Section 32 84 00
IRRIGATION

PART 1-GENERAL
1.1 RELATED WORK


FDG General Design Documents:
Landscape Design Guidelines

FDG Specifications Guidelines:
Section 01 56 39 Tree and Plant Protection
Section 31 10 00 Site Preparation
Section 31 20 00 Earthwork
Section 32 90 00 Planting
Section 32 01 00 Site Restoration and Rehabilitation

FDG Drawings:
Irrigation Drawings IR-01 –IR- 28
Planting Details PL-01 –PL- 06

1.2 QUALITY ASSURANCE
A. Certification
1. A Maxicom certified contractor (certified by Rainbird Inc.) shall furnish all labor, tools, equipment, products, materials and transportation and perform all operations necessary to properly execute and complete all work in accordance with the Drawings and these Specifications. The intent is to accomplish the work of installing an irrigation system which will operate in an optimum manner. This intention is to be met foregoing any deficiency in setting a complete detailed description of the work to be done.

B. Reference Standards:
1. ASTM: American Society for Testing and Materials
2. NSF: National Sanitation Foundation

C. Drawings:
1. Refer to the Landscape Design Guidelines in the FDG General Design Documents (http://maps.stanford.edu/fdg_available) for important Irrigation considerations.
2. For purposes of clarity and legibility, drawings are essentially diagrammatic to the extent that many offsets, bends, unions, special fittings, and exact locations of items are not indicated, unless specifically dimensioned.
3. Exact routing of piping, etc., shall be governed by structural conditions, obstructions. Contractor shall make use of data in Contract Documents.
4. The contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that unknown obstructions, grade difference or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences shall be brought to the attention of Stanford LBRE Grounds Department and the irrigation consultant. In the
event this notification is not performed, the contractor shall assume full responsibility for any revision necessary.

D. Lake Water System
1. All landscape irrigation shall be connected to the Stanford Lake Water System wherever possible. Request service from the Stanford LBRE Utilities Division in the Department of Sustainability and Energy Management.

1.3 VISIT TO THE SITE
The contractor shall visit the construction site and shall take all measurements and obtain any other information as may be necessary for a complete and conclusive bid.

1.4 SUBMITTALS
A. Substitutions:
Prior to installation, any proposed substitution from the plans or these specifications is to be forwarded, in writing, to Stanford LBRE Grounds Department and the irrigation consultant for approval.

B. Record Drawings:
1. Provide record drawings in accordance with requirements of Stanford University and as follows:
2. The contractor shall maintain in good order in the field office one complete set of prints of all irrigation drawings which form a part of this contract. In the event any work is not installed as indicated on the drawings, such work shall be indicated and dimensioned accurately on record drawings as changes occur. Dimension from two permanent points of reference, building corners, sidewalk, road intersections, etc., the location of the following items:
   a. Connection to existing water lines
   b. Connection to existing electrical power
   c. Routing of pressure lines (dimension max. 100 feet long along routing)
   d. Remote control valves
   e. Routing of control wiring
   f. Quick-coupling valves
   g. Shutoff valves
   h. Underground stubouts
   i. Other related equipment as directed by Stanford LBRE Grounds Services Department and irrigation consultant
3. Upon completion of the work, provide drawings from the landscape architect and neatly correct the plans (to be done by a competent draftsperson) to clearly show the as-built conditions. After the as-builts are reviewed and approved by Stanford LBRE Grounds Department and the irrigation consultant, obtain (provide) reduced copies of "as-built" drawings (8 1/2" x 11" sheet size), color code map of valve areas (showing coverage area of each valve under control) number and mark corresponding controller setting, laminate with weather proof coating and place in each controller cabinet. Submit plans and Autocad-compatible CAD disk to Stanford University’s Representative.

C. Guarantee, Warranties & Lists:
Prior to the final inspection of the irrigation system, furnish manuals to Stanford LBRE Grounds Department. The manuals shall contain the following:
1. Sheet indicating the contractor’s name, address, and phone number.
2. A copy of the completed guarantee following the form in these specifications.
3. Certificate of insurance verifying coverage for completed operations.
4. Copies of equipment warranties and certificates, including but not limited to:
   a. Approval from Rainbird Inc. of radio frequency for Maxicom controllers.
   b. Certification from Rainbird, Inc. of proper controller grounding for Maxicom controllers.
5. Invoices from suppliers showing proof of purchase of all Rainbird Products used. Invoices shall show Rainbird model number, quantity, date purchased and Stanford project name (prices are not required).
D. Hardware Items:
   1. Two (2) keys to each enclosure
   2. Two (2) sets of any special tool required for the maintenance of each type of component used in the
      sprinkler system.
   3. Existing irrigation equipment returned to project manager with equipment listed on receipt and
      signed/dated by both contractor and project manager.
   4. Copy of receipt/invoice of all Rainbird equipment for project.

1.5 PROJECT CONDITIONS
A. Sequencing and Scheduling:
Coordinate irrigation installation work with the installation of other site improvements, including utility
installation work and landscape installation.

B. Environmental conditions:
Site work such as trenching and backfilling shall not be performed during wet, muddy or frozen
conditions.

C. Rules and Regulations:
All work and materials shall be in full accordance with the latest rules and regulations of the National
Electric Code, the Uniform Plumbing Code and other applicable state or local laws or regulations. Nothing
in these drawings or specifications is to be construed to permit work not conforming to these codes.
   1. The contractor shall furnish any additional material and labor required to comply with these rules
      and regulations, though the work is not mentioned in these particular specifications or shown on the
      drawings.
   2. When the Specifications call for materials or construction of a better quality or larger size than
      required by the above mentioned rules and regulations, the provision of the specifications shall take
      precedence over the requirements of the said rules and regulations.

D. Safety:
   1. The contractor shall erect and maintain barricades, guards, warning signs and lights as required for
      the protection of the public and workmen.
   2. All work shall be performed in a safe manner. All regulations, all OSHA requirements and other
      authoritative agencies shall be followed.
   3. Prior to commencement of work, locate all underground utilities so that proper precautions may be
      taken not to damage such improvements.

E. Maintaining Traffic:
It is the responsibility of the contractor to ensure adequate protection and controls for pedestrian and
vehicular traffic in the vicinity of the project areas. The contractor shall provide all signs, barricades,
flagmen, etc., necessary to meet all traffic requirements for this project at his own expense.

F. Permits and Fees:
The contractor shall obtain all permits and pay all required fees to any governmental agency having
jurisdiction over the work and arrange for inspections specified by local ordinances during the course of
construction as necessary.

PART 2-PRODUCTS

2.1 PRODUCT DELIVERY, STORAGE AND HANDLING
Handling of pipe and fittings: The contractor is cautioned to exercise care in handling, loading, unloading,
and storing of pipe and fittings. Cracks can occur from sudden impact. Protect all plastic (PVC)
products from excessive exposure to sunlight. Any section or pipe that has been dented or damaged
shall be removed from the site and, if installed, shall be replaced with new undamaged piping.
2.2 MATERIALS

A. PVC pressure main line pipe and fittings:
   1. Pressure main line piping: PVC schedule 40 for all pipes and fittings.

   2. Pipe shall be made from an NSF-approved Type 1, Grade 1, PVC compound conforming to ASTM D1785. All pipe shall meet requirements as set forth in ASTM D2441, with an appropriate standard dimension (S.D.R.). (Solvent-weld pipe.)

   3. All PVC pipe shall bear the following markings:
      a. Manufacturer’s name
      b. Nominal pipe size
      c. Schedule or class
      d. Pressure rating in PSI
      e. NSF
      f. Date of extrusion

   4. All fittings shall bear the manufacturer’s name or trademark, material designation, size, applicable I.P.D. schedule and NSF seal of approval.

B. PVC non-pressure lateral line piping and fittings:
   1. Non-pressure buried lateral line piping shall be PVC schedule 40 with solvent-weld joints. Use 2725 Wet ‘R Dry Low VOC Cement Weld-On solvent as directed.

   2. Pipe shall be made from NSF approved, Type 1, Grade 11 PVC compound conforming to ASTM D1784. All pipe shall meet requirements set forth in ASTM D2441 with an appropriate standard dimension ratio.

   3. Except as heretofore specified all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as specified.

C. Sleeving and Conduit:
   Material shall be polyvinyl chloride (PVC) schedule 40, type 1120/1220 with solvent weld connections.

D. Copper pipe
   Shall be Type L and conform to ASTM 888 and copper fittings shall be solder type to conform to ANSI 816.22 and 816.18.

E. Galvanized steel pipe:
   Shall be schedule 40; ASTM (A 120) and steel fittings shall be schedule 40 hot dipped, double banded malleable steel.

F. PVC Schedule 80 nipple:
   Shall be used with molded threads. Machined threaded nipples will not be allowed.

G. Connections:
   Connections between main line and R.C.V.’s and Q.C.V.’s shall be as specified or detailed on the drawings.

H. Riser assemblies:
Shall be as specified or detailed on the drawings. (Risers shall be PVC, not galvanized, steel or marlex.)

I. Controller(s), valves, backflow preventer(s) and irrigation heads:
Shall be as specified and/or detailed on the drawings.

J. Control wire:
Shall be no.14 AWG or larger copper wire as scheduled by valve manufacturer and shall be UL-approved for direct burial in ground. Common ground wire shall have white insulating jacket. Trace wire shall have yellow insulating jacket. All other control wire shall have jacket of color other than white. Spare wire shall have jacket of color other than control, common or trace wire.

K. Miscellaneous installation materials:
1. Solvent weld joints shall be of make and type approved by manufacturer(s) of pipe and fittings. Solvent cement shall be a proper consistency throughout use. Use 2725 Wet ‘R Dry Low VOC Cement Weld-On solvent as directed. Mixing thinner with solvent will not be allowed.

2. Pipe joint compound shall be non-hardening, non-toxic materials designed specifically for use on threaded connections in water carrying pipe.

3. Wire connections shall be made using 3M-DBY direct bury wire connectors.

L. Thrust Blocks:
Concrete thrust blocks shall be as detailed on the plans.

M. Control or Valve Boxes:
1. Provide 14 x 19 inch plastic rectangular control valve boxes, green in lawns and black in other areas (e.g. shrubs, groundcovers, mulch) with lock bolt, one box for each remote control valve.

2. For gate valves and quick coupling valves: Use 10 inch plastic round box with lock bolt, green in lawns and black in other areas. Use one box per valve. Add extensions for gate valves as required.

3. All valves to have I.D. tags identifying controller and station number. Do not stamp valve covers.

PART 3- EXECUTION

3.1 GENERAL
A. Irrigation system shall be installed in accordance with all applicable local and state codes and ordinances by a licensed Maxicom certified landscape contractor.

B. Follow manufacturer's directions except as shown or specified.

3.2 INSPECTION OF SITE CONDITIONS
A. All scaled dimensions are approximate. The contractor shall check and verify all size dimensions prior to proceeding with work under this Section.

B. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities which are caused by his operations or neglect. Check existing utilities drawings for existing utility locations.

C. Coordinate installation of irrigation materials, including pipe, so there shall be no interference with utilities or other construction or difficulty in planting trees, shrubs, and ground cover.
D. All existing landscaped areas are to be restored and operational with prior approval of the Stanford University Architect and Planning Office and Stanford LBRE Grounds Department.

E. Avoid trenching within root zone of trees where possible. The root zone is defined as the area from the trunk out to 10’ beyond the outermost limits of the tree canopy. When not possible, a Stanford LBRE Grounds Certified Arborist shall be consulted prior to work in the root zone and shall be present to supervise all cutting of roots 2” in diameter or greater. All damaged roots over 2” in diameter shall be pruned leaving a clean cut. Immediately install pipe, wire, etc., refill trench and soak. After refilling trench, water thoroughly as recommended by Stanford LBRE Grounds Certified Arborist.

F. The contractor shall carefully check all grades to satisfy himself that he may safely proceed before starting work on the irrigation installation.

G. Coordinate the work of this Section with that of other Sections for the location of pipe sleeves through walls, paving, etc.

H. The landscape irrigation contractor shall verify water pressure and available gallonage (as gallons per minute, GPM) prior to construction. If deficiencies are noted that will hinder the system's performance, notify Stanford University's representative and/or the irrigation consultant for direction to correct deficiencies.

I. The design is diagrammatic. All piping, valves, etc., shown within paved areas is design clarification only. Install piping, valves, etc., in planting areas.

3.3 PREPARATION - LAYOUT OF WORK
Prior to installation, stake out all pressure main lines, routing and location of sprinkler heads and notify Stanford University's representative and/or the irrigation consultant for reviewing layout when area grade differences or obstructions are not as indicated on the plans.

3.4 INSTALLATION

A. Trenching:
   1. Dig trench straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout shown on drawings.

   2. Provide for 18 inch cover for all pressure main lines. (Class 315 PVC.)

   3. Provide for 15 inch cover for all non-pressure lines to spray heads (Schedule 40 PVC) and 15 inch cover lines to rotor pop-up heads.

   4. Provide for a cover of 18 inches for all control wiring.

   5. Provide for a cover of 18 inches over pipe and wiring under asphalt pavement.

   6. Follow all Stanford University Tree and Plant Shrub Protection Guidelines when trenching in accordance with Section 01 56 39.

   7. All drip lines shall be buried, 2-4 inches under soil, so the lines are not visible and so damage and movement of these lines is minimized.

B. Backfilling:
In Accordance with requirements of Stanford University Specification Section 31 23 33.

C. Pipe and Fitting Installation and Connections:
1. Do not bundle multiple pipe assemblies. 4 inch minimum spacing is required. Provide each assembly with its own outlet.

2. Install all assemblies specified herein in accordance with details shown on drawings. **Provide a ball valve and schedule 80 union for each valve installation.**

3. Thoroughly clean PVC pipe and fittings of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.

4. On PVC to metal connections, the contractor shall work the metal connections first. Use Teflon tape, or equal, on all threaded PVC to PVC, and on all threaded PVC to metal joints. Do not over-tighten. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded.

5. Metal to PVC connections shall be made such that male PVC threads insert into female galvanized threads, not vice versa. Schedule 80 PVC fittings shall be used for all main line and pressure pipe.

6. Install piping under existing walks by boring whenever possible. Where any cutting or breaking of sidewalks and/or concrete is necessary, it shall be done and replaced at no increase in contract sum. Obtain permission to cut or break sidewalks and/or concrete from Stanford University before proceeding.

**D. Line clearance:**

All lines shall have a minimum clearance of 4 inch from each other and 6 inches from lines of other trades. Parallel lines shall not be installed directly over one another. All fittings shall have at least a 4 inch clearance from other pipes or fittings.

**E. Automatic Controller(s):**

1. Locate controller(s) in general location(s) shown with exact placement to be determined at jobsite by contractor and the University representative. Prior to exact placement of Maxicom controllers, contact Rainbird Inc. at 866-477-9778 for a radio test and obtain written approval from Rainbird for the radio frequency to be used.

2. Connect control lines to controller(s) in sequential arrangement according to assigned identification number on plans.

3. Controller(s) shall be properly grounded per article 250 of the National Electric Code and conform to local regulations. Install grounding grid and insure less than 10 OHM ground rating per controller manufacturers recommendations. After installation of grounding, contact Rainbird Inc. at 866-477-9778 for required written certification for all Maxicom controllers.

**F. Remote control valves:**

Install where shown on drawings. When grouped together, allow at least 12 inches between valves. Install each remote control valve in a separate valve box, green in lawn areas and black in other areas. Locate boxes in ground cover areas whenever possible, and a minimum of 12 inches from paving or curbs. All valves to have yellow I.D. tags with controller and station number embossed. Do not stamp valve covers.

**G. Control Wiring:**

1. Make connections between existing automatic controls and remote control valves with direct burial copper wire. Common wires shall be white. Install in accordance with valve manufacturer's specifications and wire chart.

2. Wiring shall occupy the same trench and shall be installed along the same route as pressure main or lateral lines wherever possible. When not possible, house wiring in PVC conduit as described in "Sleeving and Conduit" section.
3. Where more than one wire is placed in a trench the wiring shall be taped together at intervals of 10 feet.

4. Provide 2 foot expansion coil at each wire connection and at least every 100 feet of wire length on runs more than 100 feet in length. Form expansion coils by wrapping at least five turns of wire around a 1 inch diameter pipe, then withdrawing the pipe.

5. Splicing on runs shall be placed in round valve boxes. Indicate all splices on the As-Built Drawings.

6. All below grade wire connections shall be made as stated in "Miscellaneous Installation Materials" section following manufacturers recommended procedures.

7. Install separate common wire for each controller. Install extra control wire of different color through all valve boxes to controller.

8. Copper tracing wire shall be imbedded in trenches of pipes to facilitate locating with a cable detector. Wire shall terminate in valve box or above grade. Copper tracer wire shall be same as control wire. Tracer wire to have yellow jacket.

H. Sleeving and Conduit:
1. All pipe and control wiring passing under proposed concrete and paving shall pass through schedule 40 PVC sleeving and conduit-size as required. All sleeving is to be clearly represented in plan drawings.

2. Sleeving and conduit shall extend six inches (6") beyond farthest edge of pavement or curb.

3. Provide removable non-decaying plug at ends of sleeves and conduits to prevent entrance of earth.

4. Flow sensors and master valves shall not be located under concrete or asphalt. Flow sensors and master valves shall be located in areas such as soil, decomposed granite or lawn where digging can occur to access for maintenance and repair.

I. Flushing of System:
1. After all new pipe lines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of irrigation nozzles, open control valves and use a full head of water to flush out the system until completely clear.

2. Install irrigation nozzles only after flushing of system has been accomplished.

J. Irrigation Heads:
1. Install irrigation heads as shown on Drawings.

2. Spacing of irrigation heads shall not exceed maximum shown on Drawings. In no case shall spacing exceed maximum recommended by the manufacturer or "head to head" spacing - whichever is closer.

3. Adjust all irrigation nozzles so that they do not hit any tree trunks or overspray into tree water basins which are to have their own separate irrigation bubblers.

3.5 FIELD QUALITY CONTROL

A. Adjustment of the System:
1. Flush and adjust all irrigation nozzles for optimum performance and to prevent overspray onto walks, roadways, buildings or trees.
2. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the contractor shall make such adjustments prior to planting. Adjustments may also include changes in nozzle sizes and degrees of arc as required. All changes must be noted in final as built drawings.

3. Any height adjustment of irrigation by the contractor shall be accomplished within ten days after notification.

B. Testing of Irrigation System:
   1. Notify the Stanford University Grounds Services Department at least three (3) days in advance of testing.
   2. Tests to be done at no extra cost to Stanford University.
   3. Center load piping with sufficient amount of backfill to prevent arching or slipping under pressure. No fitting shall be covered.
   4. Testing of pressure main lines shall occur prior to installation of remote control valves.
   5. Pressure Test for Solvent Weld Pipe:
      a. Apply tests after welded plastic pipe joints have cured at least 4 hours or more if manufacturer of solvent cement requires.
      b. Test main lines per ASTM-F690 as follows: (1) add water slowly to pipe to avoid water hammer damage, (2) bleed system to insure all air is out of pipes, (3) pressurize system to 125% of design operating pressure for one hour. Visually inspect for leaks while system is holding pressure constant. Note-use hydraulic pump or other safe method -do not use air compressor.
      c. Test irrigation lines at full pressure and visually inspect for leaks.
   6. When the irrigation system is completed, perform a coverage test to determine if the water coverage for planting areas is complete and adequate. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviation from drawings. This test shall be accomplished before any plant installation.
   7. Upon completion of each phase of work, test and adjust entire system to meet site requirements.

3.6 CLEAN-UP
Clean-up shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be swept or washed down, all drains shall be cleared and cleaned and any damage sustained from the work of others shall be repaired to original conditions.

3.7 FINAL REVIEW PRIOR TO ACCEPTANCE
A. Operate each system in its entirety at time of final review. Any items deemed not acceptable shall be reworked to the satisfaction of the Stanford University representative and irrigation consultant.

B. Final review shall take place after submission of all specified lists, record drawings, and manuals.

3.8 INSPECTIONS
The contractor shall be subject to inspections at any and all times by authorized representatives of Stanford University.

3.9 MAINTENANCE
1. The contractor is to make all repairs and maintain the entire irrigation system from the time of
installation through the landscape maintenance period. This maintenance to include but not be limited to:

a. Drip Systems:
   1. Filter cleaning and flushing should start out as a monthly procedure.
   2. The system shall be flushed after all repairs.
   3. Visually check weekly for indications of pipe breaks or clogged emitters.
   4. During winter months when the system is not in use, the drip systems should be run about every 2 weeks for a 2-4 minute minimum runtime.
   5. For systems connected to the Stanford Lake Water System, during the winter months the systems should be run about every week for a 2-4 minute minimum runtime.

2. Contractor shall provide maintenance of irrigation system for a maintenance period determined by Stanford University Architect and Planning Office, usually 90 days. At the end of the contractor maintenance period there shall be a final walk through with representatives from Stanford University Architect and Planning Office and Stanford LBRE Grounds Department, including Stanford LBRE Grounds Certified Arborist, irrigation supervisor, grounds maintenance supervisor, and horticultural supervisor. A punch list shall be prepared and agreed upon at the final walk through.

3. Upon completion of the punch list, maintenance shall be turned over to responsible party (typically Stanford LBRE Grounds Department).

GUARANTEE FOR IRRIGATION SYSTEM

WE HEREBY GUARANTEE THAT THE SPRINKLER IRRIGATION SYSTEM WE HAVE FURNISHED AND INSTALLED IS FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP, AND THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. WE AGREE TO REPAIR OR REPLACE ANY DEFECTS IN MATERIAL OR WORKMANSHIP, ANY SETTLING OF BACKFILLED TRENCHES, WHICH MAY DEVELOP DURING THE PERIOD OF ONE YEAR FROM DATE OF ACCEPTANCE AND ALSO TO REPAIR OR REPLACE ANY DAMAGE CAUSED BY ANY DEFECTS IN THE IRRIGATION SYSTEM OR RESULTING FROM THE REPAIRING OR REPLACING OF SUCH DEFECTS AT NO ADDITIONAL COST TO STANFORD UNIVERSITY. ORDINARY WEAR AND TEAR, UNUSUAL ABUSE OR NEGLECT ARE EXCEPTED. WE SHALL MAKE SUCH REPAIRS OR REPLACEMENTS, INCLUDING COMPLETE RESTORATION OF ALL DAMAGED PLANTING, PAVING, OR OTHER IMPROVEMENTS OF ANY KIND, WITHIN A REASONABLE TIME, AS DETERMINED BY STANFORD UNIVERSITY, AFTER RECEIPT OF WRITTEN NOTICE. IN THE EVENT OF OUR FAILURE TO MAKE SUCH REPAIRS OR REPLACEMENTS WITHIN A REASONABLE TIME AFTER RECEIPT OF WRITTEN NOTICE FROM STANFORD UNIVERSITY, WE AUTHORIZE THE UNIVERSITY TO PROCEED TO HAVE SAID REPAIRS OR REPLACEMENTS MADE AT OUR EXPENSE AND WE WILL PAY THE COSTS AND CHARGES THEREFORE UPON DEMAND.

PROJECT:
LOCATION:
CONTRACTOR:
LICENSE NO:
ADDRESS:
TELEPHONE:
GUARANTEE TO:

DATE OF ACCEPTANCE:
AUTHORIZED REPRESENTATIVE:

GUARANTEE TO: STANFORD UNIVERSITY, STANFORD, CALIFORNIA