This presentation premiered at WaterSmart Innovations

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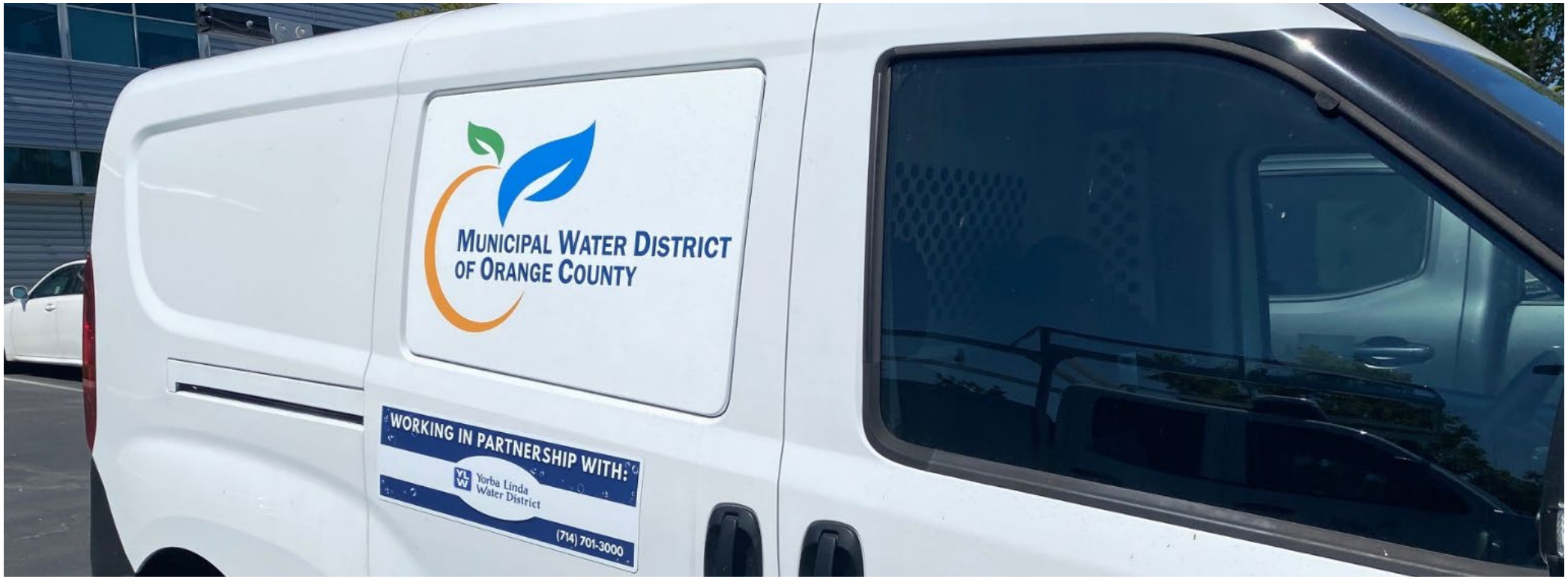


So You Want to Do Leak Detection:
Stories from Our First Year

Rachel Davis, Water Loss Control Programs Supervisor
Municipal Water District of Orange County

Kim Manago, Water Systems Optimization

October 7, 2021

Topics

01 Shared Services Background

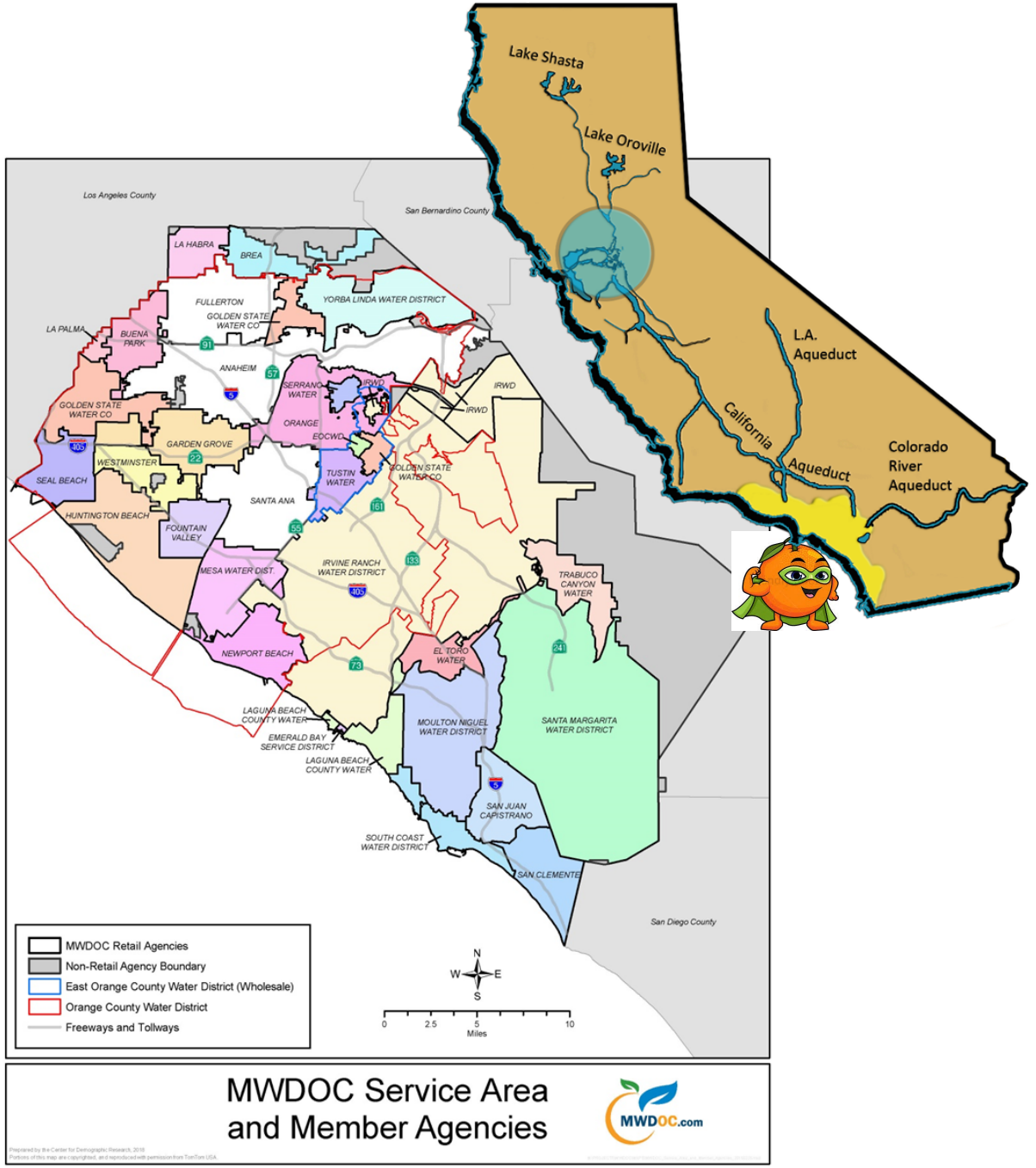
02 Leak Detection Methods

03 Leak Detection Results

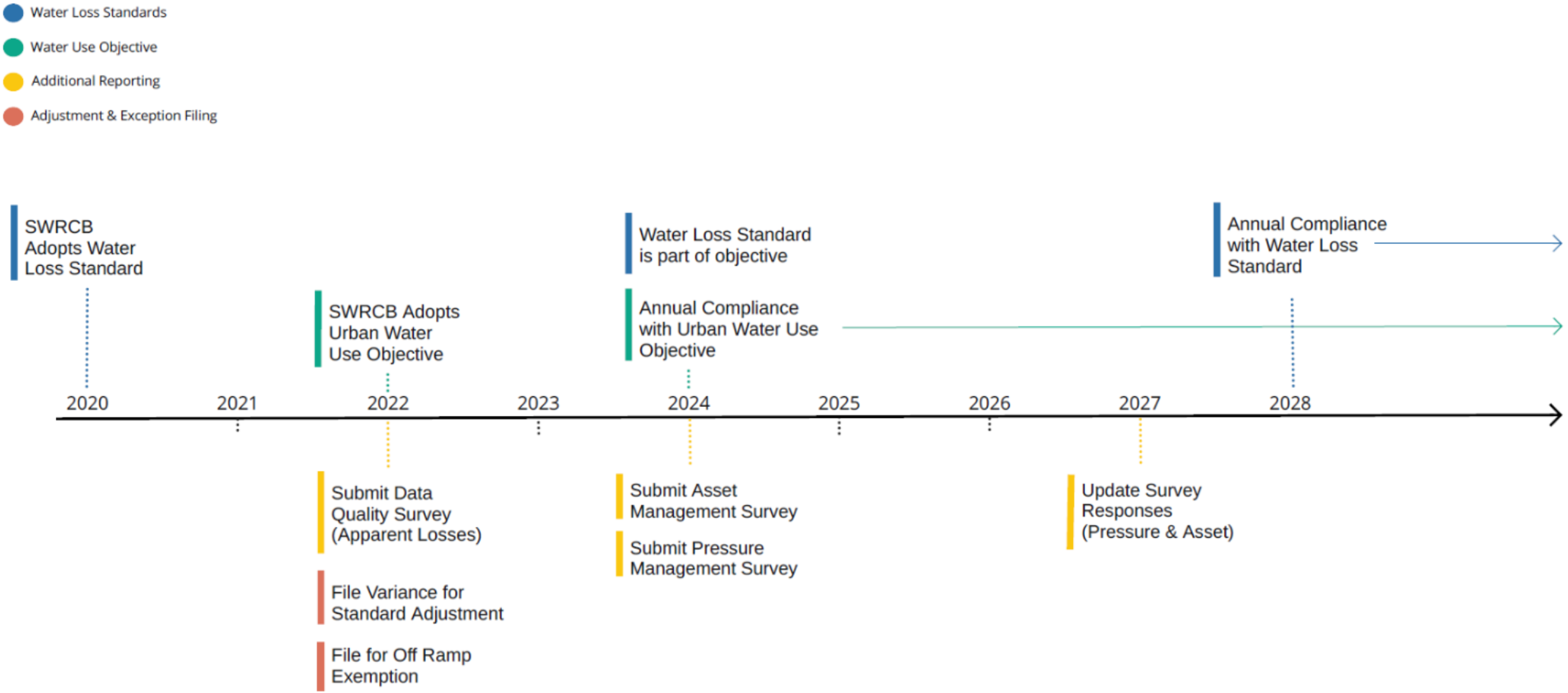
04 Looking Ahead

Who is MWDOC?

- Established in 1951
- Serves 3.2 million people and over 70 thousand businesses
- An imported water wholesaler to 28 retail agencies
  - Northern California and Colorado River
- Governed by a 7-member elected Board of Directors
- Services
  - Water Use Efficiency
  - Supply Reliability Planning
  - Governmental Affairs
  - Public Affairs & School Education
  - Water Emergency Response



Water Loss Regulation



Where We Started – Water Loss Control Program

Started in 2015 to empower Orange County agencies to:

- Comply with state water loss regulations
- Achieve cost-justified distribution efficiency
- Develop fluency in water loss analysis and management

Primary Components:

Workgroup Meetings

One-on-One Technical Assistance

The Need for Shared Services

Through the course of the Water Loss Control Work Group and Technical Assistance Programs, the need for specialized field services became apparent. MWDOC and WSO then created a formal Business Plan that included polling the Member Agencies.

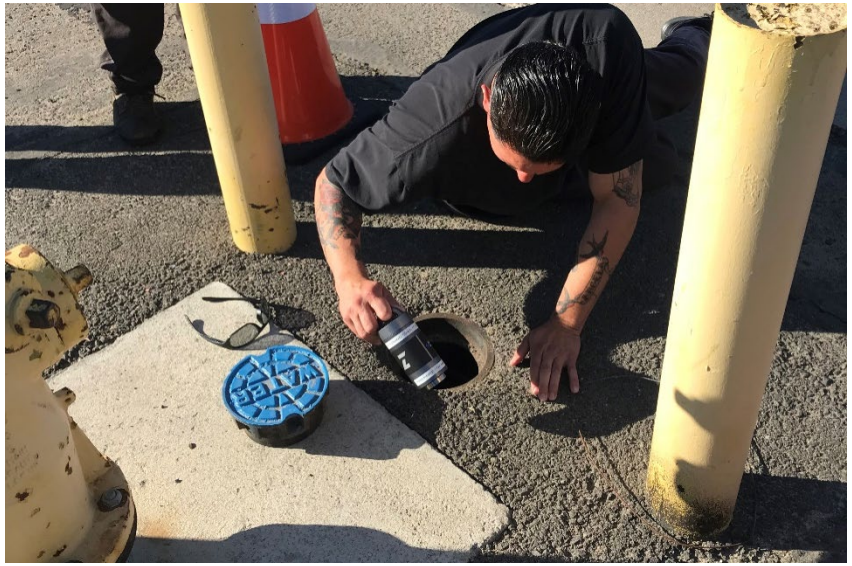
- Lending Library
- Water Audit Results
- Business Plan
  - Member Agency Survey
- Establishing a Baseline
- Innovation

Shared Services

- Task 1 – Water Audit Validation
- Task 2 – Meter Accuracy Testing
- Task 3a – Distribution System Leak Detection
- Task 3b – Suspected Leak Survey
- Task 4 – Distribution System Pressure Survey
- Task 5 – Distribution System Flushing (NO-DES)

MWDOC

Leak Detection



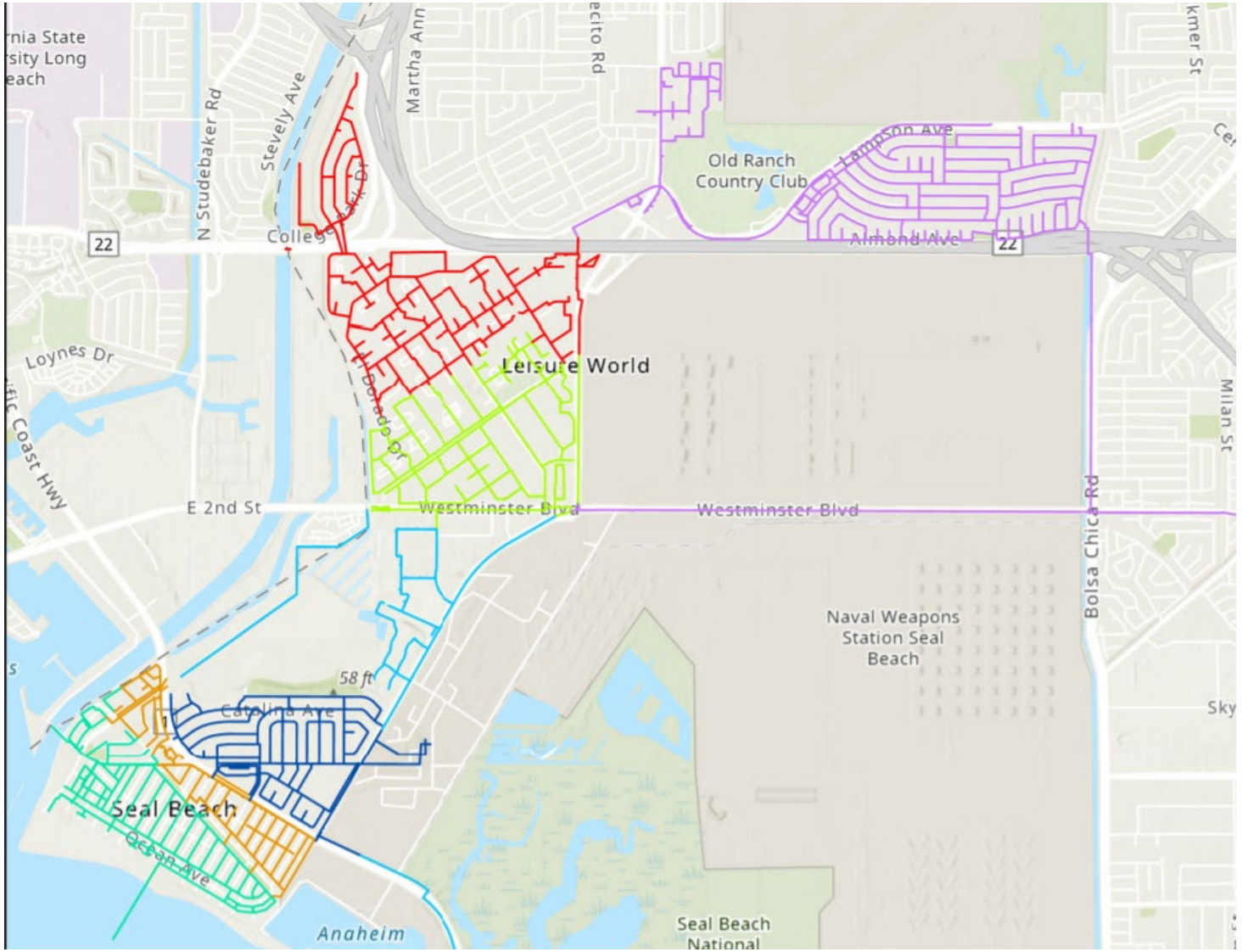
Leak Detection Process

- Prior to Survey
  - Discuss goals of survey
  - Select leak detection region
  - Go over logistics
  - Planning
- During Survey
  - Recording and tracking results
  - Confirming suspected leaks
- After Survey
  - Collecting repair information
  - Reporting

Prior to Survey

- Discuss Goals of Survey
  - Selection Criteria
- Select Leak Detection Region
  - Mileage
  - GIS Files
- Logistics
  - Schedule
  - Unique Situations
  - Signage and/or Attire
  - Special Access
  - Work Hours

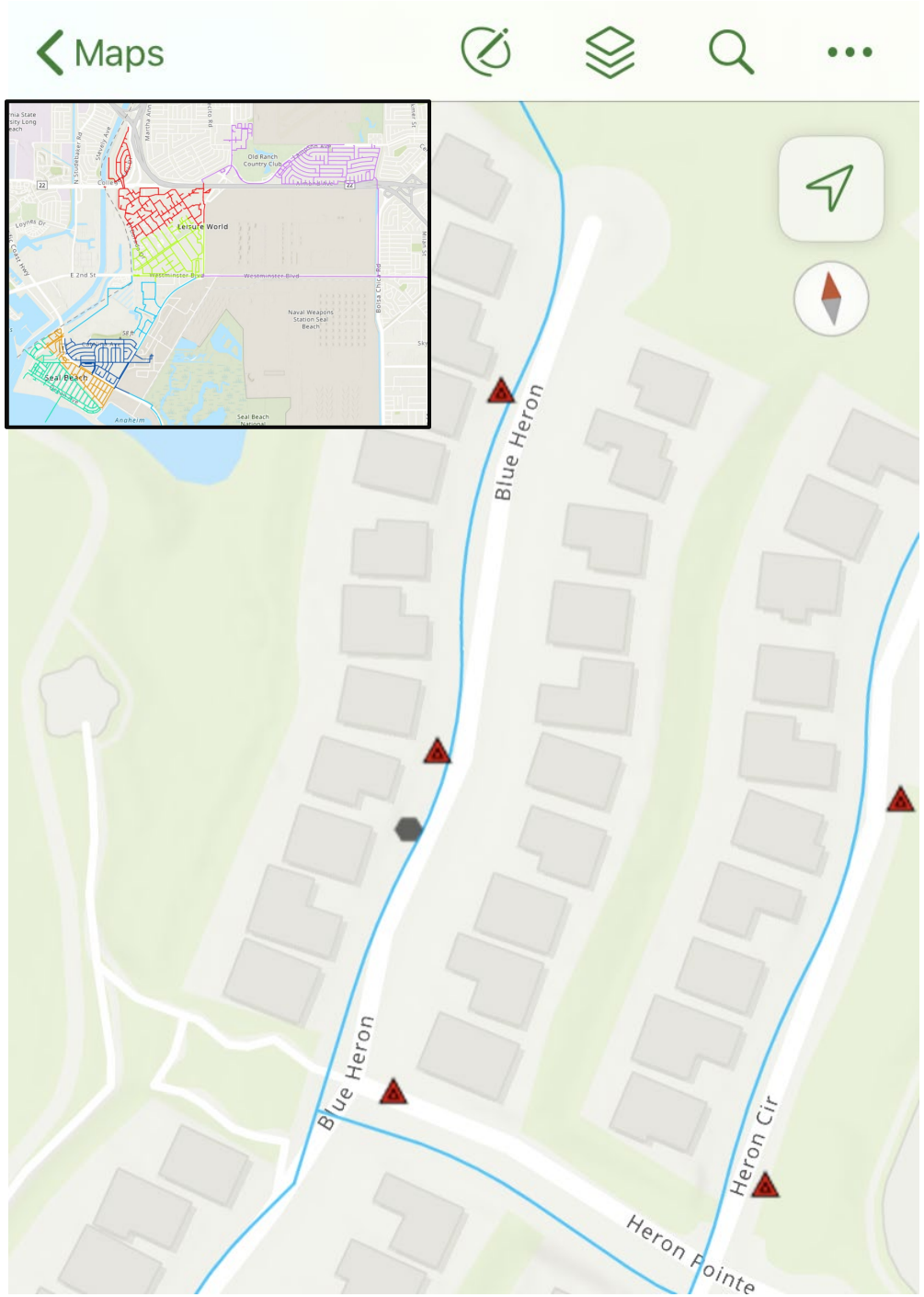
Tips:
- Select contiguous segments for leak detection
- Don't just select the leakiest areas



Planning Route

Make GIS Mobile!

- ArcGIS Explorer App
- Viewing Schedule (color code mains based on schedule)
- Locating Mains
- Important During Correlations



Tips:

- Mobile map application allows technicians to view route and potential listening locations
- Mobile map is very useful during correlations. It provides easy access to pipe size and material

During Survey

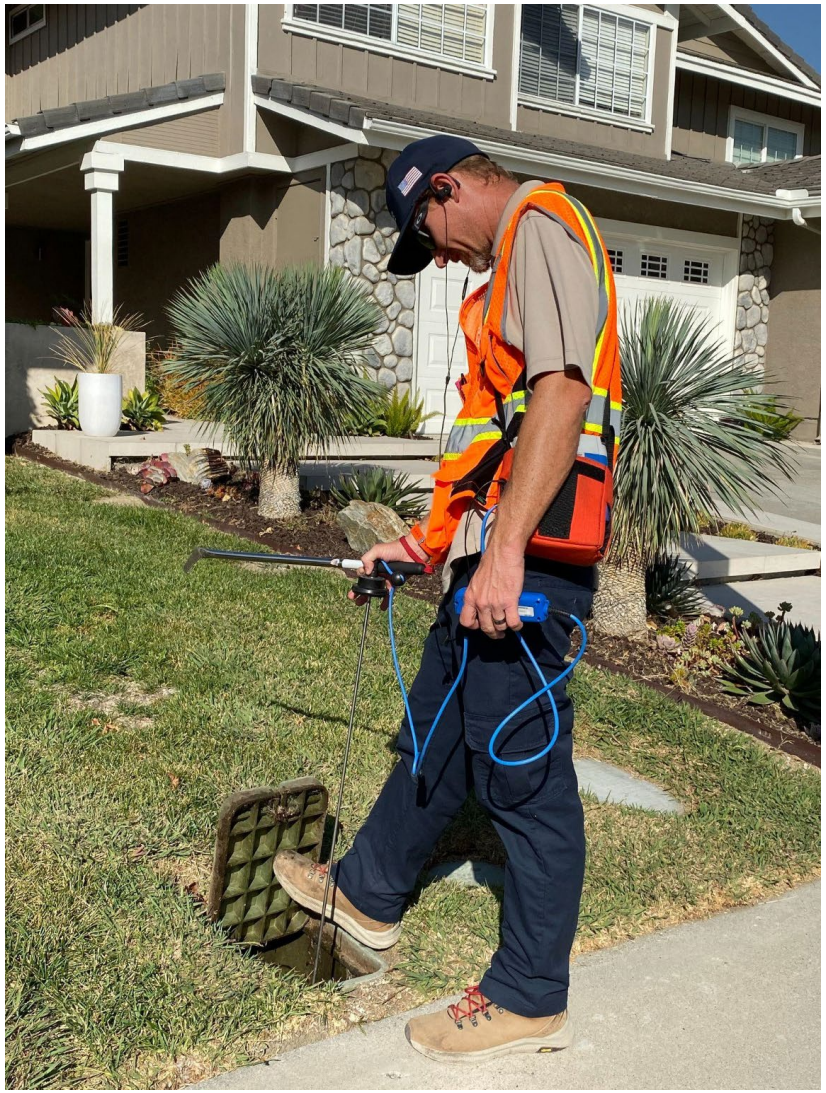
Tips:

- Proper training of leak detection technicians is key to reducing false positives and false negatives

Leak Detection Equipment

Original Equipment:
Subsurface Instruments LD-18

New Equipment: Sewerin
AquaTest T10



Service By Service

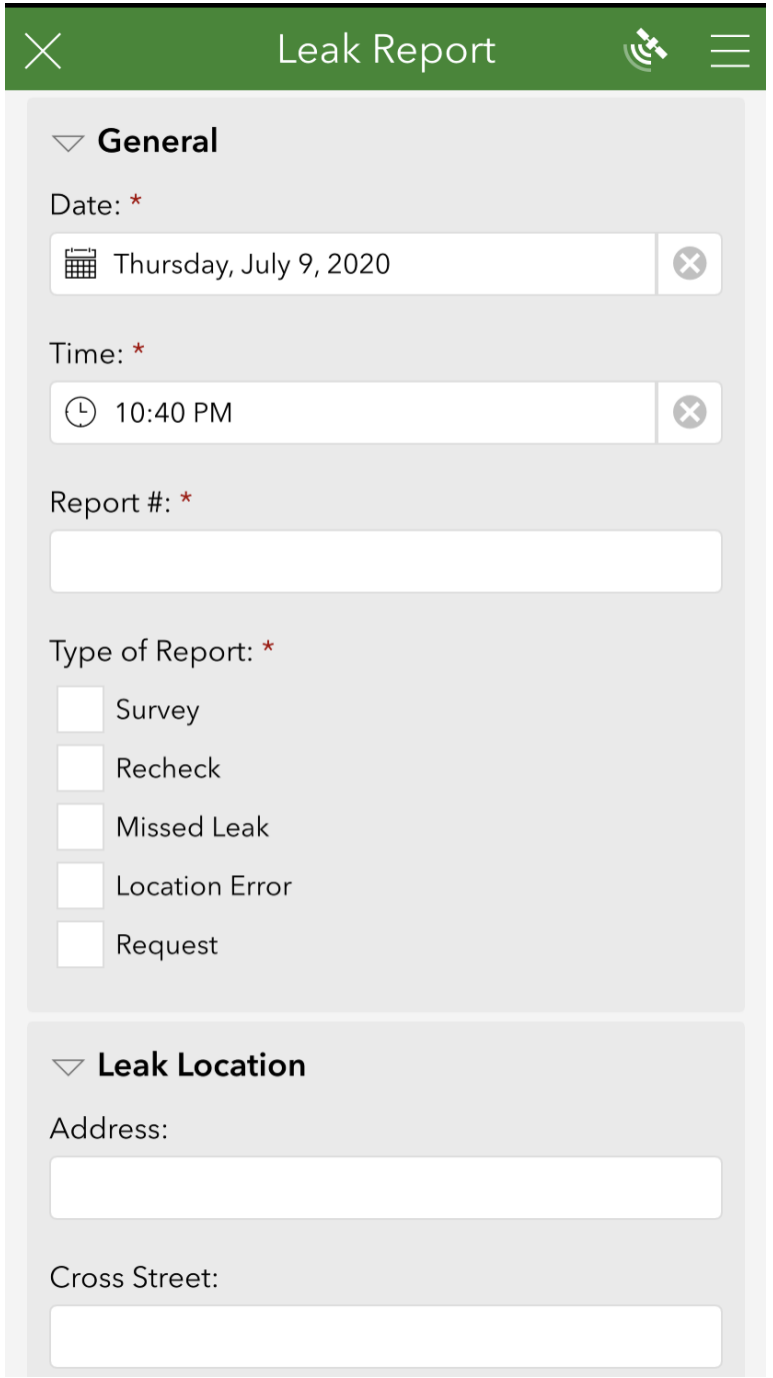
- Angle Meter Stops
- Hydrants
- Backflows
- Valves (as needed)
- Other above ground appurtenances

Tips:
- Listen to as many access points as possible to improve chances of hearing a leak

Recording and Tracking Results: Survey123

- Collect Leak Data
- Capture GPS location
- Quick Setup
- Customizable
- Mobile App

Tips:
- Mobile application streamlines documentation of suspected leaks and locations
- The more information you collect, the better!



Survey123

Leak Report

Leak Suspected On: *

- Hydrant
- Main
- Meter Connection
- AMS
- Service
- Valve
- Other

Indication of Leak: *

- Correlation
- Sonic
- Visual Water

Estimated GPM: *

Leak Location:

Please select point on map where leak detected

33°45'N 118°7'W ± 14.7 m

Leak Report

Technician Name: *

- J Thorsell
- A Blair
- Other (input in comments)

Photo:

Capture Photo/Browse to Photo 1

Note

Comments:

Does this leak report supersede an original leak report? *

- Yes
- No

Reason for superseding:

Leak Report

Leak Details

Measured GPM:

Leak Heard On:

- AMS
- Hydrant
- Valve
- Other

Priority:

- 1
- 2
- 3

Cover: *

- Asphalt
- Concrete
- Gravel
- Meter Box
- Soil

Action:

- Marked: Blue (Excavate)
- Marked: Blue (Further Action)

Leak Report

Probed Area:

- Yes
- No

Surveyed Surface:

- Yes, with a positive result
- Yes, with a negative result
- No

Pumped Out Meter Box:

- Yes
- No

Dug Out Meter:

- Yes
- No

Recommend shutting off at corp to verify that leak is on service line:

- Yes
- No

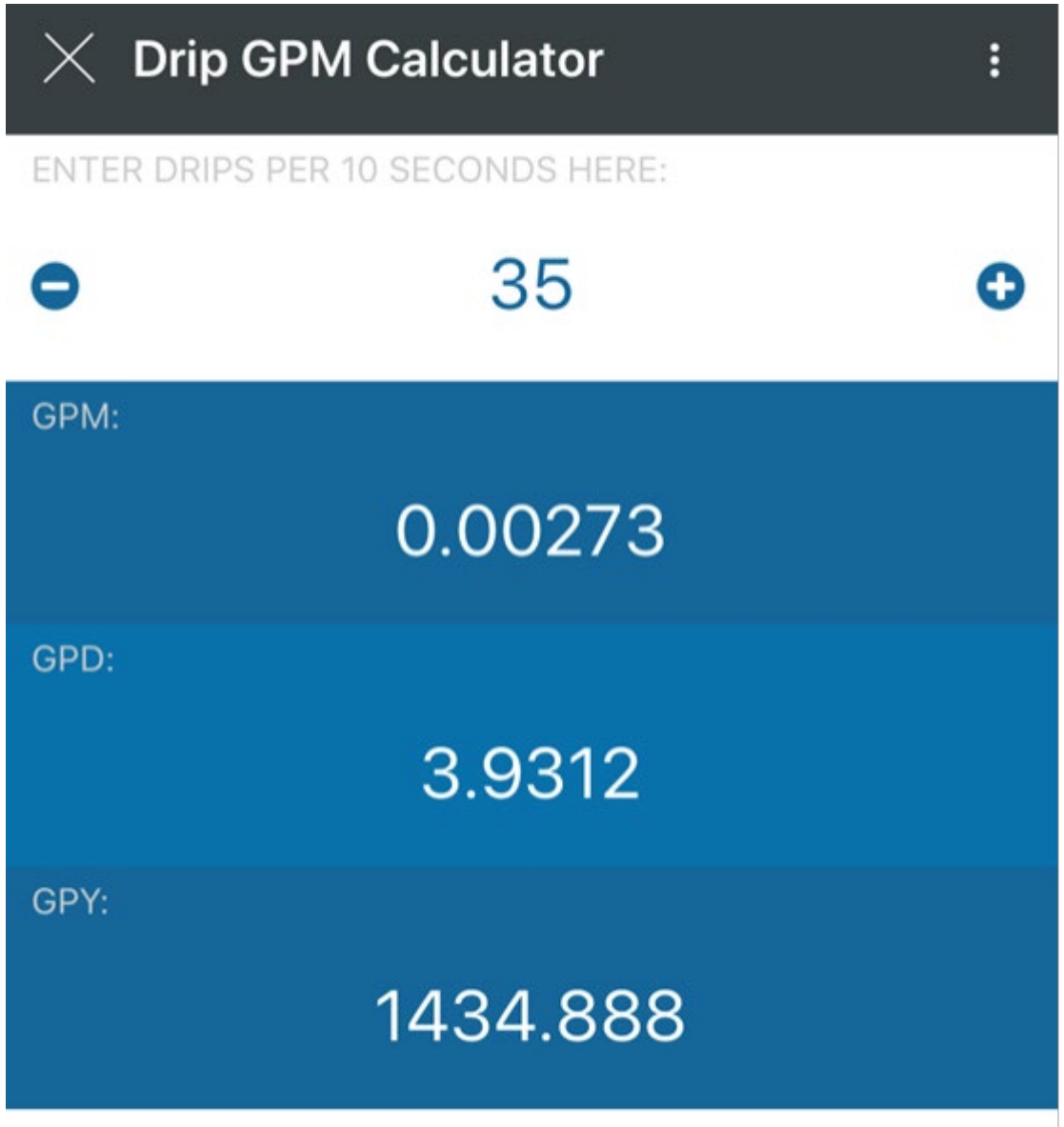
Decimal Degress Latitude

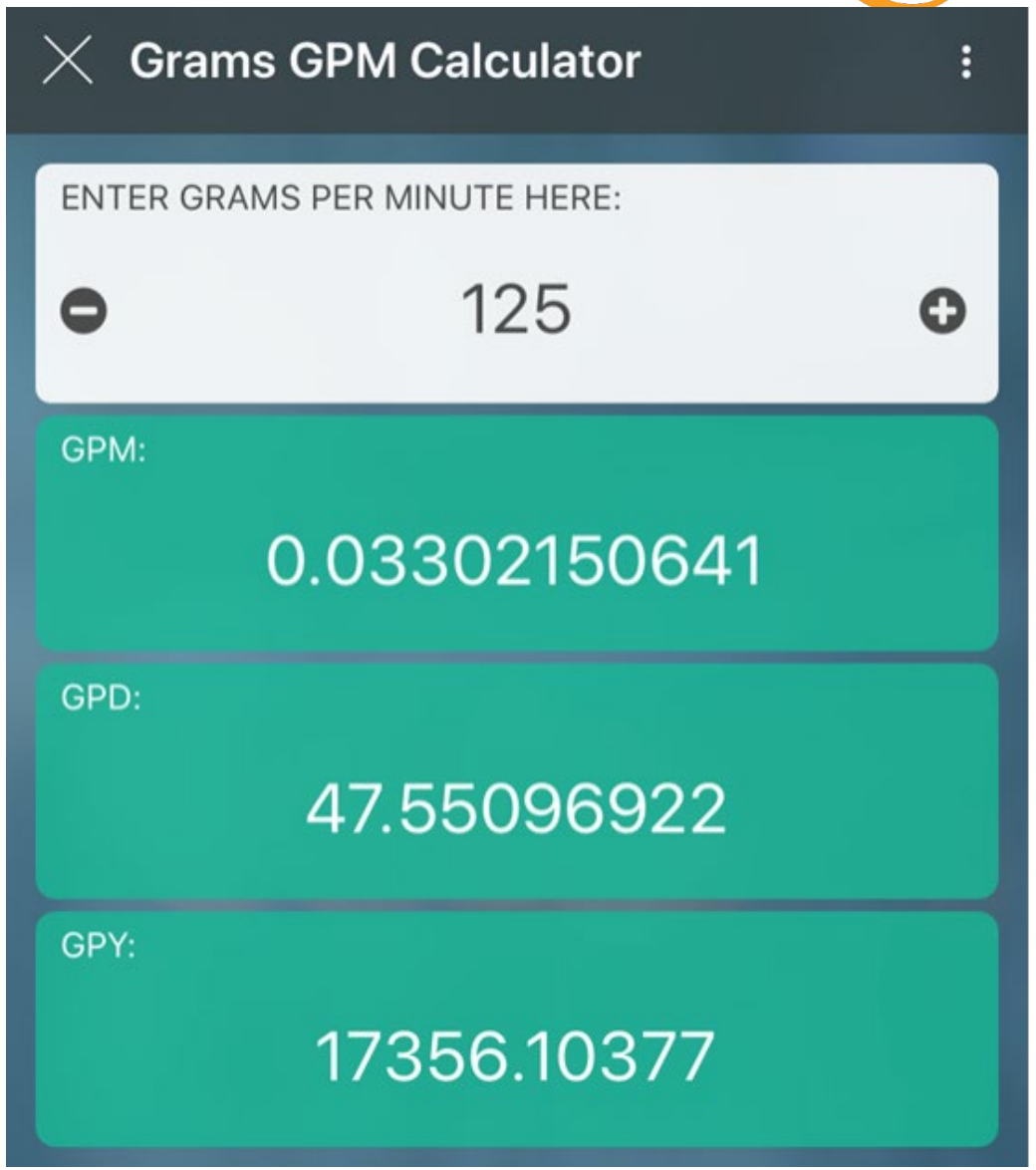
33.74734579955083

Latitude DMS

33°44'50.44 N

Our Own App??


Drip GPM Calculator
ENTER DRIPS PER 10 SECONDS HERE:
35
GPM:
0.00273
GPD:
3.9312
GPY:
1434.888


Grams GPM Calculator
ENTER GRAMS PER MINUTE HERE:
125
GPM:
0.03302150641
GPD:
47.55096922
GPY:
17356.10377

Data

- Survey123 Results
- Agency Repair Data

Tips:
- Storing data in digital, tabular format makes it easier to analyze and build upon.

Date:	Time:	Report #:	Type of Report:	Address:	Cross Street:	Leak Suspected On:	Indication of Leak:	Estimated GPM:	Leak Heard On:	Priority:	Cover:	Action:	Probed Area:	Surveyed Surface:	Pumped Out Meter Box:	Dug Out Meter:	Recommend shutting off at Corp:	Comments:	Technician Name:	Measured GPM:
5/26/2020	08:41	1	Survey			Other	Sonic	0.03125	AMS	3	MeterBox	MarkedFurtherAction	no	No	yes	yes	no	Leak coming from bottom of meter.	Jthorsell	0.038
5/26/2020	08:50	2	Survey			MeterConnection	Sonic	0.03125	AMS	3	Concrete	MarkedFurtherAction	no	No	yes	yes	no	Leak on customer side.	Ablair	0.000546
5/26/2020	11:39	3	Survey			MeterConnection	Sonic	0.03125	AMS	3	MeterBox	MarkedFurtherAction	no	No	no	no	no		Jthorsell	0.0018
5/27/2020	09:50	4	Survey			Service	Sonic	0.0625	AMS	3	MeterBox	MarkedFurtherAction	yes	YesNegativeResult	no	yes	yes	Trailer blocking service line.	Ablair	
5/27/2020	11:13	5	Survey			Service	Sonic	0.0325	AMS	3	Asphalt	MarkedFurtherAction	no	YesNegativeResult	yes	yes	yes		Jthorsell	
5/27/2020	12:32	6	Survey			Service	Sonic	0.03125	AMS	3	MeterBox	MarkedFurtherAction	no	YesNegativeResult	yes	yes	yes		Ablair	
5/28/2020	11:53	7	Survey			Service	Sonic	0.03125	AMS	3	Asphalt	MarkedFurtherAction	yes	YesNegativeResult	no	no	yes		Jthorsell	
6/1/2020	09:14	8	Survey			Other	Sonic	0.03125	AMS	3	MeterBox	MarkedFurtherAction	yes	No	no	yes	no	Leak at meter.	Ablair	0.00499
6/1/2020	12:58	9	Survey			AMS	Sonic	0.0625	AMS	3	MeterBox	MarkedFurtherAction	no	No	yes	yes	no		Ablair	0.0039
6/1/2020	13:14	10	Survey			Service	Sonic	0.0625	AMS	3	Asphalt	MarkedFurtherAction	no	YesNegativeResult	no	no	yes		Jthorsell	
6/1/2020	13:16	11	Survey			AMS,MeterConnection	Sonic	0.0625	AMS	3	MeterBox	MarkedFurtherAction	no	No	yes	yes	no		Ablair	0.0272
6/1/2020	13:20	12	Survey			Service	Sonic	0.03125	AMS	3	MeterBox	MarkedFurtherAction	no	YesNegativeResult	yes	yes	yes		Ablair	
6/1/2020	13:39	13	Survey			Service	Sonic	0.0325	AMS	3	MeterBox	MarkedFurtherAction	no	YesNegativeResult	yes	yes	yes		Ablair	
6/1/2020	13:52	14	Survey			Service	Sonic	0.03125	AMS	3	MeterBox	MarkedFurtherAction	yes	YesNegativeResult	no	no	yes		Ablair	
6/2/2020	09:03	15	Survey			AMS	Sonic	0.06125	AMS	3	MeterBox	MarkedFurtherAction	no	No	yes	yes	no		Jthorsell	0.011

Even More Data

- Survey123 Results
- Agency Repair Data

Tips:

- Collecting information on repair of the leak enhances analyses and can improve leak detection technician's technique (less false positives!)
- Collecting repair costs improves cost-benefit analysis however, it is difficult for many agencies to provide

FIELD DATA COLLECTION FORM

LEAK REPAIR

Leak Address:	Was a leak found: ☐ Yes ☐ No
Leak on: ☐ Main ☐ Service ☐ Meter	Job Foreman/Supervisor:
Job start time:	Job end time:
Service Material: ☐ Copper ☐ Plastic ☐ Other:_____	Main Material: ☐ AC ☐ DI ☐ CI ☐ Other:_____
Date of Repair:	Measured Leak Flow Rate (GPM):
Was a Contractor Used: ☐ Yes ☐ No	Repair Method:

Comments:

After Survey – Phase 1 Reporting

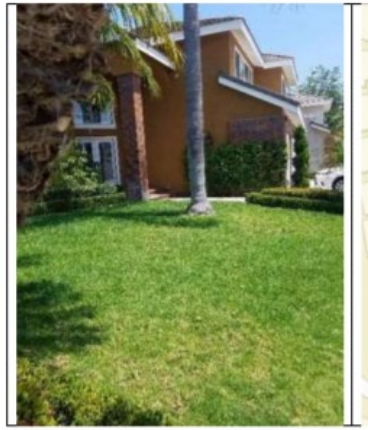
LEAK REPORT

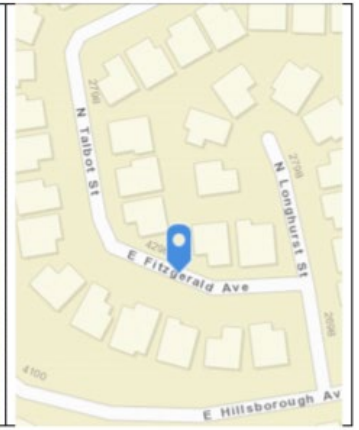
Date: Apr 30, 2020 **Report #: 1**

Survey ☑ Recheck ☐ Location Error ☐ Request ☐

LOCATION	LEAK SUSPECTED ON:	INDICATION OF LEAK:
Address: 4231 Fitzgerald *Cross Street: Longhurst* *Coordinates: 33.8340191299994, -117.808671349998*	*Leak Suspected On: Meter Connection* *Leak Heard from: AMS*	*Leak Indication: Sonic*

DETAILS	
ESTIMATED (GPM): 0.0625 MEASURED (GPM): 0.0554	PRIORITY: 3
LEAK COVER: Meter Box	ACTION: Marked: Blue (Further Action)





Comments:

Actions Taken: Probed Area: No Surveyed Surface: No Pumped Out Meter Box: Yes Dug Out Meter: Yes	Recommend Shutting Service Off at Corp Verify That Leak is on Service Line: No Retest: No Technician: J Thorsell

LEAK REPORT

Date: May 15, 2020 **Report #: 6**

Survey ☑ Recheck ☐ Location Error ☐ Request ☐

LOCATION	LEAK SUSPECTED ON:	INDICATION OF LEAK:
Address: 3105 Harbor *Cross Street: Nutmeg Pl.* *Coordinates: 33.6825235699994, -117.919558889998*	*Leak Suspected On: Other* *Leak Heard from: Other*	*Leak Indication: Sonic, Visual Water*

DETAILS	
ESTIMATED (GPM): 0.06125 MEASURED (GPM): 0.106	PRIORITY: 3
LEAK COVER: Soil	ACTION: Unmarked: (Comments)

Comments: Leak on backflow device in between Sonic Burger and Auto Zone.

Actions Taken: Probed Area: Surveyed Surface: No Pumped Out Meter Box: No Dug Out Meter: No	Recommend Shutting Service Off at Corp Verify That Leak is on Service Line: No Retest: No Technician: J Thorsell

Tips:

- Detailed reporting on suspected leak locations (including photos) will make it easier for agencies to find the suspected leak.

After Survey: Agency Repair Data

MWDOC requests repair information from agencies to confirm suspected leak and document leakage flow rate

FIELD DATA COLLECTION FORM

LEAK REPAIR

Leak Report Number: _____

Leak Address:	Was a leak found: ☐ Yes ☐ No
Leak on: ☐ Main ☐ Service ☐ Meter	Job Foreman/Supervisor:
Job start time:	Job end time:
Service Material: ☐ Copper ☐ Plastic ☐ Other:_____	Main Material: ☐ AC ☐ DI ☐ CI ☐ Other:_____
Date of Repair:	Measured Leak Flow Rate (GPM):
Was a Contractor Used: ☐ Yes ☐ No	Repair Method:

Comments:

Tips:

- Repair data collection is just as important as survey data collection!

Survey Summary

Year	Count of Surveys	Miles Surveyed
FY19-20	9	570.5
FY20-21	10	601.0
Total	**19**	**1,171.5**

Survey Findings

Total Number of Surveys: 19
Total Savings: $346,064 / year
(based on avoided MWD water purchases $1,078/AF)

System	Year	Miles Surveyed	Count of Leaks Found*	Leak Rate (gpm)	MG/Year	AF/Year	Leaks/Mile	Miles/Leak
E	FY19-20	83	82	14	7.2	22.2	1.0	1.0
G	FY20-21	20	17	5	2.5	7.7	0.9	1.2
H	FY20-21	29	23	8	4.3	13.2	0.8	1.3
O	FY20-21	61	39	12	6.6	20.1	0.6	1.6
Q	FY20-21	53	32	1	0.7	2.1	0.6	1.7
K	FY19-20	102	56	113	59.2	181.7	0.5	1.8
D	FY19-20	36	19	2	0.9	2.6	0.5	1.9
C	FY19-20	24	12	0	0.2	0.5	0.5	2.0
R	FY20-21	39	17	0	0.2	0.6	0.4	2.3
A	FY19-20	30	10	1	0.3	1.0	0.3	3.0
L	FY20-21	79	26	6	3.0	9.3	0.3	3.0
I	FY19-20	75	23	1	0.4	1.4	0.3	3.3
T	FY20-21	10	3	0	0.0	0.1	0.3	3.3
M	FY20-21	110	31	2	0.9	2.6	0.3	3.5
J	FY19-20	66	18	4	2.3	7.2	0.3	3.7
B	FY19-20	110	21	6	3.3	10.1	0.2	5.2
F	FY19-20	45	8	1	0.7	2.1	0.2	5.6
N	FY20-21	127	22	16	8.4	25.9	0.2	5.8
S	FY20-21	73	11	7	3.5	10.6	0.2	6.6
		1,172	470	199	105	321	0.4	2.5

**Does not include customer-side leaks*

Findings (cont.)

	Main	Service	Meter
Count	9	169	279
Average Estimated GPM	6.5 (n=9)	0.8 (n=106)	0.20 (n=65)
Average Measured GPM	n/a	0.3 (n=63)	0.05 (n=214)

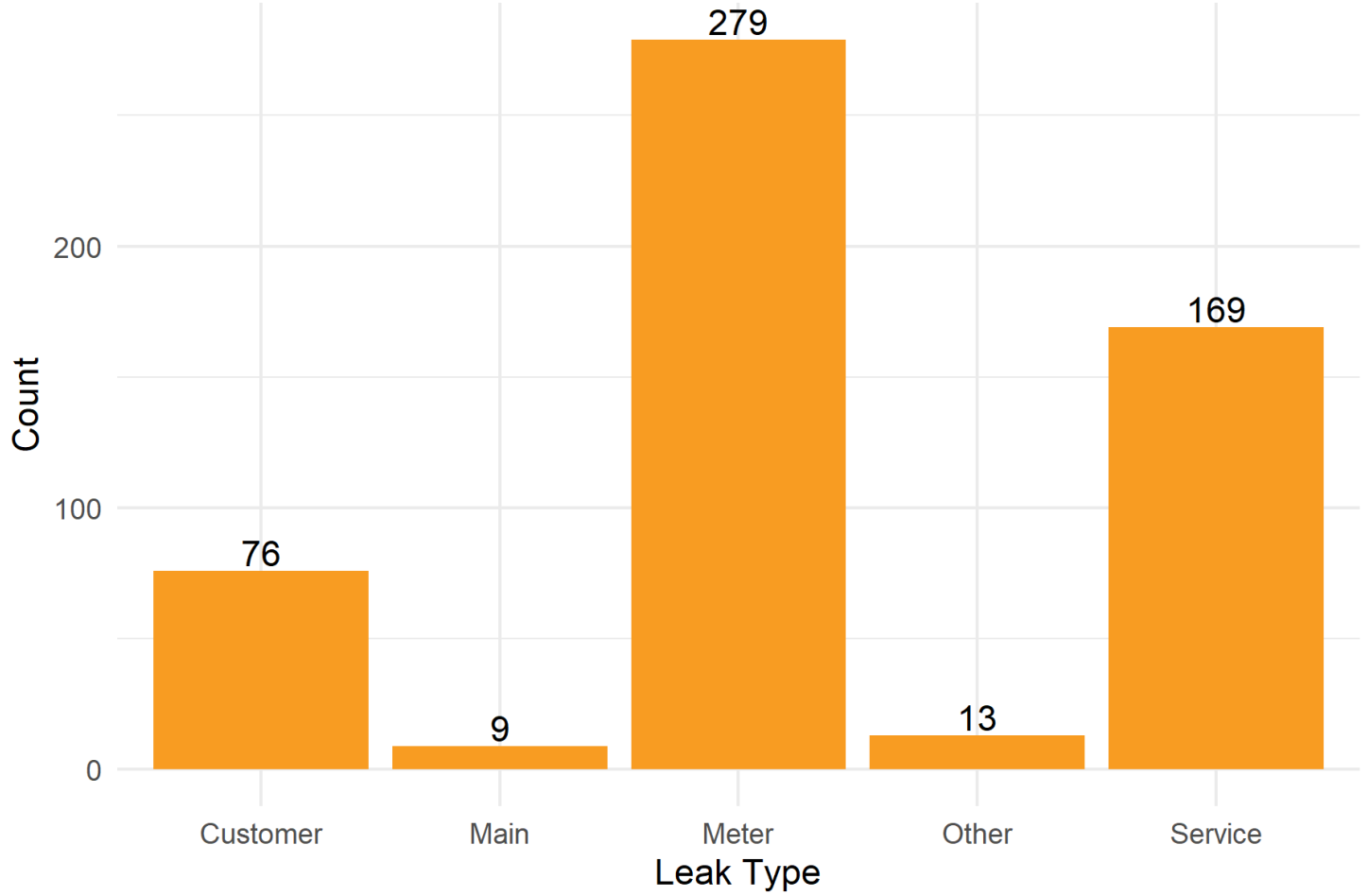
Lessons Learned:

- Meter and service leaks had lower flow rates than expected
- Repair techniques differ from agency to agency, making it difficult to standardize measurement of leakage rates. Training on measurement technique is necessary
- Measuring leakage flow rates is difficult and new creative techniques are necessary

MWDOC

Types of Leaks

Lessons Learned:
- Majority of leaks are found on meter and service connections



Main	Meter	Other	Service
2%	59%	3%	36%

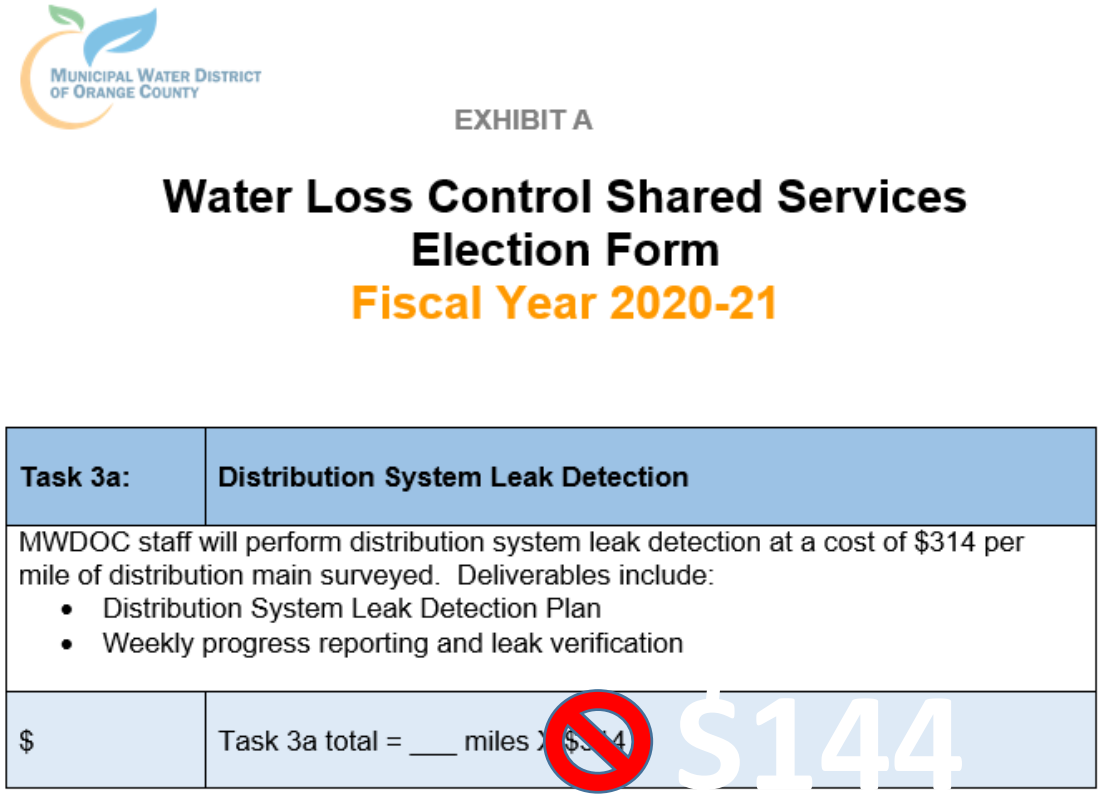
Types of Leaks

	Main	Meter	Other	Service
Count of Leaks Found	9	279	13	169
MG/Year	30	12	5	57
AF/Year	94	37	16	174
Money Saved ($/Year)	$100,886	$40,357	$17,234	$187,587

Looking Ahead

Funding

- Met MAA Funding
- Met Permanent Rebate
- Grant Funding



Municipal Water District of Orange County

EXHIBIT A

Water Loss Control Shared Services Election Form

Fiscal Year 2020-21

Task 3a:	**Distribution System Leak Detection**
MWDOC staff will perform distribution system leak detection at a cost of $314 per mile of distribution main surveyed. Deliverables include: • Distribution System Leak Detection Plan • Weekly progress reporting and leak verification	
$	Task 3a total = ___ miles X $314

Phase 2 Reporting

- Calculated Water Savings
  - Based on measured leak rates
- Payoff Period
- Cost benefit analysis
- Inputs to State Economic Model
- When repair data is available
- And More!

4.5.2 *Payback Period*

Assuming the marginal cost of water and leak flow rates remain constant over the next twenty years, the cost of the leak detection survey has a payback time of [payback time] as shown in Table 11.

Item	Value
Leak Detection Miles Surveyed	
Cost of Leak Detection per Mile	
Total Cost of Leak Detection	
Cost of Repair	
Discount Rate	
Annual Savings (At Marginal Cost of Water)	
Simple Payback Time (Years)	

Table 11: Cost-Effectiveness of Leak Detection at Marginal Cost of Water

Key Lessons Learned

- Proper **training** of leak detection staff takes time and is critical to the success of a leak detection program
- Development of a suspected leak database to **track** findings and results allows for ease of reporting and analysis
- Its very difficult to **measure** the flow rate of leaks
  - New creative techniques are needed

Thank you for your attention.
Please let us know if you have questions.

Rachel Davis

Water Loss Control Programs Supervisor

Direct: (714) 593-5038

Email: rdavis@mwdoc.com

Kim Manago

WSO Project Manager & Analyst

Direct: (808) 640-0658

Email: kim.manago@wso.us

MWDOC MUNICIPAL WATER DISTRICT OF ORANGE COUNTY