Proposal Title: Interactive Learning Modules for Irrigation Water Management

Abstract:
In this proposed project, we will develop a series of landscape-irrigation, water-management, learning modules that can be both accessed on the Internet by individuals and used for classroom, instructor-based training in a CD format. The modules will be accessible on the Internet to individuals, organizations that host or provide water conservation training, community colleges, and FFA horticulture instructors. We believe that this visually enhanced formats will strengthen the necessary conceptual understanding of landscape irrigation and water management for a wide variety of audiences, including homeowners, landscape-service providers, and professionals.

As we develop these modules, the principal target audiences will be the CUWCC website users, landscape site managers, and private individuals who want or are required to upgrade their water-management skills. The materials from this project will also be adaptable for horticulture and irrigation-related courses.

The education modules will have illustrations and visuals that make landscape-irrigation and water-management concepts and principles understandable in an animated, interactive format. Supporting instructions guide the user through the modules. These modules will address the effect of soil type, plant-water requirements, sprinkler-application rates, evapotranspiration, and sprinkler spacings on the irrigation scheduling.

The modules will be adaptable to 15 to 30-minute versions on a website, such as the CUWCCU website, or to advanced versions that are suitable for landscape, water-management, short courses that are four to six hours in length.

Upon completion of these modules, users will be better prepared to create and implement landscape irrigation schedules based on irrigation design, soil characteristics, landscape plants, and ET. These actions should result in substantial water savings by meeting plant water requirements, but minimizing runoff, deep percolation, and evaporative losses.

Section 1. Relevance and Importance
The development of the proposed landscape-irrigation, water-management modules is vitally important to fully maximizing the effectiveness of the Urban Best Management Practices (BMPs). These educational modules support and enhance efforts to achieve water saving in BMP 1 Residential Surveys, BMP 5 Large Landscape Conservation Programs, and the proposed modules could be adapted for BMP 7, Public Information Programs, and BMP 8, School Education.

The water used in landscape irrigation is estimated to be 30 to 70 percent of the total water used on a residential site. The MWD website (www.bewaterwise.com), which provides a calculator to determine the right amount of water for one's landscape, states that most people in Southern California water their landscape with double the amount of water needed to keep plants healthy. The City of San Diego's Water Department commercial landscape program website (www.sandiego.com/water) states that with

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proper irrigation methods, “many properties can expect water savings of between 20 and 40 percent."

The Pacific Institute's best estimate of outdoor water-conservation potential in urban areas is 360,000 to 580,000 acre-feet per year (“Waste Not, Want Not: The Potential for Urban Conservation in California,” 2003). In the same report, the Institute projects a potential saving of 20 to 50 percent in landscape irrigation due to changes and improvements in the irrigation system. The Irrigation Association has also developed BMPs, entitled Turf and Landscape Irrigation Best Management Practices, to raise the bar of irrigation efficiency and extend the water supply. Water districts, such as MWD, have targeted landscape water use as an important cause of water loss, in which up to 50 percent of water may be wasted due to overwatering and the use of landscape plants that are not suited for arid regions. Numerous studies by resource conservation districts, water purveyors, and researchers of landscape irrigation show that critical over-watering occurs in common landscaping practices.

Some savings have been achieved through improved irrigation technology, economic incentives, education classes for professionals and field personnel, and landscape planning permit requirements. The general consensus is that there is clear potential for additional water saving through effective irrigation scheduling; how much water can be saved and how to achieve this saving are areas that are still debated.

General industry recommendations to improve landscape irrigation efficiency include:

1. The design of the system, such as sprinkler spacing, pressure, and flow requirements, must meet accepted design standards.
2. Irrigation scheduling must be based on ET requirements of the plants or the soil’s water-holding capacity within the root zone.
3. The sprinkler system must be designed to avoid poor distribution uniformity, which often leads to overwatering in some landscape areas.
4. System installation must not be substandard, and proper maintenance must be routine.

This proposed project seeks two principal objectives: (1) the providing of sufficient and accessible background on the essential principles and concepts of landscape irrigation and water management for responsible persons to achieve and maintain the efficient use of water in landscape irrigation (see recommendations 2,3, 4 above). (2) The development of more efficient landscape irrigation systems and improved management of these systems (see recommendation 1 above). We contend that these modules can provide the necessary, underlying, conceptual basis to the efficient practice of water management in landscape irrigation.

In summary, water districts have identified landscape irrigation as an important source of wasteful water usage that can be reversed. The water saved by proper water-management practices will directly impact the amount of water required for landscapes in California.

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Section 2 Technical/Scientific Merit, Feasibility

Describe methods and procedure

We propose the development of landscape-irrigation, water-management, educational materials that can be accessed via the Internet or in a combination of paper-based and CD formats. These electronic formats will greatly enhance accessibility by a wide range of audiences, including individuals seeking information and guidance on the Internet, organizations that host or provide water-conservation training, and secondary and post-secondary environmental science and urban irrigation classes. The principal target audiences for this project at this developmental stage are CUWCC website users, landscape site managers, and other individuals who want or are required to upgrade their water management skills. The materials from this project will be adaptable for multiple educational venues, including home instruction, classroom support, and professional training.

The education modules will have interactive, animated features that make landscape irrigation understandable in a readily accessible format to both the professional and nonprofessional. Each module will have supporting text, but the underlying concepts will be presented in visual, interactive form.

In light of the diversity of the intended audiences, we believe that the use of visual features for this training is important. The H2ouse section in CUWCC's website, was created for the homeowner or those who provide services to the homeowner. In most cases, the user of the website, whether homeowner or gardener, will not have a scientific educational background related to irrigation. The visuals will enhance the probability of grasping the essential underlying concepts, providing the homeowner or gardener with the necessary background to properly apply these concepts.

A second target audience is the professional landscape service provider for either residential or commercial landscapes. Since this position often does not require a license or certification, the water management skills of the provider are learned in the field through on the job experience and short courses provided through by various local agencies. In light of this lack of technical training, this audience will also benefit from a readily accessible, visual-based presentation, supplemented with detailed instructions.

The modules will be created in Flash or similar software for creating interactive modules, in which the user can select alternative landscape conditions and explore results on a screen. For example, the user would be prompted to create various irrigation scenarios and be led to appropriate irrigation scheduling.

Examples and list of modules:

We have done preliminary planning and developed several draft versions of the animated, interactive visuals. Three examples are shown below:

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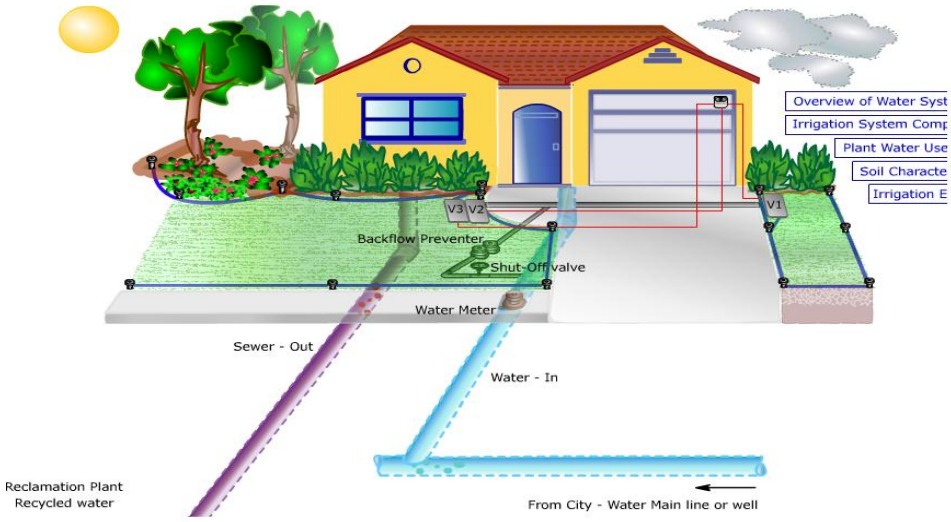

Figure 1. Residential landscape with operational water and irrigation system and visually simulated soil, plant, and ET processes.

Figure 1 is the introduction to the basic water system for landscape irrigation with water flowing through the pipes. Irrigation valves can be activated to turn each sprinkler zone on to show working sprinklers, water infiltration into the soil, and runoff from hardscapes. Supporting text can be viewed on screen by clicking on the topic title.

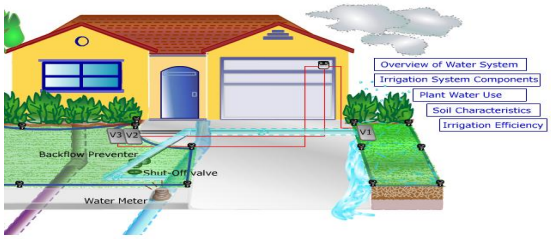

Figure 1a. Visually simulated features: irrigation water applied by sprinklers, and soil, plant, and ET processes, and runoff on hardscapes.

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A click of the mouse starts the irrigation, and water is observed flowing through the service line, meter, backflow, valves, sprinklers, unto the landscape into the soil, and down the driveway. ET moisture is shown in the atmosphere. The water-use concepts that are learned with this variation of Figure 1 are overall water accounting, irrigation water moving into the root zone, evapotranspiration, and irrigation runoff. Variations of the module will help the user visualize "what" is happening on a residential site.

The next visual, Figure 2, focuses on specific elements of the irrigated landscape.

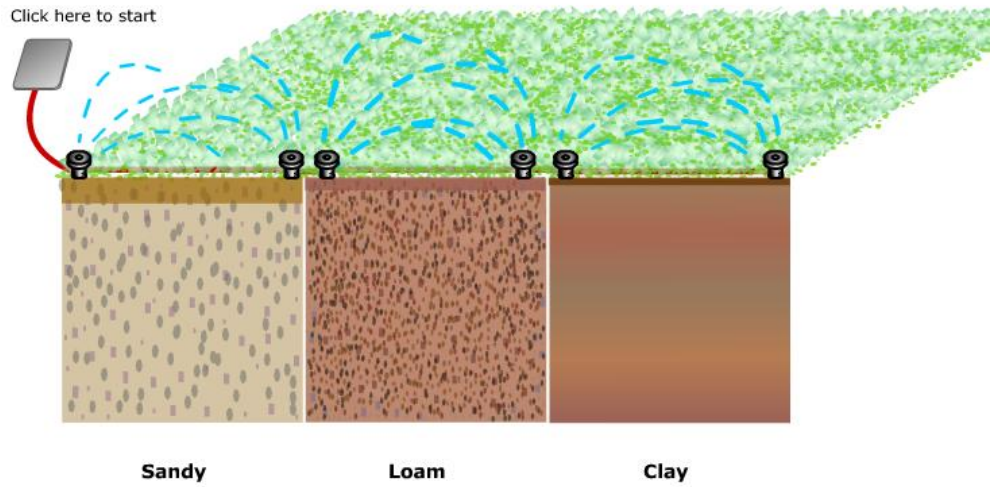

Figure 2. Water infiltration into profiles of three soil types for one irrigation run time.

Figure 2 features three soil types with low, medium, and high water-holding capacities, and the user will observe the wetting patterns in different soil for one irrigation runtime. Variations of this module will include different plant-rooting depths, high and low sprinkler precipitation rates and potential urban runoff. The user will observe that the soil type and rooting depths determine the irrigation controller runtimes.

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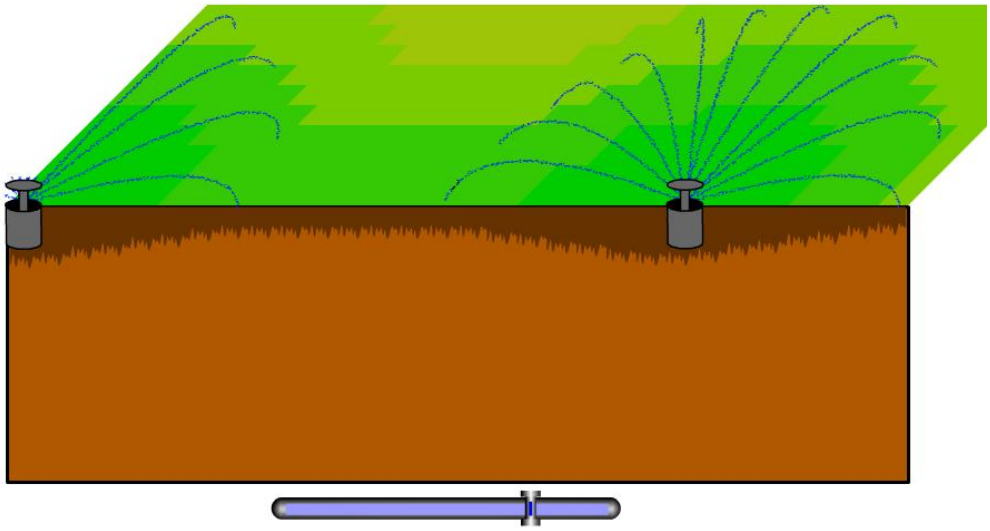

Figure 3. Plant and soil conditions change in relation to sprinkler spacing.

Figure 3 allows the user to observe that the spacing of the sprinklers affects the quality of landscape and the soil-wetted depth. Sprinkler spacing can be easily increased and decreased by the user, which causes corresponding changes in the soil moisture profile and color of the landscape.

Modules recently created in draft form are listed here. Details must be added to each figure along with several variations and interactive features for users to observe effects of their decisions. Detailed instructions guide the user to proper irrigation management principles.

List of recently created modules in draft form:

1. Residential landscape and water use overview.
2. Time it takes for high and low water need plants to withdraw all available water from the root zone in clay and sandy soils.
3. Depth of soil moisture in sandy, loam, clay soils for same run time of a controller.
4. Illustration of contaminated water (fertilizer and pesticides) in the runoff from irrigated landscape for two soil types.
5. Illustration of why rooting depth affects the proper amount of water to apply.
6. Relative runtimes to fill the plant root zone for sandy, loam, and clay soils.
7. Relation of sprinkler locations (head-to-head to narrow and wide spacing) in a landscape to soil moisture profile.
8. Relation of sprinkler locations (head-to-head to narrow and wide spacing) in a landscape to health of the plant material.

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9. Relation of sprinkler locations (head-to-head to narrow and wide spacing) in a landscape to soil moisture profile.
10. Turf condition based on available water in root zone.

Additional modules will be created to complete the learning objectives of this project. Visual and interactive details and additional instructions will be added to created learning modules that do not require and instructor.

The interactive visuals can be integrated into existing websites, such as the CUWCC site, or can be written to CDs. The instructions in each module can also be readily integrated into the CD.

We have created a similar set of materials for a Landscape Hydraulics course, using similar formats. The CD version is used extensively by the Irrigation Association landscape irrigation certification courses. The web-based version is used in our landscape irrigation courses and will soon be available as a separate, short course. Based on preliminary, informal reviews of these proposed landscape irrigation management modules, we are confident that they will supply much needed guidance for both homeowners and landscape service providers, and they will be used by instructors of both professional training classes and academic courses.

Task list and schedule

Task list for year 1

Task 1. Create the detailed outline of the two proposed learning levels
- A. Homeowner – overview and basic irrigation concepts
- B. Professional landscaper – 4 to 6 hour CD course, combining the visual modules with numerical examples and practice exercises

Task 2. Create a paper-based version of learning visuals
Task 3. Create the supporting text for each visual
Task 4. Create the visual modules using Flash
Task 5. Test with sample audiences
Task 6. Revise and improve
Task 7. Create a master digital copy of the CD-based course
Task 8. Create a master digital copy of the modules and work with CUWCC IT staff to incorporate into their website
Task 9. Develop accessibility for water districts, professional, trade organizations that offer irrigation water-management training to these materials.

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Task	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1	↔											
2	↔											
3		↔	↔	↔	↔	↔	↔	↔	↔	↔		
4		↔	↔	↔	↔	↔	↔	↔	↔	↔		
5					↔	↔	↔	↔	↔	↔		
6							↔	↔	↔	↔	↔	↔
7								↔	↔	↔		
8									↔	↔		
9										↔	↔	↔

Task list for year 2

Task 1 Schedule and conduct three short courses using the CD and manual format.
Task 2 Consult and train water districts personnel in potential uses of modules in their conservation programs.
Task 3 Consult and train landscape trade and industry organizations such as for potential uses of modules in their training programs
Task 4 Consult and train landscape water management services for potential uses of modules in their conservation programs.
Task 5 Create Spanish language module and test.
Task 6 Adapt modules for Agriscapes Environmental Education visitor center.
Task 7 Revise modules based on testing feedback.
Task 8 Assessment of training conducted in Tasks 1 – 6.
Task 9 Final Reports.

	Month											
Task	1	2	3	4	5	6	7	8	9	10	11	12
1	↔	↔	↔	↔	↔	↔	↔	↔	↔			
2	↔	↔	↔	↔	↔							
3	↔	↔	↔	↔								
4	↔	↔	↔	↔	↔	↔	↔	↔	↔			
5			↔	↔	↔	↔	↔	↔				
6			↔	↔	↔	↔	↔	↔	↔			
7								↔	↔	↔		
8									↔	↔	↔	
9										↔	↔	↔

Qualifications of the Applicants and Cooperators (Section A-15f):

Both Dr. Ramesh Kumar and Professor Eudell Vis have taught Irrigation Science courses for 20 years in the Landscape Irrigation Science program at Cal Poly Pomona. Courses in this program include irrigation hydraulics, irrigation system design, irrigation trouble shooting, automatic irrigation controllers, and water management.

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They have developed and taught short courses through the Center for Turf Landscape and Irrigation Technology, and Dr. Kumar is a certified instructor for the Irrigation Association. See resumes for additional details.

Over the past five years, they have developed a technology-based course on Basic Irrigation Hydraulics that is in two formats--one on the Internet, which is used as a module for Landscape Irrigation Program; the second is a CD-based module. The Irrigation Association uses the CD as a teaching aid in several of their courses. Irrigation equipment manufacturers use the CD for internal training. Rain Bird and the Agricultural Research Initiative funded the project.

Innovation(A-15h):
Homeowner Use:
The principle innovative feature in these proposed learning modules is their accessibility. Scientific principles of landscape irrigation and water management are presented in readily accessible, visual, interactive formats, available to a wide range of audiences with an equally diverse range of skills and background knowledge. Courses on irrigation design, installation, and water management are taught by an instructor in classrooms throughout the country. These courses can be very effective, particularly when there are hands-on activities, guided by a skilled instructor. Even is this learning environment, however, some elements of irrigation, such as the infiltration rate of water into different types of soil or the effect of sprinkler distribution uniformity on the moisture in the root zone are difficult to grasp. However computer-based modules can effectively simulate important irrigation principles.

Furthermore, the student can interact with the visuals to change the soil type, the plant type, the spacing of the sprinklers, and observe the resulting wetting profile in the root zone. The user can thereby fully comprehend what they observe; analyze the effect of various soil type, plant type, sprinkler spacing or other variables in a landscape; and determine, by adjusting different elements of the system, which course of action will result in efficient water management in the landscape. The interactive learning modules with supporting text can be more effective and far more accessible than text and fixed image-based information.

Since there are many variables in the landscape, a homeowner who grasps the basic principles of landscape irrigation and water management and can observe and analyze irrigation-related problems would be in a far better position to correct problems regarding water-use efficiency. An obvious innovation will be the accessibility of these modules on the Internet, which could easily be used by both nonprofessionals and those in professional landscape positions, such as water conservation coordinators and irrigation techs, for personal learning or in training programs.

Project Annual Physical Benefits: (Table C-5)
Benefits are two-fold, the first being the development of the learning modules described previously in detail. We are confident of the use of the modules as sources of information on the CUWCC and similar websites, as effective content for short courses

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and training, and as a segment in educational programs in secondary and college courses. Additional uses are anticipated.

The second primary benefit is water saved. For this type of project, that is, an educational, outreach project, savings will be the result of learned, landscape-irrigation principles put into practice. Both the cost savings and the positive effect on the environment will serve as strong impetuses for the public to learn the materials that will be developed. How much water will be saved, and how much water must be saved to equal the value of this project, can only be generally estimated from past programs.

"The Waste Not Want Not" report estimates conservation potential of residential outdoor water of 360,000 – 580,000 AF annually. The MWD had a recent incentive program of $154 per acre-foot (AF) saved. This incentive would require a water saving of 976 AF to pay for the project, which cost of $148,877. This water saving, projected over 3 years, would be approximately 325 AF annually. This saving can be achieved if only 14,514 residential properties would save 20 gallons per day. We are confident that the resulting improved irrigation practices from these proposed modules by individual home owners, trained landscape maintenance contractors, and others responsible for landscape irrigation could result in more significant water saving.

We anticipate that this education program will be adapted and expanded to meet training needs over the next 3 to 7 years. The water savings and consequent cost savings are expected to continue well into the future.

Additional Benefits and Anticipated Information:

1. The target benefit is to improve water use efficiency by educating landscape irrigation users to make prudent decisions in controller programming, irrigation system improvements, and general landscape changes. These prudent decisions will reduce water use per unit area of landscape.
2. Parallel savings are the reduction in energy required to provide water to landscape sites and the reduction of water use in times of peak, summer, water-system, capacity requirements.
3. Homeowners will have ready access to the landscape-irrigation management, learning modules, which will assist in the programming of their controllers and understanding of the deficiencies in their irrigation system that can be corrected by repair and more extensive retrofitting. Through this program, they will be more aware of the underlying scientific principles for effective irrigation.
4. Irrigation professionals and water-conservation officers can use the modules in a variety of formats in their local, water-conservation programs.
5. The modules could be used as a learning segment in high school agriculture and science classes. College and university courses for landscape architecture and horticulture, which address landscape irrigation, could use advanced materials.
6. The current trend to implement economic incentives to reduce water use into the rate structure will motivate users to make changes. Education will significantly help to produce these appropriate changes through a better understanding of the soil, plant, water, irrigation system, and environmental conditions that affect water use.

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Provide a clear scope of the program and materials that will be used or developed and strategy for implementing the program on a statewide basis. (B-15 proposals)

Scope:

1. The scope of the education program is to develop innovative, educational modules on water-efficient, landscape irrigation, as outlined in Section 2 above and the Task Section.

2. Since the interactive, educational modules are web-based and will be hosted on the CUWCC website, which is used by all California water agencies and members of the general public, the program will be available statewide. The modules will be in two formats, the Internet and CD self-study/classroom-based training.

3. The primary audiences are all users of water in landscape irrigation, e.g., homeowners, landscape maintenance contractors, and water managers who are directly responsible for landscape irrigation.

   A second specified audience includes water-purveyor, conservation officers; trade and professional organizations that offer short training courses; and secondary, college, and instructional extension programs in horticulture and irrigation. For these training settings, the same modules on a CD, with a companion study manual and more advanced examples and concepts, will be developed

   A third audience is the Hispanic, landscape business owners and staff. During the second year of this program, we will translate one or two of the modules into Spanish for testing. Future funding for a complete translation of the modules into Spanish will be requested if assessment of these preliminary translated materials indicate that a Spanish version is as beneficial as anticipated.

Strategy for implementing the program:

1. Arrangements have been made with CUWCC to host the learning modules on the CUWCC website (see attached letter). We will work with CUWCC staff to assess usage and effectives of the website modules. The website is assessable state-wide.
2. We will test the materials in a short course, offered through the Center for Turf Landscape and Irrigation Technology (CTILT). Students in these classes typically include public agency employees, technical staff from irrigation manufactures, and landscape contractors. Short courses are offered at least three times a year. Students will be surveyed, and a written course evaluation will be conducted. We plan to arrange these courses in Central California and the Bay area as well.
3. The course will be used as a segment in the Landscape Irrigation Science curriculum at Cal Poly Pomona in the spring of 2006. Typical students are

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horticulture, landscape architecture, and irrigation science students. A separate course evaluation (for this segment) will be conducted.

4. Both Dr. Kumar and Professor Vis are active in landscape professional organizations, such as the California Landscape Contractors Association, American Society of Irrigation Consultants, and Irrigation Association that offer professional development opportunities. They will arrange use of these modules as part of the educational and outreach activities of these organizations.
5. Both Dr. Kumar and Professor Vis have ongoing working relationships with water conservation offices in Southern California water districts and will work with them to use and adapt these materials for their customers.

Summary

End of year 1.

1. An effective landscape, irrigation-management, learning program is completed. The program modules are visual and interactive, with supporting narrative to enhance the learning of irrigation concepts for a general, landscape-water consumer. The learning objectives lead the user to understand "what" make a system an efficient system, and "what do I need to know schedule" (i.e., program the controller) to more efficiently use the water applied to the landscape.
2. The learning modules will be hosted on the CUWCC website.
3. The modules will be developed in a CD format, suitable as a teaching aid in a classroom setting.
4. The CD will have a companion manual, which can be used for self study or as a student manual for a course.

End of year 2.

1. Assessment of the Internet-based, learning modules by arranging a sample of the general public to use segments of the CUWCUU and complete a survey.
2. Assessment of the CD format and manual in a 4 to 6-hour short course for landscape professionals. Plan three courses offered by CTILT, which will be targeted for 50 people.
3. Assessment of uses of the modules in local, water-districts, conservation programs.
4. Assessment of responses from landscape trade and professional organizations, which will be asked to review modules for their training programs.
5. Complete the translation of one module into Spanish. Test within class for Spanish-speaking landscapers, taught by an experienced instructor.
6. Revise the modules based on the above assessments,
7. Use the CUWCC website to communicate the availability of these learning modules.
8. Distribute press releases and other appropriate means to communicate availability of these training modules in the trade organizations' publications.

Web users, such as homeowners, would have sufficient information to develop a schedule for their residential controller or work closely with their landscape service to ensure it is done correctly. The broadest, and possibly most effective, use of the modules is the potential use by irrigation techs, water conservation coordinators, or users of the advanced version of the modules for their personal learning or use in training programs

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for customers or employees. These users would generally be responsible for large irrigated areas and/or numerous customers. We are confident that, with the use of these modules, each target audience will be better prepared to use technology to improve water use efficiency.

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Section A projects must complete Life of investment, column VII and Capital Recovery Factor Column VIII. Do not use 0.

Table C-1: Project Costs (Budget) in Dollars)

	Category (I)	Project Costs $ (II)	Contingency % (ex. 5 or 10) (III)	Project Cost + Contingency $ (IV)	Applicant Share $ (V)	State Share Grant $ (VI)	Life of investment (years) (VII	Capital Recovery Factor (VIII)	Annualized Costs $ (IX)
	Administration[1]								
	Salaries, wages	$96,200	5	$101,010	$0	$101,010	0	0.0000	$0
	Fringe benefits	$17,316	5	$18,182	$0	$18,182	0	0.0000	$0
	Supplies	$1,000	10	$1,100	$0	$1,100	0	0.0000	$0
	Equipment	$0	0	$0	$0	$0	0	0.0000	$0
	Consulting services	$2,000	0	$2,000	$0	$2,000	0	0.0000	$0
	Travel	$2,000	10	$2,200	$0	$2,200	0	0.0000	$0
	Other	$0	0	$0	$0	$0	0	0.0000	$0
(a)	Total Administration Costs	$118,516		$124,492	$0	$124,492			$0
(b)	Planning/Design/Engineering	$0	0	$0	$0	$0	0	0.0000	$0
(c)	Equipment Purchases/Rentals/Rebates/Vouchers	$0	0	$0	$0	$0	10	0.0000	$0
(d)	Materials/Installation/Implementation	$2,000	10	$2,200	$0	$2,200	0	0.0000	$0
(e)	Implementation Verification	$0	10	$0	$0	$0	0	0.0000	$0
(f)	Project Legal/License Fees	$0	0	$0	$0	$0	0	0.0000	$0
(g)	Structures	$0	0	$0	$0	$0	0	0.0000	$0
(h)	Land Purchase/Easement	$0	0	$0	$0	$0	0	0.0000	$0
(i)	Environmental Compliance/Mitigation/Enhancement	$0	0	$0	$0	$0	0	0.0000	$0
(j)	Construction	$0	0	$0	$0	$0	0	0.0000	$0
(k)	Other (Specify) University F&A Costs	$13,535	0	$13,535	$0	$13,535	0	0.0000	$0
(l)	Monitoring and Assessment	$5,000	10	$5,500	$0	$5,500	0	0.0000	$0
(m)	Report Preparation	$3,000	5	$3,150	$0	$3,150	0	0.0000	$0
(n)	**TOTAL**	$142,051		$148,877	$0	$148,877			$0
(o)	Cost Share -Percentage				0	100			

1- excludes administration O&M.

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Table C-2: Annual Operations and Maintenance Costs

Operations (1) (I)	Maintenance (II)	Other (III)	Total (IV) (I + II + II)
$0	$0	$0	$0

(1) Include annual O & M administration costs here.

Table C-3: Total Annual Project Costs

Annual Project Costs (1) (I)	Annual O&M Costs (2) (II)	Total Annual Project Costs (III) (I + II)
$0	$0	$0

(1) From Table C-1, row (n) column (IX)
(2) From Table C-2, column (IV)

Table C- 4: Capital Recovery Table (1)

Life of Project (in years)	Capital Recovery Factor
1	1.0600
2	0.5454
3	0.3741
4	0.2886
5	0.2374
6	0.2034
7	0.1791
8	0.1610
9	0.1470
10	0.1359
11	0.1268
12	0.1193
13	0.1130
14	0.1076
15	0.1030
16	0.0990
17	0.0954
18	0.0924
19	0.0896
20	0.0872
21	0.0850
22	0.0830
23	0.0813
24	0.0797
25	0.0782
26	0.0769
27	0.0757
28	0.0746
29	0.0736
30	0.0726
31	0.0718
32	0.0710
33	0.0703
34	0.0696
35	0.0690
36	0.0684
37	0.0679
38	0.0674
39	0.0669
40	0.0665
41	0.0661
42	0.0657
43	0.0653
44	0.0650
45	0.0647
46	0.0644
47	0.0641
48	0.0639
49	0.0637
50	0.0634

(1) Based on 6% discount rate.

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Table C-5 Project Annual Physical Benefits (Quantitative and Qualitative Description of Benefits)

	Qualitative Description - Required of all applicants[1]				**Quantitative Benefits - where data are available [2]**
	Description of physical benefits (in-stream flow and timing, water quantity and water quality) for:	Time pattern and Location of Benefit	Project Life: Duration of Benefits	State Why Project Bay Delta benefit is Direct[3] Indirect [4] or Both	Quantified Benefits (in-stream flow and timing, water quantity and water quality)
Bay Delta	**See attached**	**See attached**	**See attached**		0
Local	**See attached**	**See attached**	**See attached**	**Not applicable.**	

[1] The qualitative benefits should be provided in a narrative description. Use additional sheet.

[2] Direct benefits are project outcomes that contribute to a CALFED objective within the Bay-Delta system during the life of the project.

[3] Indirect benefits are project outcomes that help to reduce dependency on the Bay-Delta system. Indirect benefits may be realized over time.

[4] The project benefits that can be quantified (i.e. volume of water saved or mass of constituents reduced) should be provided.

Applicant:

THE TABLES ARE FORMATTED WITH FORMULAS: FILL IN THE SHADED AREAS ONLY

Table C-6 Project Annual Local Monetary Benefits

ANNUAL LOCAL BENEFITS	ANNUAL QUANTITY	UNIT OF MEASUREMENT
(a) Avoided Water Supply Costs (Current or Future Source)	0	
(b) Avoided Energy Costs	0	
(c) Avoided Waste Water Treatment Costs	0	
(d) Avoided Labor Costs	0	
(e) Other (describe)	0	
(f) Total [(a) + (b) + (c) + (d) + (e)]		

Table C-7 Project Local Monetary Benefits and Project Costs

(a) Total Annual Monetary Benefits [(Table C-6, row (f)]		$0
(b) Total Annual Project Costs (Table C-3, column III)		$0

Table C-8 Applicant's Cost Share and Description

Applicant's cost share %: (from Table C-1, row o, column V)
Describe how the cost share (based on relative balance between Bay-Delta and Local Benefits) is derived. (See
Provide Description in a narrative form.

ANNUAL MONETARY BENEFITS
$0
$0
$0
$0
$0
$0

0
Section A-7 for description.)