Real World
Conservation Potential of Smart Controllers and Essentials for Program Implementation: Orange County Florida Study
AWWA Sustainable Water Management Conference
Mar. 15-18, 2015, Portland, OR
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University of Florida/IFAS
Central Florida Water Initiative
Soil Moisture Sensor Controller
Evapotranspiration (ET) Controllers

• Some can determine runtimes and days
• Programming is key!
  – Soil type
  – Plant type
  – Microclimate
  – Application rates
  – Slope
Identifying Excess Irrigation Customers

- **Historical Irrigation**
  - Total household water use provided by OCU from 2006-2011
  - 2012-2013 indoor estimates used to estimate irrigation

- **Gross Irrigation Requirement (GIR)**
  - If 0.5*AWHC was depleted,
    
    \[ GIR = \frac{SW_i - SW_{i-1} + ET_c - R_e}{DU_{lh}} \]
    
  - Assuming root depth of 8 inches,
    - AWHC was 0.56 inches (6.3%) for sand
    - AWC was 1.14 inches (14%) for flatwoods
  - \( DU_{lh} \) was 80%
  - GIR range selected as 1*GIR to 1.5*GIR
Irrigation Requirements

Daily gross irrigation requirement (GIR)

- Daily weather data
- Soil type
- Landscape plant composition
Gross Irrigation Requirements

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (inches)</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
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</tr>
</tbody>
</table>

Net Irrig. Req. Efficiency Req. Precip ETc

Turfgrass Annual Gross Irrig. Req.

N FL, 33 inches/yr
S FL, 43 inches/yr
Estimated Irrigation

- Census per capita estimate, people/home
- Monthly billing data, gal/month
- Per capita indoor use, 69 gcpd/Actual indoor

Estimated monthly irrigation
Orange County Evaluation Selection of Excess Irrigators

<table>
<thead>
<tr>
<th>Estimated irrigation (mm month$^{-1}$)</th>
<th>Number of customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,000</td>
<td>7,000</td>
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<tr>
<td>8,000</td>
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<tr>
<td>35,000</td>
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</tr>
</tbody>
</table>

Theoretical limit = 3 in month$^{-1}$
1.5 times theoretical limit = 4.6 in month$^{-1}$
4 times theoretical limit = 12 in month$^{-1}$

Area where ‘potential cooperators’ were identified

7,407 possible participants
Irrigation System Evaluation

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**IRRIGATION SYSTEM EVALUATION**

- **Address:**
- **Timer location:**
  - Garage
  - Outside wall
  - Other:
- **Original schedule:**
  - A) Start time(s):
    - Mon _____ Tue _____ Wed _____ Thu _____ Fri _____ Sat _____ Sun _____
  - B) Start time(s):
    - Mon _____ Tue _____ Wed _____ Thu _____ Fri _____ Sat _____ Sun _____
- **Run time/zone (min):**
  - A) 1 2 3 4 5 6 7 8
  - B) 1 2 3 4 5 6 7 8
- **Rain sensor:**
  - Location: Roofline
  - Not connected
  - Obstructed
  - Misplaced
  - Absent

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**Irrigation Zones (stations):**

<table>
<thead>
<tr>
<th>Zone location from the house</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Front</td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>b. Left</td>
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<tr>
<td>c. Center</td>
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<tr>
<td>d. Right</td>
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<tr>
<td>e. Back</td>
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</tbody>
</table>

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**Sun reaching the zone:**

<table>
<thead>
<tr>
<th>Sun reaching the zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tbody>
<tr>
<td>a. Full sun</td>
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<td></td>
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<td></td>
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<tr>
<td>b. Mostly sunny</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Mostly shady</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>d. Full shade</td>
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</table>

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**Plant type:**

<table>
<thead>
<tr>
<th>Plant type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Turf</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>b. Ornamentals</td>
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<tr>
<td>c. Mixed (%)</td>
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<tr>
<td></td>
<td>Turf</td>
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</tr>
</tbody>
</table>

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**4. Turf Quality (1=Dead, 9=Top Qual.)**

**Num. of Irrigation heads:**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Sprinklers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Rotors</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>c. Microirrigation</td>
<td></td>
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</tbody>
</table>

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**Irrigated Area:**

- Calculated (Aerial photo): _______ ft²
- Corrected (in situ): _______ ft²

**Flow Test:**

- Run time per zone: _______ minutes
- Meter reading before: _______ Meter reading after: _______

**Comments:**

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**Evaluator:**
Summary of Participants

Sources:
County Boundary: Orange County GIS Program (2007), Scale Unknown
Roadways: FDOT Transportation Statistics Office (2011), 1:24,000
Two Smart Controllers Evaluated

- Rain Bird ESP-SMT
  - ET treatment
  - Total Count = 28
  - Total Locations = 7

- Baseline WaterTec S100
  - SMS treatment
  - Total count = 28
  - Total locations = 7
Controller Groups

- **ET**
  - Contractor programmed with default landscape settings
  - Daily water windows
  - Rare interaction with homeowner

- **SMS**
  - Buried at 6 inches in minimally compacted soil
  - Re-programmed time clock schedules for daily irrigation:
    - 20 minutes spray
    - 45 minutes rotor
  - Rare interaction with the homeowner
“EDU” Groups

• Educational Training
  – ET+Edu treatment
    • Reprogrammed for site specifics
    • 5 minute tutorial
    • Total Count = 38
    • Total Locations = 9
  – SMS+Edu treatment
    • Inserted into soil column at 3 inch depth
    • Reprogrammed for 0.25” per event, 2 events per day, 3 d/wk
    • 5 minute tutorial
    • Total count = 38
    • Total locations = 9
## OCU Technologies & Expt. Design

<table>
<thead>
<tr>
<th>Treatment</th>
<th>ET</th>
<th>ET+Edu</th>
<th>SMS</th>
<th>SMS+Edu</th>
<th>Comparison</th>
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</thead>
<tbody>
<tr>
<td>Rain Bird ESP-SMT</td>
<td>Rain Bird ESP-SMT</td>
<td>Baseline WaterTec S100</td>
<td>Baseline WaterTec S100</td>
<td>--</td>
<td></td>
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</tbody>
</table>

**Technology**

**Locations Installed**
- 7
- 9
- 7
- 9
- 9

**Number Installed**
- 28
- 38
- 28
- 38
- 35

Monitored: 1 Dec 2011 through 30 Nov 2012 (12 months)
Materials and Methods

• Automatic Meter Recording devices (AMRs)
  – Separated flow meter to measure irrigation only
  – Records hourly irrigation volumes
  – Monthly downloads
Quarterly Turf Quality Assessment
Turfgrass Quality

<table>
<thead>
<tr>
<th>Season</th>
<th>Average Turfgrass Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before treatments</td>
<td>6.4 abcd</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>6.6 c</td>
</tr>
<tr>
<td>Winter 2011-2012</td>
<td>6.2 d</td>
</tr>
<tr>
<td>Spring 2012</td>
<td>6.5 c</td>
</tr>
<tr>
<td>Summer 2012</td>
<td>7.6 a</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>7.1 b</td>
</tr>
<tr>
<td>Winter 2012-2013</td>
<td>6.7 c</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>7.1 b</td>
</tr>
</tbody>
</table>
Irrigation Nov 2011-Nov 2014

<table>
<thead>
<tr>
<th></th>
<th>Average Weekly Irrigation (in)</th>
<th>Comparison</th>
<th>ET</th>
<th>ET-EDU</th>
<th>SMS</th>
<th>SMS-EDU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sands</td>
<td>Flatwoods</td>
<td>Sands</td>
<td>Flatwoods</td>
<td>Sands</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>BC</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.21</td>
<td>1.06</td>
<td>0.76</td>
<td>0.76</td>
<td>0.70</td>
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<tr>
<td></td>
<td></td>
<td>0.91</td>
<td>0.75</td>
<td>0.67</td>
<td>0.72</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Comparison ET ET-EDU SMS SMS-EDU

-12%/-16% -38%/-26% -38%/-21% -42%/-45%
## Irrigation Nov 2011-Nov 2014 Sand Sites

<table>
<thead>
<tr>
<th>Comparison</th>
<th>ET</th>
<th>ET-EDU</th>
<th>SMS</th>
<th>SMS-EDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Weekly Irrigation (in)</td>
<td>1.21</td>
<td>1.06</td>
<td>0.75</td>
<td>0.75</td>
</tr>
</tbody>
</table>

-12%  -38%  -38%  -42%
Irrigation Nov 2011-Nov 2014

Flatwoods Sites

Average Weekly Irrigation (in)

 Comparison | ET | ET-EDU | SMS | SMS-EDU
-16% | -26% | -21% | -45%

0.91 | 0.76 | 0.67 | 0.72 | 0.50 | 0.50
How Well Do the Controllers Perform?

Flatwoods

- (acceptable)
- (achievable)
- NIR
- ET
- ET+Edu
- SMS
- SMS+Edu
- Comparison

Irrigation Applied (in)

Jan 2012 - May 2014

Sands

- (acceptable)
- (achievable)
- NIR
- ET
- ET+Edu
- SMS
- SMS+Edu
- Comparison

Irrigation Applied (in)

Jan 2012 - May 2014

Jan 12 | Mar 12 | May 12 | Jul 12 | Sep 12 | Nov 12 | Jan 13 | Mar 13 | May 13 | Jul 13 | Sep 13 | Nov 13 | Jan 14 | Mar 14 | May 14
Acknowledgements: Water Research Foundation, Orange County Utilities, St. Johns River Water Management District, Southwest Florida Water Management District

Paper Co-authors: Mackenzie Boyer, Bernardo Cardenas, Melissa Haley, Stacia Davis, Leah Meeks,