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advancing the science of water
Presentation Outline

• Background - Orange County, Florida
• State of Water Resources in the Region
• Resource Challenges and Options
• Smart Technology Study Review
• Next Steps
Background

- 1973 Resolution Adopted, purchased 2 systems, 40 customers
- 1973 – 1985 Acquired Small Systems (over 100 systems)
- 1985 – 2000 Consolidation into regional facilities

- 2000 Water Management District consumptive use permitting process change
- 2016 – four service territories, 11 water supply facilities, 5 re-pump facilities, approximately 140K connections, averaging 65 mgd
Background

- Floridan Aquifer
- Underlies 100,000 square miles
  - AL, GA, SC and FL
- Most productive in the world
- Recharge rates of 2”–20” a year

Water use is managed by the Water Management Districts
Water Use Profile

- Over 140,000 water connections
  - 96% residential connections use 67% of water
  - 4% commercial connections uses 33% of the water
Water Use Profile

- Outdoor (54%)
- Toilet (12%)
- Showers (7%)
- Faucets (6%)
- Bathtub (1%)
- Dishwasher (1%)
- Clothes Washer (11%)
- Leaks (5%)
- Other (1%)
Water Resource Challenges

- Single groundwater source of water not sustainable
- Expensive to develop new sources of water, such as surface water or desalination
- Reluctance to change water use habits
- Environment/Wildlife
- Growth
- Stakeholders - includes visitors
Water Resource Challenges

Seasonal rainfall typically provides enough water, except during height of dry season

Information from South Florida Water Management District 2009
Water Resource Options

- Reclaimed Water
- Aquifer Recharge
- Ground Water
- Storm Water
- Conservation
- Surface Water
Central Florida Water Initiative
Smart Irrigation Study Objectives

- Water use efficiency improvements
- Ease of use
- Cost of operation
- Maintenance issues
- Performance variations:
  - Customers: Residential and Commercial
  - Soil type: Sandy and Flatwoods
  - Smart technologies: Soil Moisture Sensors and ET Controllers
Soil Moisture Sensor Controller
Evapotranspiration (ET) Controllers

- Some can determine runtimes and days
- Programming is key!
  - Soil type
  - Plant type
  - Microclimate
  - Application rates
  - Slope
Irrigation Requirements

Daily gross irrigation requirement (GIR)

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

Turfgrass Annual Gross Irrig. Req.

Net Irrig. Req.
Efficiency Req.
Precip
ETc

Month
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Depth (inches)

0
2
4
6
8
10

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

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Selection of Cooperators

~130,000 Single Family Customers
Estimated Irrigation

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

Estimated monthly irrigation
Orange County Evaluation Selection of Excess Irrigators

Estimated irrigation (mm month\(^{-1}\))

- 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
Selection of Cooperators

~130,000 Single Family Customers

7,407 Possible Participants
Cooperator Questionnaire

- Determined homeowner’s study interest and irrigation knowledge
- Irrigation controller or automated irrigation system needed
- Not a renter
- Intended to live at residence for two or more years
Selection of Cooperators

~130,000 Single Family Customers

7,407 Possible Participants

843 Questionnaire Respondents
Selection of Cooperators

~130,000 Single Family Customers

7,407 Possible Participants

843 Questionnaire Respondents

353 On-site Evaluations
Irrigation System Evaluation

[Image of a yard with sprinklers in operation]

**Irrigation System Evaluation**

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

<table>
<thead>
<tr>
<th>Irrigation Zones (stations)</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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</thead>
<tbody>
<tr>
<td>Zone location from the house</td>
<td>a. Front ☑</td>
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<td>b. Center ☑</td>
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<td>c. Right ☑</td>
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<td>d. Back ☑</td>
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<tr>
<td>Sun reaching the zone</td>
<td>a. Full sun ☑</td>
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<td>b. Mostly sunny ☑</td>
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<td>c. Mostly shady ☑</td>
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<tr>
<td>d. Full shade ☑</td>
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<tr>
<td>Plant type</td>
<td>a. Turf ☑</td>
<td>☐</td>
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<td>b. Ornamentals ☑</td>
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<td>c. Mixed (%) ☑</td>
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<td>Turf ☑</td>
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<td>Orn ☑</td>
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<tr>
<td>Turf Quality (1=Dead, 9=Top-Qual.)</td>
<td>a. Sprinklers ☑</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>b. Rotors ☑</td>
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<td>c. Microirrigation ☑</td>
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</tr>
</tbody>
</table>

Irrigated Area: Calculated (Aerial photo) _______ ft² Corrected (in situ) _______ ft²

Flow Test: Run time per zone _______ minutes Meter reading before _______ Meter reading after _______

Comments:

Evaluators: Y __ M __ N __
Selection of Cooperators

- ~130,000 Single Family Customers
- 7,407 Possible Participants
- 843 Questionnaire Respondents
- 353 On-site Evaluations
- 167 Selected Households
Summary of Participants

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

Legend
- Cooperator
- Rain Gauge
- Weather Station

Sand
Flatwoods
Two Smart Controllers Evaluated

- Rain Bird ESP-SMT
  - ET treatment

- Baseline WaterTec S100
  - SMS treatment
Contractor 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
  – SMS+Edu treatment
    ▪ Inserted into soil column at 3-inch depth
    ▪ Reprogrammed for 0.25” per event, 2 events per day, 3 days/week
    ▪ 5-minute tutorial
Automatic Meter Recording Devices (AMRs)

- Separated flow meter to measure irrigation only
- Records hourly irrigation volumes
- Monthly downloads
## 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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<tr>
<td>Technology</td>
<td>Rain Bird ESP-SMT</td>
<td>Rain Bird ESP-SMT</td>
<td>Baseline WaterTec S100</td>
<td>Baseline WaterTec S100</td>
<td>--</td>
</tr>
</tbody>
</table>

| Locations Installed | 7 | 9 | 7 | 9 | 9 |
| Number Installed    | 28 | 38 | 28 | 38 | 35 |
Irrigation Nov 2011-Nov 2014

-12%/ -16%  -38%/ -26%  -38%/ -21%  -42%/ -45%

Average Weekly Irrigation (in)

Comparison  ET  ET-EDU  SMS  SMS-EDU

a  1.21  1.06  0.76  0.75  0.70
A  0.91  0.75  0.67  0.72  0.50

Sands
Flatwoods
Phase II - Irrigation Nov 2014-Oct 2015

Average Weekly Irrigation (in)

<table>
<thead>
<tr>
<th></th>
<th>Comparison</th>
<th>ET</th>
<th>ET-EDU</th>
<th>SMS</th>
<th>SMS-EDU</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>0.96</td>
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<td>0.83</td>
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<td>0.74</td>
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<td>0.79</td>
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<td></td>
<td></td>
<td>0.72</td>
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</tbody>
</table>

-14%  -23%  -18%  -25%
Phase I & II Irrigation Nov 2011-Oct 2015

Average Weekly Irrigation (in)

Comparison
ET
ET-EDU
SMS
SMS-EDU

1.01a
0.83b
0.71c
0.74c
0.62d

-19%
-31%
-28%
-40%
Turfgrass Quality
How Well Do the Controllers Perform?

Flatwoods

Sands

Jan 2012 - May 2014
Commercial Properties

Average Monthly Irrigation (in)

- Historical Irrigation Application
- Treatment Irrigation Application
- Gross Irrigation Requirement (achievable)

Locations:
- Tanner Crossings HOA
- Waterford Lakes Pkwy
- CentraCare
- Clarion Hotel
Smart Controllers - Bottom Line

- ET/SMS significantly reduce over-irrigation
- ET controllers must be targeted to sites with savings potential
- Proper installation enhances savings
- Longevity of savings?
Customer Surveys

• Pre-test questionnaire
  – Irrigation knowledge
  – Water Conservation attitudes

• Post-test Survey
  – Informed conclusions on resident’s attitudes and knowledge of smart irrigation technologies
Post-test Survey Methodology

- Each survey fit specific technology
- Education treatment
  - Included questions on knowledge of technology
- Comparison group
  - Surveys excluded controller related questions
    - Irrigation practices
    - Water use
    - Demographics
Post-test Survey Results

- 143 respondents, 86% response rate
- Self reported understanding of installed controller:

  "Do you understand how your SMS/ET works?"

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yes</th>
<th>No</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMS (n = 22)</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>SMS+EDU (n = 29)</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>ET (n = 26)</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>ET+EDU (n = 38)</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
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</tbody>
</table>

Percentage of Survey Participants
Post-test Survey Results

- Technical knowledge test scores

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Survey Participant Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET (n = 26)</td>
<td>[Diagram showing scores]</td>
</tr>
<tr>
<td>SMS (n = 22)</td>
<td>[Diagram showing scores]</td>
</tr>
<tr>
<td>SMS+EDU (n = 29)</td>
<td>[Diagram showing scores]</td>
</tr>
<tr>
<td>ET+EDU (n = 38)</td>
<td>[Diagram showing scores]</td>
</tr>
<tr>
<td>Comparison (n = 23)</td>
<td>[Diagram showing scores]</td>
</tr>
</tbody>
</table>

- Percent Correct
- Percent Incorrect
Satisfaction with Technology

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>SMS (n = 22)</th>
<th>ET (n = 26)</th>
<th>SMS+EDU (n = 29)</th>
<th>ET+EDU (n = 38)</th>
</tr>
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<tbody>
<tr>
<td>Very Satisfied</td>
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<tr>
<td>Satisfied</td>
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<tr>
<td>Neutral</td>
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<tr>
<td>Dissatisfied</td>
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<tr>
<td>Very Dissatisfied</td>
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<tr>
<td>No Response</td>
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</tbody>
</table>

Percentage of Survey Participants
Conclusions

• Significant decrease in irrigation by all treatments (selection of excessive irrigation customers).
• Edu tended to enhance irrigation reduction.
• Irrigation Knowledge: No difference between Edu & Non-Edu.
• Less irrigation on flatwoods applied.
Next Steps

- Change the rules associated with irrigation
- Incentives
- Longevity of the devices (Study Phase II)
Acknowledgements

Orange County Utilities Board of County Commissioners
Water Research Foundation
St. Johns River Water Management District
South Florida Water Management District
- Community Partners -
Ameriscape Management Services
Hunter’s Creek Maintenance and Landscape Department
Tailored Collaboration

Smart Irrigation Controller Demonstration and Evaluation in Orange County, Florida

You can download or order the report:

http://www.waterrf.org/Pages/Projects.aspx?PID=4227

Subject Area: Water Resources and Environmental Sustainability
Thank You

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