

THE IRRIGATION TECHNOLOGY CENTER
Concept Budget and Specifications

March 2000

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Figure 1. The Irrigation Technology Center: Conceptual Layout and Schematic

A. BUDGET SUMMARY

Cost estimates are for illustrative purposes only and are based on a concept design and arbitrary site layout of the Irrigation Technology Center (ITC) as shown in Figure 1. Funding is being sought for a Development Plan. For details see the Appendix.

for details, see page

1. COSTS BY BUDGET CATEGORY

	\$	
Testing Equipment and Supplies	1,160,400	3
Urban/Landscape Irrigation Unit	526,000	3
Agricultural Irrigation Unit	674,800	4
Wastewater Unit	703,000	5
ET Unit	616,700	5
Shop	99,200	5
Computer/Information Systems	209,000	6
Support Equipment	437,700	6
Infrastructure*	234,100	9
Buildings**	-----	10
Development Plan	465,000	Appendix
TOTAL	5,125,900	

2. ANNUAL OPERATING EXPENSES

	\$	8
Personnel	1,770,000	
Maintenance and Repairs	330,000	
Equipment Replacement	165,000	
Utilities**	-----	
Janitorial and Security Services***	-----	
Education Programs**	-----	
Other**	-----	

footnotes

* partial specifications and cost estimates are provided

** only specifications or descriptions are provided
*** may be permanent employees or contractual services

B. SUGGESTED IMPLEMENTATION PLAN AND SCHEDULE

		TIME FRAME (months from start)
PHASE I.	DEVELOPMENT PLAN (see the Appendix for more details)	
	Task 1 Site Evaluation and Selection	1 - 4
	Task 2. Design of Infrastructure, Buildings and Facilities	2 - 10
	Task 3. Construction and Implementation Schedule	3 - 8
	Task 4. Costs and Financing Plan	3 - 9
	Task 5. Detailed Economic Impact Assessment	3 - 5
PHASE II.	Site Preparation:	4 - 12
	(a) Construction/installation of basic infrastructure and lab buildings	
	(b) Procurement of Equipment	
PHASE III.	Buildings and Systems:	6 - 24
	(a) Construction of buildings	
	(b) Establishment of field, plots and demonstration areas	
	(c) Installation of equipment and irrigation systems	
PHASE IV.	Establishment of Testing Programs	12 - 24
PHASE V.	Establishment of Education Programs	18 - 30
PHASE VI.	Design and establishment of an interactive visitors center ¹	24 -

¹ Costs for an interactive visitor's center is not included in this budget.

C. DESCRIPTION, GENERAL SPECIFICATIONS AND COSTS

Specifications and costs are based on about a 400-acre facility as illustrated in Figure 1. Additional costs and specifications are included in Section D.

1. IRRIGATION SYSTEMS TESTING UNIT

a) Hydraulics Lab (\$656,500)

Testing and certification of flow meters, valves, and turbine and centrifugal pumps for pipe sizes up to 12 inches. The directors of the Utah Water Resources Lab, Logan, were contracted to develop costs estimates based on TITC needs and specifications (a copy of their report is provided in the Appendix).

b) Irrigation System Testing Equipment and Supplies - indoor (\$395,900)

Indoor testing of emission/application rates and uniformity, effects of wind on sprinkler patterns, drip tape and tubing properties, and durability and resistance of irrigation equipment to corrosion and wear. Testing equipment must be custom designed and constructed. Cost estimates are based on similar testing facilities (Center for Irrigation Technology and Senninger Irrigation). Three separate labs will be constructed:

- (1) Lab #1, a conventional indoor irrigation test facility;
- (2) Lab #2, indoor irrigation test facility with wind tunnel
- (3) Lab #3, "open-air" drip irrigation test facility- to allow for laying out field-scale lengths of drip lines.

c) Irrigation System Testing Equipment and Supplies - outdoor (\$108,000)

In addition to emission/application rates and uniformity, outdoor testing will also examine the long term durability and performance of whole systems. A special facility of reflective surfaces will be included to examine ultraviolet light resistance. A paved area equipped with automatic catch devices will be used for testing of landscape sprinklers.

2. URBAN/LANDSCAPE IRRIGATION UNIT

A number of blocks will be established, as follows:

- a) Sprinkler Testing and Performance Plots (16, 100 ft x 100 ft): to evaluate sprinkler application rate and efficiency under varying operating pressures and head spacings (\$108,500).
- b) Runoff Collection Plots (4, 100 ft x 100 ft): to determine runoff potential, and chemical and sediment loss under varying sprinkler application rates, soil conditions and degrees of slope (\$49,000).
- c) Microclimate Plots (18, 50 ft x 50 ft): to document the effects of common microclimate conditions, such as wind speed and direction, percent shade and slope on plant growth and water use (\$69,000).
- d) Irrigation Scheduling and Water Use Plots (18, 100 ft x 100 ft): to evaluate existing irrigation scheduling methods and products, including the PET based method and soil moisture sensors, and to quantify plant water requirements under different levels of stress (\$111,000).
- e) Surface and Sub-surface Drip Irrigation Plots (24, 100 ft x 100 ft): to test drip irrigation product performance and system management techniques under real conditions (\$124,000).
- f) Open-component Installation Plots (100 ft x 200' ft): to train and demonstrate proper design and installation of landscape irrigation systems (\$29,500).
- g) Efficient Turf Farm Irrigation: a 3-span linear-move machine equipped with efficient applicators (\$35,000).

3. AGRICULTURAL IRRIGATION UNIT

- a) Field-scale irrigation systems (\$483,600) will be used for testing and evaluation, for development and documentation of performance standards, and for education and technology transfer programs. These systems will cover 180 acres and will consist of the following:
 - (1) center pivots (640 ft long systems) will be equipped with various application devices. These systems are electric and hydraulic drive machines, and two emerging technologies: a variable rate application and dc (direct current) drive machine.
 - (2) linear-move (940 ft long systems) will be equipped with various application devices and will consist of an electric drive/ pipeline feed and a hydraulic drive/canal feed machine.

- (2) solid set (20 ac) will include various types of impact sprinklers and applicators.
 - (3) improved furrow blocks will include both canal and pipeline feed systems. The three main sub-blocks include gated pipe/polypipe (20 ac), surge (20 ac), and a new furrow irrigation technology “ARFIS” (automatic feedback control system, 20 ac), canal-feed (20 ac), and general purpose (20ac).
 - (4) drip irrigated sub-blocks will include tape (10 ac), tape with plastic mulch (10 ac), permanent buried drip (20 ac), micro spray (20 ac), a teaching area on drip tape/plastic mulch installation (10 ac), and general purpose (20 ac). The drip systems will have both permanent pump/filter installations with the major types of filters and injectors, and a portable unit (“drip trailer”).
- b) Teaching Systems (\$82,000) includes irrigation technologies that are relatively low in cost and which may be used for special proposes such as wastewater disposal and irrigation of problems areas. These will not be permanent installations, but will be changed according to the current programs at TITC. The systems will include portable solid set (10 ac-set), big guns (2-200 gpm and 1-100 gpm units), and 3 types of side roll (640 ft) machine, for a total of 40 ac.
- c) Pumping Plant Efficiency Testing Unit (\$52,700) will be housed in a trailer and used for training at TITC, and for regional testing offsite.
- d) Misc. category (\$56,500) includes components, spare parts, application devices, specialized tools, pipe sections, meters and monitoring devices, and other supplies and materials needed in the Agricultural Unit (priced at 10% of cost of irrigation systems).

4. WASTEWATER UNIT

This unit will investigate the effects of various wastewaters on irrigation components, management requirements for maintaining drip irrigation and other application technologies, and long-term environmental and water quality effects on soils, urban landscapes and crops. Sites within the urban and agricultural irrigation areas will be dedicated to wastewater irrigation.

Wastewater capabilities are included in 4 other budget categories: Testing Equipment and Supplies, Urban Unit, Agricultural Unit, and Infrastructure. Addition needs are listed below.

- a) Storm water catchment and recirculating system.**
- b) On-site wastewater treatment and reuse systems (\$205,000). Includes septic, aerobic, and sand filters.
- c) Water and wastewater characteristics laboratory (\$175,000).
- d) Instrumentation of long-term wastewater application sites (\$100,000).
- e) Disinfection systems (\$84,000). Includes chlorine, ozone, and ultraviolet systems.
- f) Wastewater storage facilities (\$54,000).
- g) Pumps and filters for wastewater containing solids (\$35,000).
- h) Design services (\$50,000)

5. ET UNIT

Cost estimates include equipment needed for directly measuring and calculating the water requirements or ET (evapotranspiration) of plants under selected water supply conditions.

- a) Three sizes of weighing lysimeters (\$530,000) are included: 4 large (3 m²) lysimeters for agricultural crops, 9 medium (1.5 m²) for turf, and 18 small (3/4 m²) for landscape plants. The medium and small lysimeters will be used for replicated studies of plant water requirements.
- b) 3 weather stations (\$27,200) for hourly and daily PET (potential evapotranspiration) determination, one in each of the Urban and Agriculture Units, and one for education programs.

- c) Various ET and soil moisture monitoring devices and supplies (\$59,500) including infrared, ET gauges, sap flow gauge measuring system, neutron probe, TDR, blocks and meters, portable probes, and tensiometers.

6. CENTRAL SHOP

- a) General support shops for center including welding, woodworking, and machine tools (\$87,200).
- b) Automotive maintenance tools and equipment (\$12,000)

7. COMPUTER/INFORMATION SYSTEMS

Includes costs for a Internet server to established web sites for public education and information transfer, a local network to link all computers in order to facilitate the analysis of test equipment and communication among the staff, costs of the TTVN (Texas Tele Video Network) classroom, a computer lab for education programs, standard audio/visual aids, and an instrumentation lab (\$246,000).

8. SUPPORT EQUIPMENT

Support equipment includes agricultural equipment and tractors, landscape maintenance equipment, and vehicles (\$470,700).

9. INFRASTRUCTURE

- a) Water distribution System estimates are based on the assumption that 3 wells exist at the chosen site, and that the site has the layout and dimensions shown in Figure 1 (\$159,100).

Separate main pipeline supply systems are used for the (i) Agricultural Sprinkler area and /Urban Unit, (ii) Drip and Furrow areas, and (iii) /Testing Laboratory Complex. A canal feeds one linear move and furrow irrigated sub-block. The secondary water distribution pipelines delivery water from the mains to individual irrigation systems. Costs for three main pumping plants (pump and motor/engine) are included, but the costs of drilling and completing wells are not.

- b) Land forming, landscaping, roads and parking areas**

Land forming and leveling includes excavating the pond, constructing an open canal, and leveling part of the site if needed. A paved road will service the Administration/Education and Testing Complex, with a paved parking area for visitors. Dirt service roads will service the rest of the facility.

- c) Electricity, control lines, local network (Ethernet) lines (\$81,000)

- d) Security fence and lighting**

Depending on location, the site may need to be surrounded by a 10 ft security fence and lights. Additional security lights will be installed by all buildings and storage areas.

e) Water and sewage utilities.**

10. BUILDINGS

Building specifications.

a) Hydraulics Lab: (120 ft x 250 ft x 30 ft):

Two floor levels. The upper level housing the front lobby, rest rooms, small storage rooms, 4 offices, a tilting test flume, a constant level tank and a hydraulics testing area where a variety of open channel, low head and small pipe tests may be performed. The lower level will contain the weigh tanks, multiple laboratory pumps, pipe and fitting storage, and a hydraulics testing area where large pipe tests, pump tests, valve tests, flow meter calibrations and pipe model simulations can be performed. Viewing areas will be available from an elevated walkway. A sloping ramp will provide access from the upper to lower levels. The laboratory floor will contain a large sump, from which test water will be pumped. Floor channels will direct the discharge water to the weigh tanks and back to the pump sumps

b) Irrigation Testing Lab #1 (140 ft x 70 ft x 32 ft):

Climate controlled, 2 offices, a below-floor water tank for the water supply and recirculating system, an elevated viewing area, internal windows, 2 offices, a separate 1-story room (40 ft x 60 ft), storage room.

c) Irrigation Testing Lab #2 (100 ft x 70 ft x 32 ft):

With wind tunnel, below-floor water tank for the water supply and recirculating system, internal windows, a separate 1-story room (40 ft x 60 ft), storage room.

d) Drip Testing Lab (1200 ft x 50 x 20):

“Open air” with closeable hangar doors for security, below-floor water tank for the water supply and recirculating system, removable walls.

c) Administration and Education:

8 offices, 16 person conference room, 1 classroom and 1 TTVM room (50 person capacity each), computer lab (25 person capacity) auditorium (300 person capacity), outdoor pavilion, wet lab, instrumentation lab, storage rooms.

d) Central Shop (120 x 80 x 22, 1- 20' door), 4 - 13' doors, overhead crane system, heated.

- e) Storage structures, one each for agricultural, wastewater, and urban units, and a garage.

11. ANNUAL OPERATING COSTS

a) personnel:

director
 urban programs coordinator
 agricultural programs coordinator
 wastewater technician
 testing engineers (2)
 computer/network administrator
 office manager
 accountant
 field technicians (4)
 mobile pumping plant testing technician
 PET Director
 unskilled workers (16)
 security guards (8)
 janitors (4)

salary/wages \$1,770,000

b) Maintenance and repairs: calculated at 0.10% of purchase costs for equipment and supplies (\$330,000)

c) Equipment replacement: calculated at 0.05% of purchase costs for equipment and supplies (\$165,000)

d) Other:**

i) utilities: phone, electricity, natural gas, Internet access.

ii) janitorial and security.

iii) transportation: gasoline, diesel, automotive supplies, vehicle replacement.

iv) crop and turf production: plant materials, seeds, fertilizer, herbicides.

v) operating: travel, education programs, supplies.

footnotes:

* partial specifications and cost estimates are provided

** only specifications or descriptions are provided

D. ADDITIONAL SPECIFICATIONS AND BUDGET DETAILS ON SELECT ITEMS

ITEM 1: IRRIGATION SYSTEMS TESTING UNIT

a) hydraulics lab

	<u>\$</u>
<u>Laboratory pumps:</u>	70,500
<p>This cost includes seven pumps of various capacity and pressure ratings to provide versatility and efficiency for hydraulic tests. We were directed to assume that seven cubic feet per second was the maximum capacity necessary for the hydraulics laboratory. The pumps, starters and motors are included.</p>	
<u>Laboratory valves and operators:</u>	80,500
<p>This cost includes approximately 50 laboratory bypass and control valves in various sizes, up to 12-inch diameter. The number and size of the valves necessary was determined based on conceptual layouts of the hydraulics laboratory during the cost evaluation process. Details of this conceptualization will be provided in the detailed design phase of this project. Thirteen of the valves quoted have Limitorque operators, which are quite expensive. Approximately \$60,000 of the total valve cost is in these automatic motor operators.</p>	
<u>Flow meters:</u>	51,000
<p>Although weigh tanks will be the basic method of flow measurement in the laboratory, venturi flow meters will be necessary to make some valve and fittings tests quicker and more efficient and allow multiple tests to be performed at the same time. With flow meters, all flows will not have to be measured by the weigh tanks. Nine flow meters were estimated in 12-inch, 6-inch and smaller sizes.</p>	
<u>Laboratory pipe and fittings:</u>	38,500
<p>Pipe in sizes between ¾-inch and 12-inch was priced. The laboratory will need an inventory of schedule 40 steel pipe both for testing purposes and for the laboratory pipe supply network installed in the floor of the facility. Risers at convenient intervals will be installed in the pipe network for ease in making test connections. The cost includes an assortment of elbows, tees, flanges, couplings, and pipe reducers. Test sections will be fabricated in all pipe sizes between ¾-inch and 12-inch.</p>	
<u>Sound isolation:</u>	45,000
<p>Provision will be made for isolating the noise of the pumps, the overflow and outlet from</p>	

the constant head tank and possible some of the control valves. This will require isolating them in sound resistant enclosures. Without this the noise level in the laboratory will be uncomfortable.

Fork lifts: 60,000

The cost of two electric fork-lifts, one extra battery pack and a safety cage (used to lift workers).

Laboratory weigh tanks: The cost of two 30,000lb capacity weigh tanks, compressor, pneumatics, electronic readouts and load cells is provided. Included in this total cost is a 2000lb and a 1000lb portable electronic scale for very small flow measurements. 58,250

Electronic equipment, computers and photography equipment: 56,500

This cost includes four U-tube manometers, six Rosemount DP transmitters, a transmitter calibrator, two precision dial pressure gauges, and several essential electronic devices necessary in the laboratory (thermocouple, accelerometer, oscilloscope, sound level meter, power supplies, digital signal analyzer, and volt/ammeter). The cost also includes a digital video camera, four PC computers, lab view (data acquisition system), and miscellaneous computer accessories.

Constant level tank: 15,900

The cost of a constant level tank was determined. (To be used when extremely constant test flow rates are necessary). The cost of the pipe and valves necessary to supply water to and from the constant level tank are included with the piping and valving. Details for the construction of the constant level tank will be provided in the design phase of this project.

Tilting test flume: 3,500

This is a cost estimate for an adjustable tilting flume. The flume will be used for many types of tests including weirs, flumes, sectional physical models, open channel flow meters, etc. The flume will have glass walls and precision water-depth measurement capabilities.

Miscellaneous: 66,700

Several miscellaneous laboratory items are needed including; poly-tubing and fittings, adjustable pipe dressers with hydraulic rams, inventory of small pipe and fittings, dead weight tester, two way radios, manometer fluids, point gauges, pipe stands to support the

test pipe, and personal safety and first aid needs. Also included are the bolts and nuts necessary to make the pipe connections, electric hoists, chains, slings, and pipe carts. Heavy-duty wall racks to be used to store pipe in an orderly fashion are priced here. Most pipe fittings, pumps and unsightly test materials will be stored in an enclosed storage area attached to the lower hydraulic testing laboratory. Forklift access is necessary to both the pipe storage racks and the exterior storage bay.

<u>Engineering design:</u> (see Appendix for details on cost calculations)	50,650
<u>Open channel meter calibrations</u>	10,000
<u>Training of laboratory personnel:</u>	49,500
Four weeks of laboratory training will be provided once the facility is operating. The laboratory personnel will be trained in the use of all laboratory equipment and test procedures. Tests which may be completed during the training period include: calibrating the laboratory venturi meters, Cv and cavitation tests on valves, pump efficiency tests, and calibration of weirs. (see Appendix for details on cost calculations)	
TOTAL	656,500

b) & c) irrigation system testing equipment and supplies

		<u>\$</u>
Lab #1:	Test equipment and supplies ¹	80,000
	automatic catch volume system	14,000
Lab #2:	test equipment and supplies ¹	80,000
	automatic catch volume system	14,000
	<u>wind machines and control system:</u>	
	200, 48" fans and motors	80,000
	control system	20,000
	support structures	30,000
	engineering design	12,000
Lab #3:	test equipment and supplies ¹	50,000
	constant level tank	15,900
Outdoor:	test equipment and supplies ¹	80,000
	automatic catch volume systems	<u>28,000</u>
	TOTAL	503,900

¹Description of test equipment and supplies: pump, recirculating tanks, outlets every 10 ft, custom-built materials and equipment (catch devices, stands, sprinkler enclosures, working platforms, corrosion and wear test tanks), ladders, 2 computers, software and accessories, flow meters, pressure gauges, hand and power tools, pipe sections, control valves, hose, and misc. supplies.

ITEM 2. URBAN/LANDSCAPE IRRIGATION UNIT

Category Breakdown

	\$	
Landscaping and plot establishment	240,000	
Irrigation systems	149,000	
Materials and supplies	47,000	
Installation	<u>90,000</u>	
TOTAL	526,000	

ITEM 3: AGRICULTURAL IRRIGATION UNIT

a) & b) irrigation systems

item	unit	cost per unit (\$)	total (\$)
center pivot (4)	640 ft	30,000	120,000
linear move (2)	960 ft	60,000	120,000
solid set	20 acre	50,000	50,000
portable solid set	10 acre set	25,000	25,000
surge valves (2)	10-inch	1,600	3,200
surge valves (2)	6-inch	1,200	2,400
ARFIS	20 acre	24,000	24,000
DRIP/MICRO			
tape	20 acre	20,000	20,000
tape/plastic mulch	20 acre	30,000	30,000
permanent buried drip (2)	20 acre	24,000	48,000
micro spray (2)	20 acre	24,000	48,000
drip pump trailer	2-filter unit	18,000	18,000

Big guns (3)	200 gpm	13,500	40,500
Side roll (3)	640 ft	5,500	16,500
TOTAL			565,600

c) pumping plant efficiency testing unit (some equipment, materials and supplies remain from a previous project).

	<u>\$</u>
torque cell and instrumentation	7,500
flow meters (propeller and ultrasonic)	11,000
tools and parts	2,500
test shaft kits	4,600
portable computer and printer	2,600
trailer	2,500
vehicle- pickup	22,000
TOTAL	52,700

ITEM 5. ET UNIT:

a) weighing lysimeters

item	cost per unit (\$)	total (\$)
large weighing lysimeters (4)	85,000	340,000
medium lysimeters (9)	10,000	90,000
small lysimeters (18)	5,000	90,000
engineering design services		10,000
TOTAL		530,000

b) weather stations

	<u>\$</u>
weather stations (3 @ \$5000 each)	15,000

spare parts and sensors	7,000
installation costs	3,000
portable computer	<u>2,200</u>
TOTAL	27,200

c) soil water monitoring\control devices and ET devices

	<u>\$</u>
neutron probe	5,000
TDR (time domain reflectometer)	15,000
resistance blocks and meters	6,000
portable probes	3,000
tensiometers w/charge kits, spare parts	2,500
switching tensiometers, solenoid valves	4,000
automatic moisture sensing (capacitance meter system), irrigation control system	12,000
ET devices (infra-red gun, ET gauges, etc.)	4,000
sap flow system	<u>8,000</u>
TOTAL	59,500

ITEM 7. COMPUTER AND INFORMATION SYSTEMS

	<u>\$</u>
Internet server	5,000
local network server	5,000
TTVN equipment	119,000
computer lab (20 computers)	50,000
office computers (12 computers, network printers)	45,000
audio/visual equipment	12,000
instrumentation laboratory equipment	<u>25,000</u>
TOTAL	261,000

ITEM 8. SUPPORT EQUIPMENT

a) machinery/implements

	<u>\$</u>
Tractor	83,000
6-row planter	16,000
6-row conservation cultivation	15,000
flail shredder	12,000
6-row ripper	4,000
6-row fertilizer injector	5,000
6-row tiller	9,000
6-row disk bailer	7,000
4-row ripper	8,000
4' drill	14,000
8-row, 4 wheel drive sprayer	80,000
tank set	3,500
drip tape/plastic mulch installer	<u>15,000</u>
TOTAL	271,500

c) landscape maintenance equipment

	<u>\$</u>
mowers	30,000
aerifiers	8,000
fertilizer spreaders and sprayers	8,000
lawn tractor with box blade and front end loader	<u>35,000</u>

TOTAL	<u>81,000</u>
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d) vehicles

	<u>\$</u>
pick-ups (2)	44,000
auto	22,000
trailer	1,200
van (passenger)	<u>18,000</u>
TOTAL	85,200

ITEM 9. INFRASTRUCTURE

a) water distribution system

		\$
main pipeline #1	650' 10" Class 310 PVC (installed)	6,400
main pipeline #2	650' 10" Class 310 PVC (installed)	6,400
main pipeline #3	2000' 6" Class 200 PVC (installed)	7,400
secondary pipelines	4500' 6" Class 310 PVC (installed) 2000' 4" Class 310 PVC (installed)	20,200
canal**	2000', 10' x 3', lined	
pumping plants	3 @ \$35,000, 1 @ \$10,000	115,000
values, fittings, supplies	20% of pipe cost	3,700
TOTAL		159,100

b) electricity, control lines, local network - based on 60,000 ft, @ \$1.35/ft, \$81,00

THE IRRIGATION TECHNOLOGY CENTER

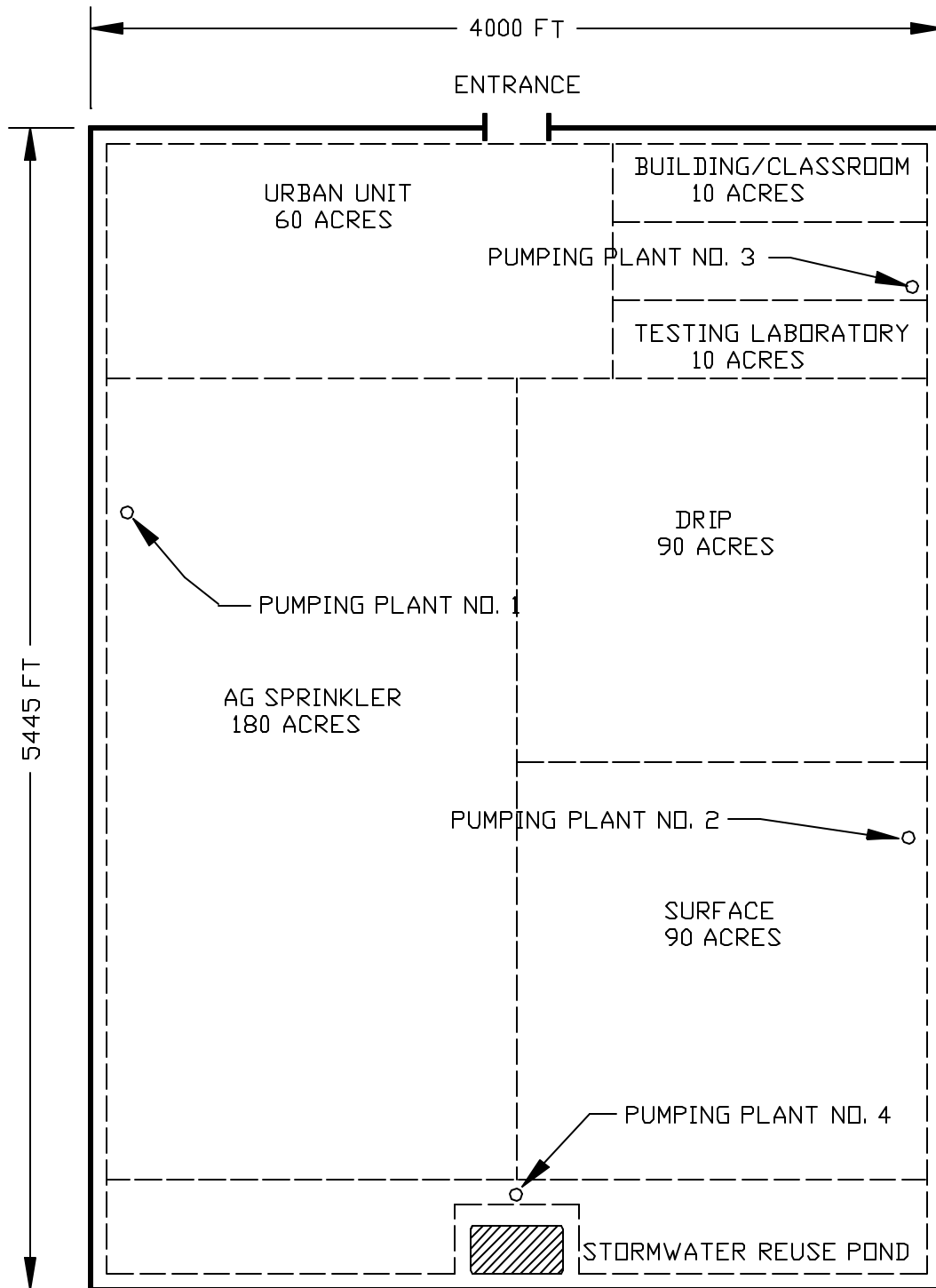


Figure 1. Conceptual layout and schematic.