Project Title: SWAT Soil Moisture Sensor Testing Protocol 3rd Draft Reviewers

Project No.: 1000-8 (SWAT)

Date: April 16, 2004

By: Edward M. Norum, P.E.

Subject: Listing of individuals submitting comments on the SWAT 3rd Draft Soil Moisture Sensor Testing Protocol (dated October 2003)

Reviewers Name	E-Mail Date	Organization
1. Brenden Duncan	02-04-04	Streat Instruments
2. Scott DeHart	11-12-03	Baseline Systems
3. Simon Eching	11-10-03	CIMIS
4. Dana Lonn	11-07-03	Toro Company
5. John Wynn/Simon Eching	11-04-03	Mobile Lab/CA/GOV
6. Scott Anderson	10-31-03	Acclima, Inc.
7. Jan Windscheffel	10-31-03	Netafim, Inc.

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Subject: Review of comments with explanation of acceptance or rejection.

Item #	Comments/Observation	Accept	Reject	Explanation
(#)				
1.	Need to have a box long enough to contain a 10-ft long sensor.	X		We plan to discuss these specifics with each manufacturer. The only fixed dimension is to locate the moisture sensing element at the root zone depth of 3.0 in.
2.	How does the protocol deal with probability that the moisture content will be variable depending on location?	X	X	The protocol accepts the fact that the moisture content will vary by location within the box. The sensor however will always be at the same relative position and therefore should give a consistent reading relative to the average moisture content in the box. The protocol is meant to test the consistency of this relationship with no special concern about the actual moisture content. With the demonstration of a consistent calibration curve it remains then to correlate grass quality with sensor scale reading.
3.	Test could be more closely focused on the intended end use.	X	X	Reminder – this is a screening test meant to sort out devices not founded on fundamental science. It should eliminate these devices before the expensive phase 2 program is undertaken.
4.	Soil in box needs to be wet up from the bottom to avoid air entrapment and incomplete wetting.	X		This was our intention. The box wets up through holes in the bottom. Explanatory wording added to paragraph 6.2.1.

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5.	Suggest using 0.01m Ca Cl2 instead of de-ionized water. No water is completely salt free.		X	The testing involves adding salt to observe its effect on the calibration. In this case we feel it is better to wet up the box with DI water thereby avoiding any possible salt contamination.
6.	Suggest using Soil Science Society of America Glossary of Terms	X	X	We have done this generally with some modifications.
7.	Phase 1 seems to be focused on determining the scientific validity of sensors only and not focused on the value of sensor/controller combinations.	X		That is the intention of the protocol. Phase 1 is sensor screening followed by Phase 2 involving actual turf irrigation.
8.	Some sensors will not perform well in the protocol but will save water with periodic adjustment.		X	The protocol allows for absolute and relative soil moisture sensor testing. The protocol emphasizes "predictable" performance without which the sensor is useless.
9.	Consider using a slurry during the installation of some sensors		X	Care will be taken in the hand placement of soil around the sensor. Wetting of the box occurs from the bottom up to avoid trapping air.
10.	May want to consider calibration during wetting to take hysteresis into account		X	All calibrations will be made during the drying cycle as occurs with irrigation events. Will consider follow on studies to characterize the potential hysteresis affect.
11.	In the box weighing procedure caution must be exercised to prevent distorting or impacting soil thereby causing separation of the soil from the sensor.	X		Care will be taken. Further, if the sensor gives an inconsistent result, soil contact with the sensor will be investigated as the potential cause.
12.	Long-term (say over 100) repeatability tests could be made to test reading-to-reading uniformity.	X		The test may be best handled as part of the Phase 2 outdoor operational test by comparing the sensor under test to say neutron probe readings.

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13.	While Phase 1 is desirable, we suggest that the test be focused more closely on the intended use.	X		Phase 1 is a screening test to qualify sensors for the more expensive Phase 2 field tests. Phase 2 will be conducted under more realistic field conditions with the irrigation on turf plots.