a sweeping curve with a minimum radius of 8" and a minimum included angle of 90°. Mechanical clamps shall be permitted temporarily during the resistance test process, but are to be replaced with Cadweld "Plus" color coated container kits immediately thereafter.

b. BONDING

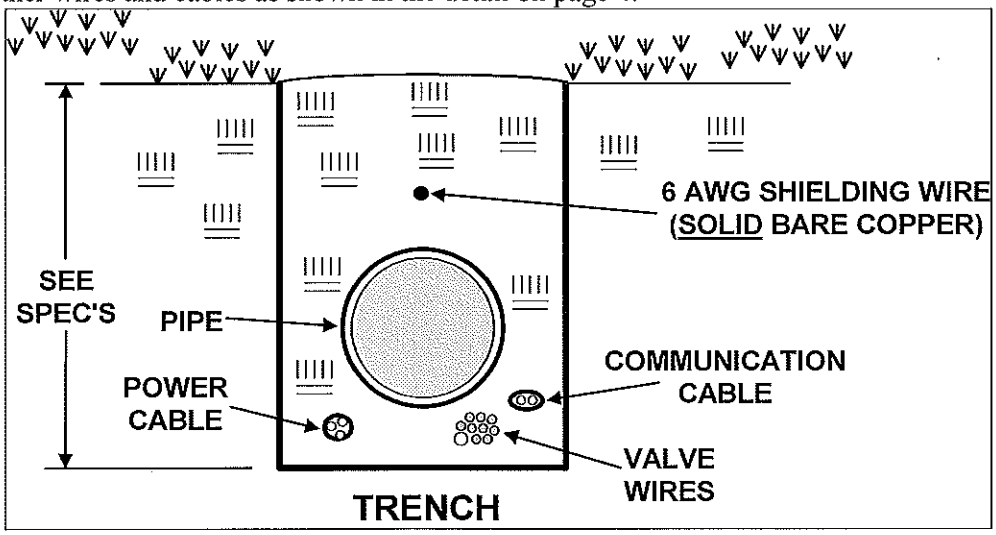
The above grounding circuit is referred-to as "supplementary grounding" in the NEC. And for safety reasons, the NEC requires that all supplementary grounds be "bonded" to each other and to the service entrance ground (power source) as shown below. This is also "recommended practice" of IEEE Standard 1100-1999. Note that this is in addition to the equipment ground, which is commonly referred-to as "the green wire." The Black, White and Green wires must always be kept together in a trench/conduit/tray/etc.



The bonding conductors are to be 6 AWG solid bare copper unless the system power conductors are larger than 1/0 AWG, in which case they are to be 4 AWG solid bare copper. All splices to the bonding conductors shall be made using a Cadweld Plus Control Unit kit.

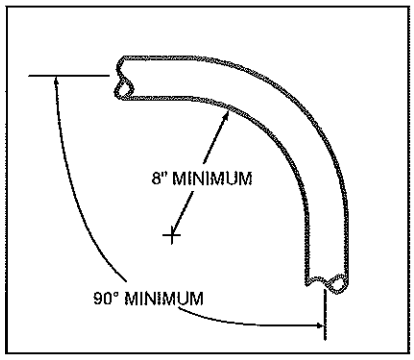
c. SHIELDING

The bonding conductors are to be installed in such a way so that they also act as shielding conductors. This becomes a network of solid bare copper wire over all the main bundles of other wires and cables as shown in the detail on page 4.



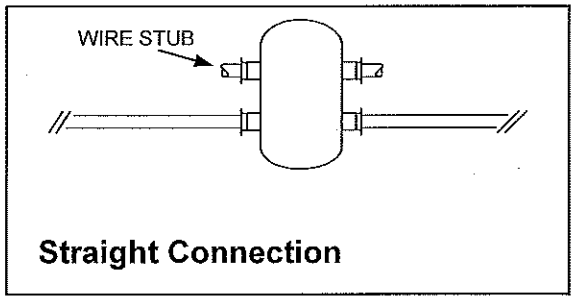
The bare copper wire is to be installed as close to the surface as possible, yet being sufficiently below the ground level as to prevent damage from maintenance equipment such as aerators. And it must be placed above all other valve/power/communication wires and cables, per detail, and installed in all trenches as shown on the electrical plan drawings. It is not necessary to install this conductor over short wire runs (less than 150 feet) away from the main wire bundles. The conductor is laid in as straight a line as possible, and when necessary to make bends, do so in a sweeping motion using the following detail as a guideline.

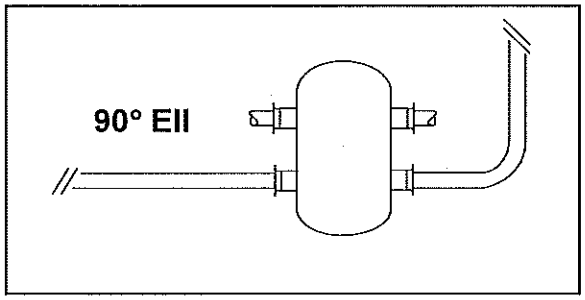
Note: When connecting bare copper wires to the ground lug of electronic equipment, feed it through a dedicated 1 ½" plastic sweep ell to automatically meet the requirements of the "sweep bend" shown here.

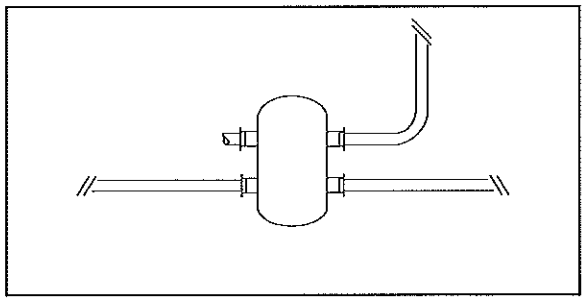


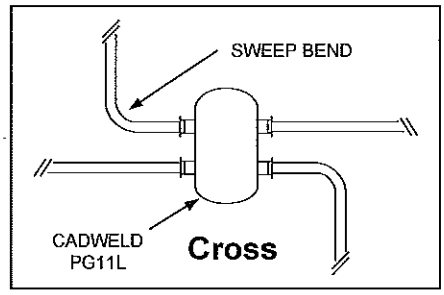
The shield network is to be connected to the service entrance earth ground, to all electronic equipment ground lugs, and all equipment supplementary grounding electrodes. One such network is necessary for each power source. Do not interconnect the equipment ground wires from different power sources.

When joining bare copper wires, do so using an Cadweld Plus Control Unit t kit as shown in the details below, Paige Electric part number 1820074 or equal.









SECTION 8 - PUMP STATION

1. Pump Station

The existing pump station will be replaced. The pump house and wet well will be reconditioned and modified by the Owners. The Owner will be responsible for any of the necessary electrical power service connections and or modifications for the pump and satellite power sources.

A new 1,000 GPM pump station will be installed. A new 12" discharge pipe will be installed and stubbed out for the new irrigation system.