

**Weather- or Sensor-Based Irrigation Control Technology  
Notification of Intent Meeting Summary  
April 19, 2007**

Crowne Plaza Hotel Tampa East  
10221 Princess Palm Avenue  
Tampa, Florida 33610  
8:00 a.m. – 4:00 p.m.

**Participants**

Eighty three participants attended the meeting. A full list of participants and their affiliations is provided in Appendix A.

**Meeting Summary**

**Introduction & Review of Meeting Purpose, Agenda, & Format**

Jan Connery (ERG) reviewed the agenda and format of the meeting. Jan explained that the Notification of Intent (NOI) meeting marks the beginning of the specification development process for weather- or sensor-based irrigation control technologies and that discussions will focus on areas where EPA seeks technical input in order to develop a WaterSense specification for these products. Participants were encouraged to provide technical input during the discussion periods or by submitting technical input on note cards. Participants were also told they could submit input by email to [watersense-irrigation@erg.com](mailto:watersense-irrigation@erg.com). All presentations are available on the WaterSense website (<http://www.epa.gov/watersense/>).

**Overview of WaterSense Approach to Product Specifications**

Stephanie Tanner (EPA) provided a brief history of the WaterSense program and an overview of the WaterSense approach to developing product specifications. WaterSense was launched in June 2006 to create an ethic of water efficiency. Stephanie reviewed the WaterSense mission, which is to promote the value of water, to help Americans make smart decisions regarding water use and water-using products, and to transform the marketplace by encouraging consumers and organizations to purchase water-efficient products and services. WaterSense labeled products will be backed by the credibility of the U.S. EPA and will be promoted through partnerships with utilities, manufacturers, and retailers. Stephanie reviewed the criteria a product must meet to be considered for the label. Products must realize water savings on a national level; perform as well or better than their less efficient counterparts; be about 20% more efficient than conventional counterparts; achieve water efficiency through several technology options; be effectively differentiated by the WaterSense label; be independently verified by a third party to confirm that the product meets EPA criteria for efficiency and performance; and provide measurable results.

Stephanie provided a brief overview of the specification development process. The NOI outlines the technical issues that must be resolved before a draft specification can be developed. Once a draft specification is available for comment, a public meeting will be scheduled. Once the public comment period is closed, and public comments have been reviewed and addressed, a final specification will be issued.

**Discussion Topic: Product Category Name and Scope**

Roy Sieber (ERG) provided background information on the development of the weather- or sensor-based irrigation control technology product category. He explained that outdoor water use accounts for up to 50% of residential total water use and to address this inefficiency, WaterSense is labeling certification programs for irrigation professionals. WaterSense also recognizes that irrigation system efficiency is achieved through a systems approach and requires efficient components and proper installation and maintenance. Roy briefly reviewed publicly available studies on weather-based irrigation controllers and soil moisture sensors that have demonstrated approximately 20% water savings compared to clock driven irrigation systems.

Roy indicated that the scope for this product category includes all products that establish an irrigation schedule, or modify a predetermined irrigation schedule, based on data input from off-site weather stations or on-site weather stations or sensors.

Roy explained that all products that fall within the scope and are certified to meet the performance specifications are eligible for the WaterSense label. All product types will have the same water efficiency performance requirements; however, the testing requirements will differ with each type of product. For example, the weather-based irrigation controllers will be tested according to a different protocol than soil moisture sensors. Further, WaterSense specifications will be developed in conjunction with appropriate industry-accepted testing protocols.

The participants were asked whether this general approach and the scope of the intended product category were appropriate. The participants were also asked whether there were other irrigation control technologies that WaterSense should consider within this scope, such as rain sensors.

**Product Category Name & Scope Questions & Comments**

Ron Wolfarth (Rain Bird Corporation) asked whether EPA intends to include historical based ET controllers in the product scope. He explained that the current definition does not include these products. Ron noted that the ET based controllers on the market today that have completed SWAT testing perform well; however, they are expensive. Ron explained that a large segment of the market will be missed if lower priced products are excluded and may result in a missed opportunity for reducing water use. Although historical based ET controllers may not perform at the same level as those that have completed SWAT testing, they may be more widely adopted.

Dave Bracciano (Tampa Bay Water) commented that EPA should clarify the baseline for the 20% water savings.

David Chacon (Water2Save) commented that SWAT should focus on each technology's water consumption as well as the human component that affects water savings in landscapes, such as proper installation, maintenance, and monitoring. David stated that SWAT does not currently provide the water savings potential of these technologies and therefore does not relate to real world water savings.

Mike Van Bavel (Dynamax) asked why WaterSense stated that the SWAT soil moisture sensor protocol is still under development. He noted that Dynamax soil moisture sensors have

completed the Phase 1 SWAT testing. Mike asked whether WaterSense will adopt both Phase 1 and Phase 2 SWAT testing protocols and inquired of EPA's input into SWAT; specifically determine the adequacy of the protocol. Stephanie Tanner clarified that EPA wants the industry to determine whether the protocol is adequate. WaterSense team members may sit in on SWAT committee conference calls; however, WaterSense does not take an active role in providing input on the protocols. Mike asked Stephanie if WaterSense was funding field studies on weather-based controllers or soil moisture sensors to determine real-world water savings and commented that EPA should provide input into the development of the protocols.

Scott Anderson (Acclima) commented that there cannot be both SWAT and WaterSense testing protocols. Scott explained that two protocols would be time consuming, expensive, and would result in a confused market place.

Troy Carson (The Toro Company) asked for clarification on WaterSense's requirement for 20% water savings compared to other products. He stated that this requirement may establish a moving target that products must meet, eventually resulting in insufficient water for landscape health and appearance. Troy asked whether WaterSense plans to adopt the SWAT protocols. Stephanie Tanner clarified that SWAT protocols would be adopted unless the industry was not satisfied with them. WaterSense does not wish to reinvent the wheel and would like to use SWAT protocols, with minor modifications, if necessary. Stephanie explained the high efficiency toilets (HETs) protocol development process, in which an existing and accepted protocol was already established. The protocol was "frozen in time" according to what was published in the specification and the 20% water savings was also frozen with that specification. Therefore, the products were not required to meet a moving target. WaterSense would like agreement on how SWAT could fit into the WaterSense specification for weather- or sensor-based controllers.

Jeff Lee (Town of Gilbert, AZ) commented that WaterSense's goal of 20% water savings is commendable; however, the protocol also needs to demonstrate that the landscape was irrigated properly. Water can be saved by adjusting runtimes, but WaterSense also needs to ensure that water savings are achieved through practices.

David Zoldoske (CIT) asked why WaterSense chose to use 'weather' instead of 'climate' when describing these technologies. A WaterSense team member clarified that WaterSense thought this was the most widely used terminology in the industry. David noted that 'climatologically based controllers' was developed by SWAT with significant industry input. The participants were polled for their preference on this terminology. The room was split between 'weather' and 'climatologically,' although many participants did not have a preference about the product category name.

Dale Hansen (Signature Control Systems, Inc.) commented that WaterSense should not get hung up on the terminology. Rather, WaterSense should use the term, 'smart controller,' which includes those technologies that use climatological data. He believes a simple definition is necessary.

Mike Van Bavel (Dynamax) briefly discussed the Irrigation Association's (IA) 2004 Water Management Committee report. According to this report, 'excellent' performance ratings are given when the water management efficiency is 95-100%, meaning the maximum amount of

water lost due to management is 5%. He believes the same target performance should be established for any technology in this product category.

Ed Osann (Steering Committee for Water Efficient Products) expressed his surprise on the possible inclusion of rain sensors in this product category, as these technologies would have a more narrow range of functionality compared to climate-based irrigation controllers or soil moisture sensors. Ed asked whether there is a testing protocol in development for rain sensors and whether rain sensors will occupy the same venue as the climate-based controllers. Stephanie Tanner explained that WaterSense team members attended the SWAT rain sensor meeting, which was held on April 18, 2007. WaterSense does not intend to make decisions about what technologies can be labeled; rather, products that meet the performance and water efficiency requirements and fit within the scope are eligible for the WaterSense label. It is premature at this time to determine whether rain sensors will be included in this product category because a testing protocol has not been accepted.

#### Presentation: SWAT Protocol Development & Status

Karen Guz (San Antonio Water System & SWAT Technology Promotions Group Vice Chair) presented the history of Smart Water Application Technology (SWAT) and the development of the climate-based irrigation controller protocol. Karen identified the SWAT committee members in attendance.

Karen explained that SWAT is an international initiative developed to achieve exceptional landscape water use efficiency through the application of irrigation technology. SWAT identifies, researches, and promotes technological innovations and related management practices that advance the principles of efficient water use.

Karen reviewed the climatologically-based irrigation controller protocol. The bench test was developed to allow climatologically-based controllers to process real-time weather data to produce efficient irrigation schedules. The controllers are programmed with hypothetical plant material and the theoretical output and water balance are calculated to determine the efficiency of the product. The protocol was designed to quickly test products, test a variety of plant material, soil types, and slopes, and to establish the minimum requirements a controller should meet before it is installed in a landscape.

Karen reviewed the performance measures of irrigation adequacy and irrigation excess. Irrigation adequacy represents how well irrigation met the needs of the plant material. SWAT does not provide a pass or fail score; however, it is acknowledged that between 80 to 100% irrigation adequacy will result in good landscape health. Irrigation excess represents how much water was applied beyond the needs of the plant material.

Karen clarified that the SWAT protocol does not provide information on the usability of the product, does not determine how the product might function if the signal is lost, or how plants might respond to irrigation plus rain in a variety of climate conditions in the real-world.

Karen reviewed several frequently asked questions regarding the SWAT protocols. She explained that there is only one testing site (Fresno) because CIT is the only volunteer thus far. However, any site can test products using the SWAT protocol. The test results are confidential

to manufacturers to allow small companies the opportunity to test products in a research and development mode. SWAT has not established a passing score to allow each utility to determine the cut off for their respective rebate program. However, there is a misperception that less than 100% irrigation adequacy is 'failing.' Manufacturers are permitted to test more than one time; however, it is not known how many times each product has been tested. The manufacturer provides a batch of ten units to CIT and three are randomly selected for testing.

#### SWAT Protocol Development & Status Questions & Comments

Steven Moore (Irrisoft) mentioned that he has submitted several proposed changes to the climatologically-based controller protocol; however, SWAT has stated that the protocols are closed to modification for three years. Brian Vinchesi (SWAT) explained that the protocols are living documents and can be modified; however, major reviews are scheduled for every three years. Steven requested that SWAT conduct the review period prior to WaterSense's adoption of the protocols. Steven commented that WaterSense should be aware that there is some disagreement with the protocol within the industry.

James Jolly Clark (Climate Computer) asked whether the comments Steven Moore was referring to were publicly available. It was noted that comments to the protocols are available on the SWAT website; however, this list does not include comments that were not submitted through the website.

Steve Springer (Rain Master) recommended SWAT review the protocols prior to WaterSense adoption. He asked whether products will have to be tested every time the protocols are modified. Karen Guz explained that once a product completes SWAT testing, the results are valid for that product. Brian Vinchesi noted that the products that have completed SWAT testing have been tested to protocol versions five through seven, which did not include any substantive changes.

Jill Hoyenga (Eugene Water & Electric Board) clarified that SWAT testing is voluntary; therefore, a manufacturer can choose to test products to an updated protocol if one becomes available.

Jan Connery (ERG) asked that SWAT protocol comments be directed to the SWAT committee through other forums. Karen Guz (SWAT) asked participants to submit their comments through the SWAT website. Steven Moore (Irrisoft) commented that SWAT protocols should be revised prior to its scheduled three year revision to allow WaterSense to adopt a 'solid' protocol. Karen informed participants that a document will be posted on the SWAT website that discusses how the protocol was developed and how decisions on protocol changes are made.

Mike Van Bavel (Dynamax) commented that the current soil moisture sensor Phase 1 protocol requires over 300 days of testing, ten times longer than the duration of the ET controller bench testing. Mike asked whether a time limit for the protocol should be established and whether testing should be accelerated. Mike also asked SWAT to respond to comments within a specified time frame. David Zoldoske (CIT) commented that the soil moisture sensor protocol was published for public comment, and the testing period is what is required to meet this protocol. He agreed that all comments should be addressed and asked that commenters copy him on the email if they did not receive a response. David explained that informal questions and comments are not always addressed with a written response.

### Presentation: Overview of Notification of Intent & Technical Issues

Stephanie Tanner (EPA) presented the technical issues related to weather- or sensor-based irrigation control technologies and explained that the NOI marks the beginning of the specification development process. WaterSense seeks technical input on these technical issues, which were identified through conversations with manufacturers, utilities, and other irrigation stakeholders. Follow-up discussions on these topics are anticipated through issue specific working groups.

Stephanie briefly reviewed the technical issues, which include: potential specification performance requirements, user interface features, product testing requirements, and product certification process.

### Notification of Intent & Technical Issues Overview Questions & Comments

David Chacon (Water2Save) asked if WaterSense plans to adopt SWAT testing protocols and hope for real-world water savings. David explained that there are many challenges with getting these technologies to work properly and asked how WaterSense will communicate these difficulties to the consumer.

Steven Moore (Irrisoft) commented that ET formulas should be discussed in addition to weather station standards. He explained that there are numerous ET formulas in use and that some work well in some climates but poorly in others.

### Discussion Topic: Potential Specification Performance Requirements

Joanna Kind (ERG) presented the proposed specification performance requirements. She explained that irrigation adequacy is a measure of how well the plant's or landscape's consumptive water needs are met and that studies have shown acceptable turf grass appearance when plants receive between 80 to 100% ETc. The irrigation scheduling excess is a measure of the water applied in excess of the plant's or landscape's consumptive needs and includes direct runoff, soak runoff, and irrigation surplus. SWAT tested technologies have scored less than 5% irrigation scheduling excess. Participants were asked to discuss the WaterSense proposed performance requirements of 80-100% irrigation adequacy and less than 5% irrigation scheduling excess.

### Potential Specification Performance Requirements Questions & Comments

Steven Moore (Irrisoft) commented that the SWAT protocol includes crop coefficients for turf in the theoretical plant requirements. This coefficient brings water needs as low as 53% of ET<sub>0</sub>. The test already accounts for irrigation at less than the reference ET. His experience has been contrary to reports of adequate turf appearance with deficit irrigation. Steven explained that if a controller is irrigating at a value less than the ET<sub>c</sub> (reference ET times the crop coefficient), and irrigation is dropped down even further through deficit irrigation practices, manufacturers will receive phone calls on the appearance of the landscape. This may result in a lack of confidence in the product, followed by the disabling of the controllers. Steven recommends an irrigation adequacy requirement of 95-100%.

Ron Wolfarth (Rain Bird Corporation) commented that although Steven raised a valid point, Gibeault and others have conducted studies in the 1980's, where turf quality was examined following irrigation events at various levels of ET. The studies demonstrated that turf quality was not significantly impacted by deficit irrigation. Ron commented that WaterSense needs to clearly state that 100% irrigation adequacy is 100% of ETc.

Ron also commented on the irrigation scheduling excess measure, noting that the proposed 5% performance measure was established based on tested products. However, the products that have been SWAT tested are expensive. Inexpensive products that have not been tested or products that may not have published results due to greater excess values may be more affordable. The 5% excess measure may inhibit the development of inexpensive products that have a greater potential in the market. The average landscape today irrigates at double the amount of ET. An inexpensive product that results in 20% excess would result in significant water savings. Ron cautioned WaterSense not to leap to the conclusion that 5% is a reasonable measure based on current results. Ron was asked to clarify expensive versus inexpensive products. He noted that there are standard controllers on the market for approximately \$29; however, ET controllers today range from \$200 to \$400. There is a huge gap between price points in the market. WaterSense could eventually establish a higher threshold; however, this wide leap might inhibit widespread adoption.

Brian Vinchesi (SWAT) commented that the 5% irrigation scheduling excess should clearly state that this is an average over six zones, and not per zone.

Karen Guz (SAWS) reminded participants that WaterSense is a water conservation program. She commented that she would not respect the WaterSense label if greater than 5% excess were allowed.

Karen also commented that in San Antonio, customers irrigate using a stress factor of 70% and customers are happy with the aesthetic of their grass. Karen argued that an irrigation adequacy value of 80% would not disengage homeowners. Additionally, many ET controllers have generous default crop coefficients for plant material. SAWS often asks manufacturers to reprogram the controllers in San Antonio. Karen supports both of the proposed performance measures.

Dominic Shows (Alex-Tronix) commented that less than 5% irrigation scheduling excess is a high standard and may stifle creativity. He recommends no more than 10% irrigation scheduling excess. A slightly less effective technology that allows more people to understand it will result in greater water savings than a more effective but expensive technology that is not adopted. The focus should be on 'real' water savings and not theoretical water savings.

Scott Anderson (Acclima) commented on soil moisture sensor performance measures. Scott explained that soil moisture performance should be measured according to the maximum allowable depletion and field capacity. Irrigation adequacy can be measured by how well the soil moisture sensor keeps moisture above the maximum allowable depletion level. Irrigation excess can be measured by determining if moisture exceeds field capacity.

Steven Moore (Irrisoft) compared the potential water savings associated with controllers to washing machines. He explained that the washing machines that save water are more expensive and the same is true with controllers. The more expensive controllers can save more water. If WaterSense's goal is to save water, the focus should be on the higher priced products, in order to achieve effective water savings.

Steven explained that he is in agreement with the proposed irrigation adequacy measure if it is defined as 80% of the reference ET (ET<sub>0</sub>). However, if it is defined as 80% of ET<sub>c</sub>, then he is not in agreement with this measure because the SWAT protocol already takes crop coefficients into the equation.

Lou Bendon (PMSI) commented that the 5% irrigation scheduling excess measure does not have value in the market place. He explained that water savings depend on the market and price drives business. For a product to achieve market acceptance, it has to be available to a large portion of the industry. Research has demonstrated that consumers will not pay above a certain price for water-efficient products. Consumers would rather pay more money for water rather than change their irrigation system. Lou encouraged WaterSense to explore what the market will accept at this point in time and adjust accordingly.

Dave Bracciano (Tampa Bay Water) noted that WaterSense should not attempt to change the quality of the products because utilities apply incentives to drive the market. Dave also commented that 'adequacy' does not mean the same thing as 'efficiency' and asked whether there is a distribution uniformity (DU) requirement in the SWAT protocol. An adequate irrigation system may not be an efficient one.

James Jolly Clark (Climate Computer) commented on his experience with consumers and controllers. Most consumers do not know how to operate their controllers. He indicated there is a bill in Texas legislation that will require ET based controller installation in all irrigation systems by 2011.

Tom Penning (Irrometer Company) asked whether the irrigation scheduling excess parameter is sufficient for irrigation system leaching and if the 5% value is too limiting for managing salinity. David Zoldoske (CIT) noted that reclaimed water has higher salt concentrations and recommended a 10% leaching requirement.

It was noted that California legislation has been passed that will require smart controllers by 2010. California is looking to adopt the IA's SWAT protocols, but will follow what the industry decides.

Mike Van Bavel (Dynamax) clarified the performance measures. A measure of 80% to 100% of irrigation adequacy means that plant water needs are supplied between 80% and 100%. The plant's need is defined as the reference ET (ET<sub>0</sub>) times the crop coefficient (K<sub>c</sub>) (ET<sub>0</sub> \* K<sub>c</sub>=ET<sub>c</sub>). Irrigation scheduling excess is defined as the water applied that is greater than field capacity. If there is leaching, runoff, or any amount of water applied when the soil is at field capacity, more than 5% over this value is deemed unacceptable. In terms of soil moisture, a scheduling excess value of 5% more than field capacity, is appropriate. Regarding under watering, if the soil moisture level is below the maximum allowable depletion, then the plants will

be stressed. If the performance measures are looking at 80% of that value, then there will be some issues with the appearance of the landscape.

Scott Anderson (Acclima) addressed Tom Penning's question regarding soil moisture systems and leaching. He stated there are some systems that report when leaching occurs and these systems can be programmed with a leaching cycle when irrigating with saline water.

Karen Guz (SAWS) commented that smart controllers should be used on sites that are irrigating with reclaimed water; however, there should be a better solution to leaching requirements other than allowing for 10% excess, such as allowing for leaching on an as needed basis or through the use of other methodologies to flush the system.

Rose Mary Seymour (University of Georgia) asked for clarification on the assumptions of the irrigation system performance beyond the controller. The SWAT test only examines the performance of one part of the system (the controller). David Zoldoske commented that the SWAT protocol tests virtual irrigation systems with DUs that range between 55% and 80%.

Ed Osann (Steering Committee for Water Efficient Products) asked for clarification on the performance measures and whether WaterSense was proposing 80% ET<sub>o</sub> or 80% of the SWAT measure. David Zoldoske commented that there is a standard water budget found in literature, which defines the plant's crop coefficients (K<sub>c</sub>) for warm season and cool season turf grasses. These are incorporated into the SWAT calculations. The proposed WaterSense performance measure is 80% of the SWAT measure (ET<sub>c</sub>), not 80% of the ET<sub>o</sub>.

Dale Hansen (Signature Control Systems, Inc.) asked whether the 80% was referring to reference ET (ET<sub>o</sub>) or ET<sub>c</sub> (ET<sub>o</sub>\*K<sub>c</sub>). WaterSense team members clarified that the SWAT protocols already take into consideration the crop coefficients; therefore, the proposed performance measure is 80% of ET<sub>c</sub> (ET<sub>o</sub>\*K<sub>c</sub>).

Mike Van Bavel (Dynamax) commented that irrigation adequacy should be called 'water management efficiency.' Brian Vinchesi (SWAT) commented that SWAT does not measure irrigation system efficiency because the controllers are tested for how well they water to the plant's needs on a theoretical landscape. Brian commented that the proposed performance measure is in agreement with industry's acceptance that 80% of ET<sub>c</sub> is sufficient.

John Wiedmann (MWD) stated that they service approximately 18.5 million people, of which 3.5 million are single family homes that use an enormous amount of water. He agrees with adopting lower cost products because there are many people that are irrigating inappropriately that cannot afford controllers. John stated water savings would be more likely if inexpensive products are labeled.

Steven Moore (Irrisoft) commented that most homes irrigate at twice the reference ET. If crop coefficients are applied to irrigation schedules, water savings will be achieved; however, if controllers are set to irrigate below this level, the landscape will be stressed. Consumers will then apply more water to their landscape to address the poor appearance. Homeowners are concerned about the landscape appearance and not water use.

Jill Hoyenga (Eugene Water & Electric Board) reminded the participants that the DU measures included in the SWAT protocol represent real-world settings. The 80% to 100% irrigation adequacy performance measure already takes into account the inefficiencies of the irrigation system. Jill noted that in her service area, there is a lot of over watering due to poor DUs. If a homeowner installs a controller that scored between 80-100% irrigation adequacy, that homeowner has the best 'brain' they can buy. It is up to the industry to communicate to consumers that poor landscape appearance is not due to the controller; rather, it may be due to the design, the nozzles, or other components.

Jan Connery polled the participants for their acceptance of the performance measures. All participants agreed that irrigation adequacy and irrigation scheduling excess were the appropriate performance measures. A working group will be established to discuss and recommend an appropriate value for these performance measures.

#### Discussion Topic: User Interface Features

Joanna Kind (ERG) presented user interface features that were identified as desirable features that WaterSense labeled products should have. Examples of these features include automatic grow-in schedules for new landscapes; default conservation features if the signal is lost; rain data management; zone by zone control to allow for each zone to operate in a different mode; user friendly data review; percent up/down adjustment of ET; adjustable start times for peak daily demand management; ability to comply with potential drought restrictions; ability to see and change crop coefficients; and non-volatile memory for programs that are not reliant on back up battery power. The participants were asked for input on these features and others that should be considered in a WaterSense labeled product.

#### User Interface Features Questions & Comments

David Chacon (Water2Save) commented that WaterSense should consider utilizing a grading scale to inform consumers of the product's usability. He stated that most technologies have a mechanism for notifying the user when the signal is lost; however, there should also be a feature that notifies the user when the controller is shut off. For example, a landscape contractor may turn the controller off when fertilizing the landscape. Often times, the controller is not turned back on.

Karen Guz (SAWS) informed the participants that the proposed list of features was developed by several utilities that wanted to express their concerns to EPA. She explained that although SWAT testing is an appropriate first step, weather adjustments are not the only feature required for water savings. For example, the controller must be properly programmed. Karen clarified that the automatic grow in feature should be added to address the 'rice growing schedule' programmed to new landscapes. Often, landscape contractors do not revisit the newly established landscape to change the schedule to a 'normal' one. Controllers should be programmed to allow for an automatic transition from grow-in to conservation. Utilities would like WaterSense labeled products to have this feature. Karen stated that new homes in San Antonio use more water in the first couple of years and the newer homes use more water over time compared to older models. Therefore, the payback over time for this feature would be enormous.

Karen also commented that those who install controllers should be able to scroll through the program to see what the default zone settings are or what is currently programmed. Karen noted that it would be difficult to grade the controllers according to their usability but the products should clearly list the features they have available.

Dave Bracciano (Tampa Bay Water) commented on rain data management issues experienced in Florida, where there may be large differences in rainfall accumulation over small distances. For these reasons, extensive smart controller field testing is conducted in Florida. Utilities and consumers need to be able to look at a product and know how it will work in a specific geographic region.

Ron Wolfarth (Rain Bird Corporation) commented that it is important for WaterSense to consider the criteria they want to use for the WaterSense label. Market research has demonstrated that these features are desirable; however, most of these features should be determined by the market and not necessarily by WaterSense. Ron stated that some of these features may be applicable to one region of the country and not another. This creates complex products and may cause prices to rise. Complex products may eliminate the acceptance of products in regions where the irrigation need is not as complex. WaterSense should not develop a detailed list of controller features to apply at a national level.

Mike Van Bavel (Dynamax) agreed with the need for automatic grow in features. He explained that the default settings on most controllers result in significant over watering. Rain data management is a good feature to address; however, non-volatile memory is a relatively minor issue.

Jill Hoyenga (Eugene Water & Electric Board) expressed the need for WaterSense to include a list of required features for the label. Specifically, labeled controllers should not be 'dumb' when the signal is lost and should perform at the best level possible.

Troy Carson (The Toro Company) noted that landscapes with WaterSense labeled controllers should not be subject to watering restrictions. From an agronomic standpoint, watering restrictions force homeowners to water when it is not needed, strictly because they are able to.

Ed Osann (Steering Committee for Water Efficient Products) agreed with the list of features and recommended that WaterSense determine where the market would be more likely to drive features. For example, easily programmed technologies may best be determined by the market; however, automatic grow in is a failure in the market place and should be required in WaterSense labeled products.

Bill Sauelle (Weathermatic) noted that the price of water drives the consumer's behavior. He recommended that utilities implement tiered water pricing and water budgets to drive the customer to install a more efficient irrigation system.

Stephanie Tanner provided a summary of WaterSense customer surveys, noting that people are more interested in saving water because of environmental benefits versus cost savings. WaterSense's target audience includes those individuals who want to be 'green' and are seeking information on these practices.

Allen Wright (Motorola) stated that there are some controllers in their product line that do not have a user interface; rather, they are managed by a central system. Allen asked whether the testing requirements would exclude these types of controllers. It was noted that WaterSense has not yet evaluated this issue.

Warren Gorowitz (Ewing Irrigation) noted that discussions have focused on the consumer; however, professional contractors also need to be educated on smart technology to effectively promote these products to their customers. He explained that this is the biggest challenge to water savings. Many contractors believe that these products do not work and that the homeowner does not need them. Training and education needs to be focused at the contractor level.

Carole Davis (City of Dallas Water Utilities) explained that water utilities often have mandates that people must follow and goals and objectives to meet. WaterSense should bear in mind that there is a segment in the target audience that want to follow local mandates.

Lou Bendon (PMSI) noted that there are a number of studies on consumer's level of water efficiency. It has been shown that the top 20% of water users are aware of the pressures on water systems and the environment and they see themselves as environmentally conscious. However, these homeowners are not aware of how much water they use. Approaching water efficiency from an environmental standpoint will not 'hit home.' Another approach is needed.

Peter Mayer (Aquacraft) expressed interest in ranking the user interface features because WaterSense will need to make a decision on which features to require.

Mike Van Bavel (Dynamax) asked for clarification on some of the features listed in the handout. Jill Hoyenga explained that the feature, 'stand alone irrigation controller without signal' references the fact that there are numerous inexpensive standard controllers on the market that include very basic features (such as cycle and soak for slope, independent zone programming, ability to review program, etc.) that are capable of saving water when properly programmed. At a minimum, a smart controller should also include these features.

The feature, 'zone by zone control' means each zone should be able to be programmed independently.

The feature, 'adjustable start times for energy and peak pumping planning' refers to an emerging problem that many utilities are facing where the controller default start time is between 5 and 6 a.m. Jill explained that over the last ten years, Eugene has seen a huge increase in hourly demand between 5 and 7 a.m. Although Eugene has been successful with addressing daily demand concerns and has deferred infrastructure build up, 25 million dollars of upgrades over the next ten years are still necessary to address hourly demand concerns.

The feature, 'ability to comply with potential drought restrictions' is important because drought restrictions are about managing a distribution system. Jill explained that irrigation drives infrastructure and drought restrictions are necessary to manage water distribution systems. A

controller should be able to handle a watering window (e.g. day, week). There is also a need to eliminate default settings to water during the day.

Randy Pearson (The Toro Company) agreed that the market should determine the appropriate features for a smart controller. WaterSense should be careful when determining which features to include in a labeled product.

Lou Bendon (PMSI) expressed confusion over how to distinguish or quantify the controller's ease of use because this is specific to each individual.

Don Clark (Rain Bird Corporation) noted that a disabled add-on device has the same over watering results as a real-time controller with a lost signal. Because add-on devices are easy to disable, Don asked whether WaterSense has considered how to deal with these technologies.

Dave Bracciano (Tampa Bay Water) noted that part of the challenge for WaterSense with these controllers is the human intervention component. A consumer knows exactly what they are going to get with a WaterSense labeled toilet. Dave stressed the importance of defining the marketing strategy for this effort.

Scott Anderson (Acclima) cautioned WaterSense to be careful about the number of features that are required in a labeled controller because the more features that are added, the more complex the front panel will be. This will then require more training on programming. Further, WaterSense should be careful not to require so many features that it is contradictory to user friendliness.

Steven Moore (Irrisoft) noted that WaterSense cannot adopt a 'set and forget' approach to these products, as this will not result in water savings. These products require professional installation and consumers and contractors need to understand this. WaterSense should include marketing materials and installation requirements in addition to user features.

#### Discussion Topic: Testing in More Than One Geographically Distinct Climate Zone

Joanna Kind (ERG) presented the first proposed product testing requirement, testing in more than one geographically distinct climate zone. This is an issue because WaterSense labeled products must realize water savings under variable climates and prevailing weather conditions. WaterSense is considering requiring testing in at least two distinct climate zones to address these concerns. WaterSense has researched several climate zone maps and suggest using the International Energy Conservation Code (IECC) Climate Zone map, which is based on temperature and moisture and divides the United States into three distinct zones, including moist, marine, and dry.

Joanna presented ET<sub>0</sub> and precipitation data for Fresno, California and Citra, Florida. These data demonstrate distinctly different weather patterns, with higher ET<sub>0</sub> in Fresno, and larger and more frequent rain events in Citra. The data also demonstrate that rainfall in Citra often meets ET<sub>0</sub> requirements.

WaterSense recognizes that there are secondary issues to this testing requirement, including the availability and capacity of testing facilities, cost, and products that are designed to work in one specific region.

The participants were asked whether a requirement to demonstrate successful performance in more than one climate zone adequately addresses these concerns and whether testing in two distinct zones was sufficient. The participants were also asked how products designed to operate in one region should be addressed and how best to define distinct climate zones if testing in more than one distinct climate zone is required.

**Testing in More Than One Geographically Distinct Climate Zone Questions & Comments**

Jill Hoyenga (Eugene Water & Electric Board) commented on page 5 of the Notification of Intent, which stated, "Please note that manufacturers that have tested their products and not published the results may confidentially submit the SWAT testing results to EPA for consideration in establishing this performance requirement." She asked for clarification as to whether WaterSense wanted results before or after WaterSense labeling begins. Stephanie Tanner clarified that WaterSense seeks this data now, while the specification is being developed, because it may assist WaterSense with determining appropriate performance measures. Stephanie explained that for HETs, WaterSense was able to examine a database of testing results, which assisted with the establishment of an appropriate level of performance. Regarding test data, WaterSense is only concerned with whether the product passed and not its exact score. Jill recommended that WaterSense not accept partial data from manufacturers. Manufacturers should provide the entire test set. Jill prefers the test results to be public for the purposes of determining whether a product is appropriate for a specific region. It would be necessary to know if a product scored 80.5% irrigation adequacy and 4.6% irrigation scheduling excess because this indicates that the product is hard to dial down without compromising the adequacy.

David Zoldoske (CIT) discussed the Citra and Fresno weather data. He noted that if the SWAT protocol is a good protocol, it should not matter where products are tested. Different results in different regions indicate a bad protocol. David also noted that there are few controllers on the market that would not meet a national market, although there are a few exceptions. David highlighted that the greatest water savings occur when the smart controllers make seasonal adjustments because most people do not change their clocks in the fall when ETc decreases. Smart controllers need to recognize ET and rainfall, and the current protocol requires minimum ETo and rainfall measurements to ensure that the controller is accounting for these conditions.

Steve Springer (Rain Master) agreed with David's comment that if the protocol is correct, it should work anywhere in the U.S. Steve noted that it is unacceptable to have products waiting for long periods to complete testing in two regions. He stated that one manufacturer waited for nine months for rain to complete SWAT testing.

Steven Moore (Irrisoft) clarified that the current SWAT protocol requires the use of accepted formulas for crop evapotranspiration, and noted that the protocol defines the standard ET equation that is used for calculating ET. Steven explained that if a controller uses the same equation, then the performance results for that product should be the same in any region. However, if the controller uses a different equation, which many do, the results may vary in

different regions because ET equations have shown to vary depending on the climate of the region. Further, soil moisture sensor testing requires more than 200 days to determine the sensor's accuracy. Steven pointed out that the climatologically based controller protocol does not require validation of the ET equation that the product uses.

Bill Sauelle (Weathermatic) noted that the SWAT protocols need improvements and changes; however, he is encouraged that many stakeholders are meeting today to come to agreement on the protocol. Bill thanked SWAT for their efforts. Bill also noted the need for more testing sites throughout country to expedite testing.

Tom Penning (Irrrometer Company) asked whether real-time controllers could be fed a weather signal from any location, for example, from Citra. David Zoldoske confirmed that this is possible; however, this approach does not work for controllers with on-site sensors.

#### Discussion Topic: Weather Station Standards

Joanna Kind (ERG) presented the technical issues related to weather station standards. She explained that under the current SWAT protocol, products are evaluated at CIT against California Irrigation Management Information System (CIMIS) weather stations. The weather station provides the reference ET and rain measurements used to calculate the performance measures. However, national and state-run weather networks vary in their quality requirements (i.e. siting, maintenance, & sensor specifications). The reference weather station should experience the same weather as the testing facility, and not be subjected to microclimate effects.

The participants were asked how the quality of the reference weather data should be defined and whether standards for weather stations should be established. Participants were also asked whether there should be a maximum allowable distance of the reference weather station to the testing facility.

#### Weather Station Standards Question & Comments

Steven Moore (Irrisoft) commented that there are specific American Society of Agricultural and Biological Engineers (ASABE) weather station requirements.

David Zoldoske (CIT) explained that SWAT chose to adopt the standard approved processes for calculating ET because it is widely accepted. He clarified that CIMIS stations use the modified Penman calculation. CIMIS station #80 is on the Cal State Fresno campus, approximately 0.5 miles from the testing facility. Weather data from other CIMIS locations, specifically, Mt. Shasta has been used when Fresno is not experiencing the minimum rain and ET requirements. The bottle neck of products on the bench occurred because the on-site controllers must be tested against Station #80.

Mike Van Bavel (Dynamax) asked what type of sensors the on-site climatologically based controllers used. David Zoldoske explained that many different sensors are used by these controllers, such as rain sensors, temperature sensors, or atmometers. Mike asked for clarification on how the controllers were compared to CIMIS stations. David explained that the reference ET from the CIMIS station is used to calculate the performance of the technology. All other parameters are programmed into the controller or calculated in the virtual study. Mike

commented that it should be up to the manufacturers to determine which ET calculation they want to use.

Troy Carson (The Toro Company) stated that controllers should be tested in two environments because each technology deals with rainfall differently. He explained that if the proper amount of rainfall is not accounted for, then the landscape will be over watered, especially in areas where there are frequent rain events. Soil type and rainfall intensity also impact landscape water needs; therefore, it is critical that controllers are tested in more than one environment.

Regarding the climate zones, Troy commented that the IECC Marine zone is dry in the summer; therefore, if WaterSense chooses to require testing in two of these three zones, it should be clear that the Marine zone is not applicable in the summer.

Brian Vinchesi (SWAT) commented that IA and ASABE use the standardized Food and Agriculture Organization (FAO) modified Penman equation to calculate ET. The SWAT protocol does not require a standard equation.

Regarding testing in two locations, David Zoldoske informed the participants that the soil and plant types will not change because these parameters are built into the virtual test. The only factor that will be different will be the rainfall. However, the protocol is designed to account for rain first; therefore the results should be the same no matter where the product is tested.

Roy Sieber (ERG) agreed that a good protocol should be effective in any location; however, how the product accounts for rain is still of concern. He asked whether there were any data demonstrating performance results in two regions. David Zoldoske explained that the products tested to date have been tested in a wide range of weather in California.

A participant recommended using standardized ET equations on a region specific basis. Stephanie Tanner clarified that WaterSense does not plan to specify which ET equations should be used.

#### Discussion Topic: Real-World Interactions

Roy Sieber (ERG) presented WaterSense's desire for product testing to replicate real-world installation, including programming, signal processing, and communication. There should be the same level and type of manufacturer to vendor support that a typical customer will experience. Additionally, testing should use the same communication and signal processing that would occur in real-world settings.

The participants were asked for their input on how WaterSense should specify testing requirements so that controllers are tested under conditions that will replicate real-world performance.

#### Discussion Topic: Real-World Interactions Questions & Comments

David Chacon (Water2Save) expressed concern over the topics discussed during the meeting. He is unclear why WaterSense would examine the performance of a product compared to ET in a laboratory and then approve the equipment as water saving. He stated that discussions should focus on real-world results because there have been some products installed in the field

that failed. The irrigation industry should reexamine current business practices before it is backed by EPA. WaterSense should not move forward with labeling these products until the irrigation industry addresses these issues.

Jill Hoyenga (Eugene Water & Electric Board) commented on the smart controller use in Eugene, Oregon where residential customers were studied for their outdoor water use over a ten year period. Jill explained that 60% of their customers water more than ET and benefited from an education program, where the percent adjustment feature was used. This change resulted in water savings ranging from 24% to 89%. More than 30% of the customers used more water following this education program. The remaining customers saw no change in their water use. Jill explained that the industry needs to be careful when selecting which customers should receive smart controllers. Contractors also need to be educated on who should have these products installed. Smart controllers need to be used intelligently.

Peter Mayer (Aquacraft) commented that WaterSense is taking a big step forward. Although Energy Star is a successful program, it does not require third party testing; therefore, bench testing is a huge improvement compared to Energy Star. Field testing is where the most information can be collected; however, field testing for labeling is not practical.

Jeff Lee (Town of Gilbert) agreed that there are some cases where controllers will result in increased water use. He explained that the regional park system in Phoenix used to water at 60% of the reference ET. Now smart controllers have been installed and are programmed to irrigate at 60% of the theoretical needs. In the residential sector, some homeowners apply more than 60,000 gallons per month on their landscapes. Smart controllers may be able to significantly reduce this water use.

Dave Chacon (Water2Save) noted that EPA should clearly explain the limitations of these technologies to consumers.

Steven Moore (Irrisoft) clarified that many people perceive that these technologies will save water. However, these products are not guaranteed to perform well under all circumstances.

Karen Guz (SAWS) spoke to the fact that developing programs for these technologies is a different issue than setting a standard for a high performing controller. Karen noted that San Antonio has seen similar results with controllers and water use as Eugene, Oregon. Those that water under ET may see an increase in their water use if a smart controller is installed. Karen stated that WaterSense should focus on the elements that should be included in a successful technology and the implementation programs can vary by region.

Mike Van Bavel (Dynamax) agreed that testing requirements are necessary to ensure that a smart controller's test results are applicable to real-world conditions. Mike asked WaterSense to continue working toward this goal and determine whether each class of controllers (weather-based, soil moisture sensors, etc.) really saves water. Mike commented that the region does affect testing results. For example, a product tested in December in California will be stressed differently than a product tested in the summer in Florida. ET equations fall apart in hot and dry conditions; therefore, testing in Fresno would be a better indication of performance compared to Florida. Mike also asked whether EPA would be funding field tests for smart controllers.

Peter Mayer (Aquacraft) indicated that there are EPA funded studies for the New Homes initiative; however, climatologically- based controllers and soil moisture sensors are optional in this program. He noted that there are studies underway in southern and northern California that examine the grant programs in these regions, where 5,000 and 1000 controllers have been installed, respectively. Data on these efforts will not be available until late 2008.

Jill Hoyenga (Eugene Water & Electric Board) noted that the California programs allow the customer or contractor to select the product installed.

Bill Sauelle (Weathermatic) commented that the water districts' actions are what drive consumer's behavior. For example, tiered pricing and fines may cause residents to respond with landscape changes.

Dave Bracciano (Tampa Bay Water) stressed the importance of real-world performance, because this is what water agencies are looking for.

#### Discussion Topic: Test Reproducibility

Roy Sieber (ERG) explained that many of the technical issues are due to the variability of weather between regions over time, which creates testing challenges. Further, no two products are subject to the same test conditions.

Roy asked the participants whether a standard set of weather conditions could be used to test the controller's response. For signal-based controllers, this may be a pre-recorded weather data set. For the on-site sensors, this could be under simulated weather.

#### Test Reproducibility Questions & Comments

Ron Wolfarth (Rain Bird Corporation) stated that WaterSense should establish standards for on-site sensor-based controllers if they plan to establish standards for off-site weather stations. Ron stated that the danger of bad weather data from on-site weather stations that feed into the controller may be a bigger issue than off-site weather station data quality. Ron noted that sensor maintenance should also be considered for on-site weather stations and weather-based controllers.

Regarding the use of 'canned' weather data, Ron hopes that this would not happen in the industry. He feels this would allow testing to be gamed. If the data were known, then products could be fine-tuned to perform perfectly during testing, but not in the real world.

Paul Morgenstern (Climate Computer) explained his experience with testing noting that testing quality is dependent on the testing facility and their ability to produce scientific results. He recommended developing data streams from real weather data to be randomly used in testing.

Steve Springer (Rain Master) commented that WaterSense should keep in mind the economics of scale. Commercial central controllers that address several types of weather input are ready for many different weather signals. However, a residential controller may not be designed to take in several different weather feeds may make the product more expensive.

Bill Sauelle (Weathermatic) commented that there are many off-site weather stations that provide free weather data. Many controller models on the market are supported by these weather stations. Bill believes there is going to be free weather data in all regions; therefore, the ability of the product to take a variety of ET based formulas is important.

Ed Osann (Steering Committee for Water Efficient Products) highlighted several issues that have not been discussed. First, WaterSense should develop criteria related to the durability of the products. For example, the plumbing industry has American Society of Mechanical Engineers (ASME) standards and minimum warranty requirements. Secondly, WaterSense should address the product's energy consumption of controllers in stand-by mode.

Tom Penning (Irrometer Company) commented that WaterSense overlooked water conserving conventional controllers in this product category. These products have many of the features discussed earlier, although they are not self adjusting.

Tom also commented that a product with an 80% irrigation adequacy score is best from a conservation perspective.

Peter Mayer (Aquacraft) asked whether the product's scores would be published. Stephanie Tanner clarified that WaterSense intends to determine a pass/fail level and all products that meet the requirements receive the label. However, the testing results could be made publicly available.

Jill Hoyenga (Eugene Water & Electric Board) commented that water purveyors currently determine which products they want to include in their rebate programs based on the product's scores that are published on SWAT's website. Once WaterSense begins labeling these products, utilities can use this measure to determine which products to include in their program. However, Jill would like an informed label with published results.

Troy Carson (The Toro Company) expressed concern over WaterSense's adoption of the SWAT protocols due to the numerous discussions on the inadequacies of the protocol. He commented that discussions have not focused on soil moisture sensors, and it is unclear how these technologies will fit into this product category.

Jan Connery asked the participants whether testing should take place in more than one zone. Half of the participants felt that testing should be conducted in more than one zone; however, all agreed that more work on this topic is needed.

Dale Hansen (Signature Control Systems) stated he would be comfortable with testing in one location if it was clear how rainfall was taken into account.

Dave Bracciano (Tampa Bay Water) recommended that studies conducted in Florida be compared to those conducted at CIT. If the results are the same, then people should feel confident in the protocol.

The participants agreed that some subset of user features is necessary to include with the WaterSense label.

The participants asked for clarification on the testing interaction question. Roy Sieber explained that WaterSense has received concerns on the validity of testing and the level of interaction that manufacturers are allowed.

Randy Pearson (The Toro Company) explained that he is concerned with individuals actively messing with the protocol. The protocol should be designed such that the test administrator can determine the performance of the controller, and that any other person who reviewed the results could make the same decision. There should be no ambivalence when determining testing results.

Brian Vinchesi (SWAT) explained two concerns that have been raised to SWAT's attention. The first is that manufacturers are tampering with the signal while their product is on the bench. The second concern is that products are tested and then their product name changes after testing has been completed. SWAT's position is that the test results are applicable to the model tested. Products cannot apply the results if the name was changed. SWAT has not determined how to address human intervention during testing other than the signature of a statement that says no interaction took place.

Roy Sieber asked whether these products could be tested using simulated weather data. Jill Hoyenga noted that this is possible and the data source could be CIMIS historical weather data.

David Byma (Calsense) stated that their product was tested this year with no problems and testing was completed within 45 days. He stated that the protocol is not perfect but is a good starting point.

The participants agreed to establish several working groups to further work the issues. These working groups will discuss the following topics: performance measures, multiple zone testing/rain management, user interface features, and simulated testing. Participants were asked to sign up for these working groups at the end of the meeting.

#### Presentation: Certification Process

Stephanie Tanner (EPA) presented the current WaterSense certification process for indoor plumbing products. Currently, all products must be certified by an accredited Product Certification Body (CB) or other organization approved by the WaterSense program. Manufacturers apply to an approved CB of choice and the CBs certify the products in accordance with WaterSense specifications. The CB authorizes the manufacturer to use the WaterSense label and conducts periodic surveillance including factory visits, product retesting, and label policing.

The CBs are accredited to certify products to WaterSense specifications. The accreditation process is under development, with anticipated implementation in Spring 2008. In the interim, CBs are approved by EPA. EPA licenses CBs to certify products and authorize the use of the WaterSense label.

There are numerous benefits for product certification, including: EPA can focus on marketing and product development; EPA is in compliance with the National Technology Transfer and

Advancement Act (NTTAA); simplification of record management; the process is more rigorous; there is better policing of the label and on-going surveillance of products; there is faster product approval times and no limit on business relationships; and there is an increase in the consistency in product testing. However, WaterSense recognizes that this process may be different for irrigation products. At a minimum, the irrigation product certification process must provide independent, third-party testing, provide ongoing surveillance of the manufacturing process, not be overly burdensome for manufacturers to obtain or EPA to administer, and must provide an appropriate level of assurance to the customer that the product meets WaterSense specifications.

Product Certification Process Questions/Comments

Ron Wolfarth (Rain Bird Corporation) asked EPA to reconsider the performance requirement approach, including certification of third party verification. Ron referenced the Energy Star Program, which uses manufacturer declaration. This approach has had a fairly large impact on the acceptance of the program by manufacturers. The success of Energy Star is based on manufacturer declaration; however, Ron acknowledges that there is a credibility issue there. WaterSense should adopt an approach in between, for example, manufacturer self declaration with auditing. Third party testing goes too far because there are currently no standards. Further, there are no testing facilities that are currently available, thus requiring a large investment or high testing fees. The irrigation market is relatively small compared to others. Ron asked what CB is going to invest in this industry if there are only 100-200 products that will be tested. This may result in lower program acceptance.

Mike Van Bavel (Dynamax) stated that he would not accept manufacturer self declaration and commented that there are industry standards in existence for pumps, pipes, etc. that products are being certified to.

Stephanie polled the participants for their interest in independent third-party testing. The majority of the participants felt that independent third-party testing was important for WaterSense labeled products.

Brian Vinchesi (SWAT) commented that the IA initiated SWAT because of industry interest in third-party testing. He noted that SWAT has been in development over the past five years. SWAT was established to address the industry's need for independent testing.

A participant commented that the most problematic issue is that the CBs don't care and they do not complete testing in a timely fashion. WaterSense's process needs to be expedient and cost effective.

Wrap-Up and Next Steps

Stephanie Tanner informed the participants that they will receive a summary of the meeting. Working groups will be established to continue to discuss the technical issues identified during the meeting. Stakeholders have plenty of time to provide input on the technical issues.

## **Appendix A** **List of Meeting Participants**

Cynthia Amos, Irrigation Association  
Lou Bendon, Planned Marketing Solutions International (PMSI)  
Judith Benson, Clear Water PSI  
Lauren Bissey, Decagon Devices  
David Bracciano, Tampa Bay Water  
Doug Burt, Aquarius Brands, Inc.  
David Byma, Calsense  
Maribel Camps, International Association of Plumbing & Mechanical Officials (IAPMO)  
Bernard Cardenas, University of Florida  
Troy Carson, The Toro Company  
David Chacon, Water2Save  
Ian Chang, Intertek  
Don Clark, Rain Bird Corporation  
James Jolly Clark, Climate Computer  
Chris Claus, City of St. Petersburg  
Norman Davis, Hillsborough County Water Resource Services  
Stacia Davis, University of Florida  
Carole Davis, City of Dallas Water Utilities  
Chris Dewey, Pasco County Florida Utilities  
Dawn Dickens, Hillsborough County Extension  
Michael Dukes, University of Florida  
Ha Duong, Melnor, Inc.  
Nicholas Fuller, Tampa Bay Water  
John Gardner, Valmont Industries  
Warren Gorowitz, Ewing Irrigation Products  
Clark Graham, LR Nelson Corporation  
Hugh Gramling, Hillsborough River Basin Board  
Karen Guz, San Antonio Water System (SAWS)  
Melissa Haley, University of Florida  
Rick Hall, K-Rain Manufacturing  
Deborah Hamlin, Irrigation Association  
Dale Hansen, Signature Control Systems, Inc.  
Lloyd Hathcock, Niagara Conservation Corporation  
Rick Heenan, DIG Corporation  
Jill Hoyenga, Eugene Water & Electric Board  
Gail Huff, Ballenger & Company, Inc.  
Mike Jacobson, Aquarius Brands, Inc.  
Alex Korol, The Toro Company  
Jeff Kremicki, Hunter Industries  
Lisa Krentz, Hazen and Sawyer PC  
Jeff Lee, Town of Gilbert  
Elana Lundy, Rain Bird Corporation  
Chris Manchuck, HydroPoint Data Systems, Inc.  
Peter Mayer, Aquacraft, Inc.

Dennis McKenna, McKenna Irrigation Services, Inc.  
Phoenix McKinney, City of Tampa Water  
Steven Moore, Irrisoft, Inc.  
Paul Morgenstern, Climate Computer  
Lauren Morris, ValleyCrest Landscape  
Greg Natvig, Rain Bird Corporation  
Tom Olmsted, University of Florida  
Ed Osann, Steering Committee for Water Efficient Products  
Randall Pearson, The Toro Company  
Tom Penning, Irrrometer Company, Inc.  
John Peters, Baseline Systems  
Brent Philpot, University of Florida  
Alison Ramoy, Southwest Florida Water Management District  
Jason Reichard, Rain Bird Corporation  
Ivelina Rodenbaugh, Tampa Bay Water  
Bill Sauelle, Weathermatic  
Rose Mary Seymour, University of Georgia  
Thomas Shannon, Ewing Irrigation  
Dominic Shows, Alex-Tronix GNA Industries  
Mark Spears, U.S. Bureau of Reclamation  
Steve Springer, Rain Master  
Chet Townsend, Agrilink International, Inc.  
Eileen Tramontana, St. John's Water Management District  
Michael Van Bavel, Dynamax  
Rick Villemana  
Brian Vinchesi, Irrigation Consulting, Inc.  
Arthur Vos, Vos Sprinkler Company  
Philip Warren, Hunter Industries  
John Wiedmann, Metropolitan Water District of Southern California (MWD)  
Lynda Wightman, Hunter Industries  
Ron Wolfarth, Rain Bird Corporation  
Jessica Woods, Austin Water Utility  
Allen Wright, Motorola  
David Zoldoske, University of California Fresno Center for Irrigation Technology (CIT)

Jan Connery, Eastern Research Group, Inc. (ERG)  
Joanna Kind, Eastern Research Group, Inc. (ERG)  
Christy Milstead, Eastern Research Group, Inc. (ERG)  
Roy Sieber, Eastern Research Group, Inc. (ERG)  
Stephanie Tanner, U.S. Environmental Protection Agency (EPA)

## Appendix B Working Groups

### Performance Measures Working Group

Don Clark (Rain Bird Corporation)  
Don Cooper (Weathermatic)  
Norman Davis (Hillsborough County)  
Michael Dukes (University of Florida)  
Dale Hansen (Signature Control Systems, Inc.)  
Steven Moore (Irrisoft)  
Randy Pearson (The Toro Company)  
Tom Penning (Irrometer)  
Jon Peters (Baseline)  
Rose Mary Seymour (University of Georgia)  
Steve Springer (Rain Master)  
Mike Van Bavel (Dynamax)  
Jessica Woods (City of Austin)

### User Features Working Group

Judith Benson (Clear Water PSI)  
Don Cooper (Weathermatic)  
Norman Davis (Hillsborough County)  
Greg Natvig (Rain Bird Corporation)  
Tom Shannon (Ewing Irrigation Products)  
Steve Springer (Rain Master)  
Allen Wright (Motorola/Seacom)

### Multiple Test Zone Working Group (Accounting for Rainfall)

Troy Carson (The Toro Company)  
Don Cooper (Weathermatic)  
Michael Dukes (University of Florida)  
Dale Hansen (Signature Control Systems, Inc.)  
Steven Moore (Irrisoft)  
Paul Morgenstern (Climate Computer)  
Jason Reichard (Rain Bird Corporation)  
Steve Springer (Rain Master)

### Simulated Testing Working Group (Library Testing)

Maribel Campos (IAPMO)  
Troy Carson (The Toro Company)  
Ian Chang (Intertek)  
Don Cooper (Weathermatic)  
Michael Dukes (University of Florida)  
Paul Morgenstern (Climate Computer)  
Jon Peters (Baseline)  
Steve Springer (Rain Master)  
Chet Townsend (Agrilink)  
Mike Van Bavel (Dynamax)