



WATER LOSS IMPACTS

**OPERATIONAL & FINANCIAL CONSEQUENCES OF UNACCOUNTED-FOR
WATER**

FRED HANDY FRWA DW CIRCUIT RIDER

PATRICK DANGELO, FRWA ASSET MANAGEMENT CIRCUIT RIDER



OVERVIEW

- WHY WATER LOSS MATTERS
 - WATER AUDITS & UFW
 - LEAK DETECTION EQUIPMENT
 - FINDING WATER LOSS
 - TAYLOR COASTAL CASE STUDY
 - LESSONS LEARNED
- 



Real Losses: leaks,
breaks, overflows



Apparent Losses:
meter errors, billing
issues



Every gallon lost was
pumped, treated, and
distributed

WHAT IS WATER LOSS?

WATER LOSS AND UTILITY RATES

- HIGHER POWER COSTS
- HIGHER CHEMICAL COSTS
- INCREASED LABOR
- REDUCED REVENUE RECOVERY
- PRESSURE FOR FUTURE RATE INCREASES

HIDDEN COSTS OF WATER LOSS

- OPERATIONAL: EQUIPMENT WEAR, OVERTIME, EMERGENCY REPAIRS
- FINANCIAL: REDUCED RESERVES, DEFERRED PROJECTS, HIGHER O&M

UNDERSTANDING UNACCOUNTED-FOR WATER

- $\text{WATER PRODUCED} - \text{WATER SOLD} = \text{UNACCOUNTED-FOR WATER}$
- EXAMPLE: $100 \text{ MG PRODUCED} - 75 \text{ MG SOLD} = 25\% \text{ UFW}$
- EXCLUDES WATER USED FOR FLUSHING AND WATER LINE BREAKS

WATER AUDITS

- ESTABLISH A BASELINE
- IDENTIFY TRENDS
- PRIORITIZE INVESTIGATIONS
- SUPPORT FUNDING AND PLANNING

LIKELY CAUSES OF WATER LOSS

- OLDER WATER METERS
- ACCOUNTING / READING ERRORS
- WATER LINE BREAKS
- FLUSHING

HIDDEN CAUSES OF WATER LOSS

- FIRE DEPARTMENT / TRUCKS
- ILLEGAL WATER CONNECTIONS
- STUCK METERS
- WATER DEPARTMENT DAILY ACTIVITIES
- CONTRACTORS / UNAUTHORIZED USAGE OF HYDRANTS
- BYPASS VALVING



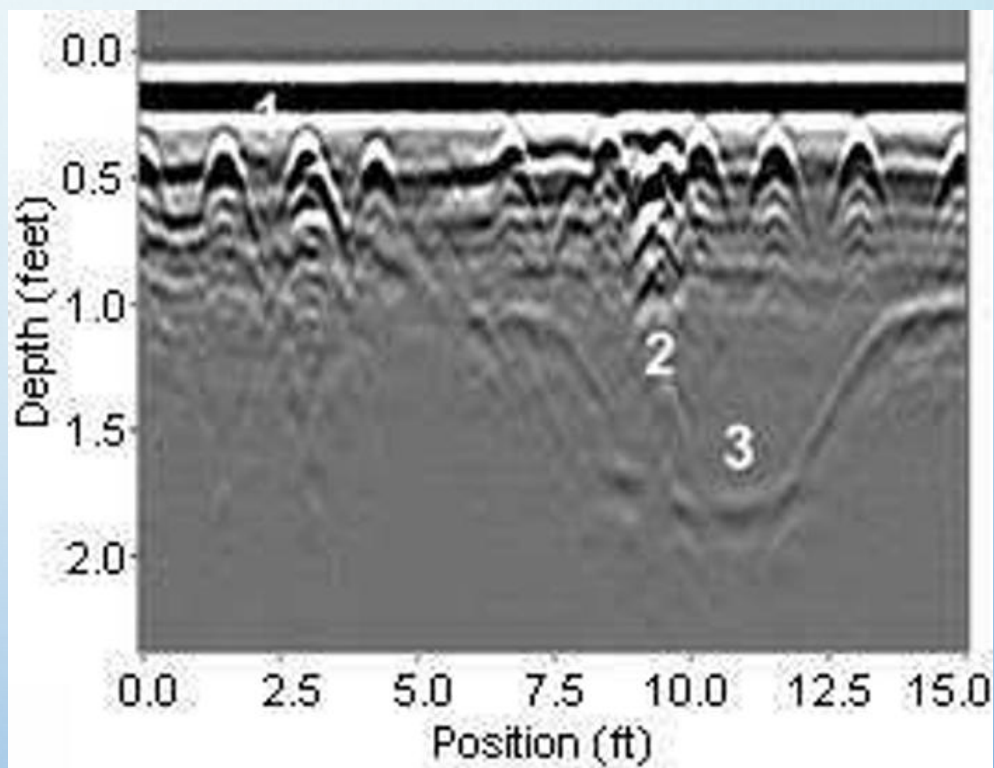
LEAK DETECTION OVERVIEW AND EQUIPMENT

- SYSTEM KNOWLEDGE
- GIS
- FLOW MONITORING
- ACOUSTIC TOOLS
- FIELD INVESTIGATION



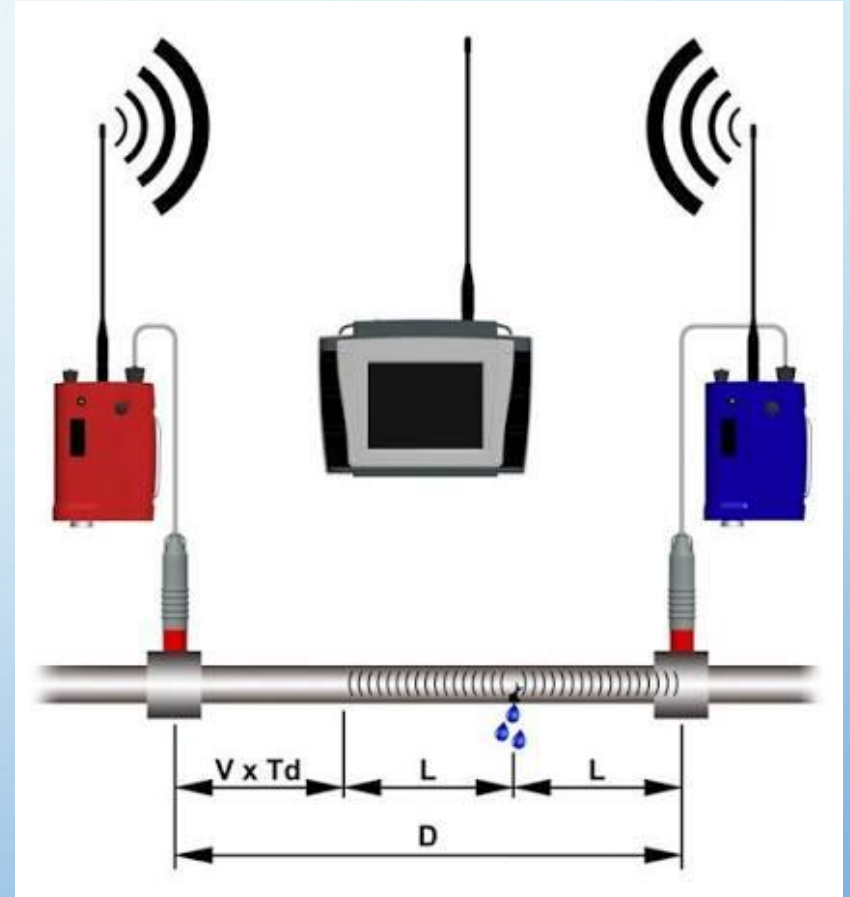
GROUND PENETRATING RADAR (GPR)

- LOCATE BURIED UTILITIES
- IDENTIFY VOIDS AND ANOMALIES
- ADVANTAGES AND LIMITATIONS



LEAK CORRELATORS

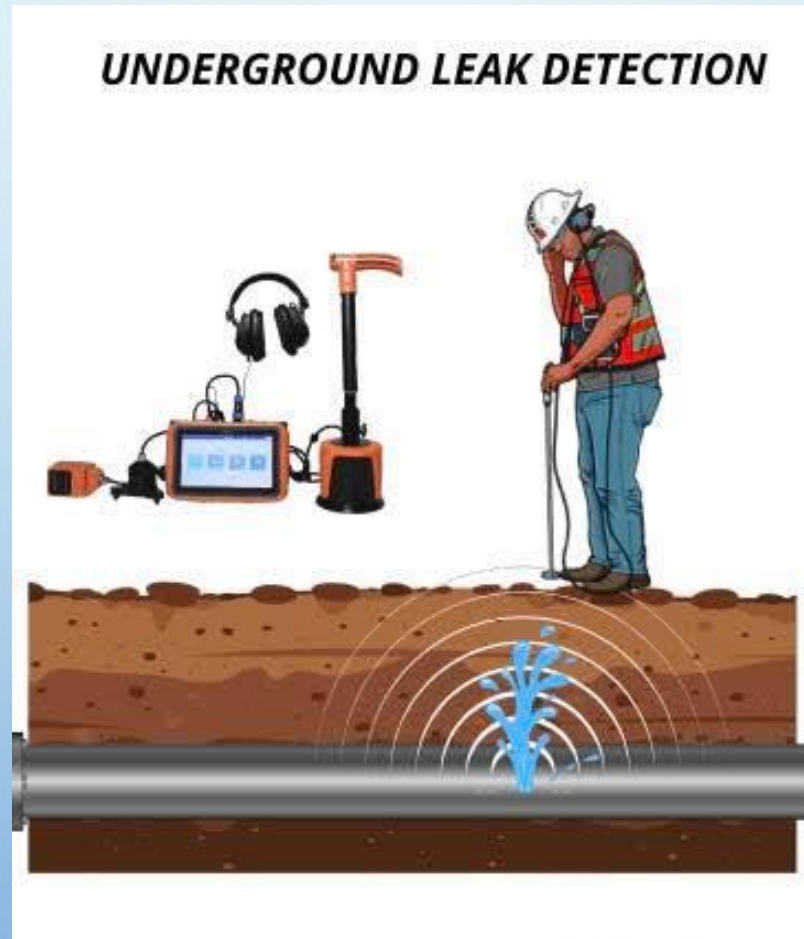
- SENSORS DETECT LEAK NOISE
- SOFTWARE CALCULATES LOCATION
- EFFECTIVE ON TRANSMISSION MAINS



ACOUSTIC LISTENING DEVICES

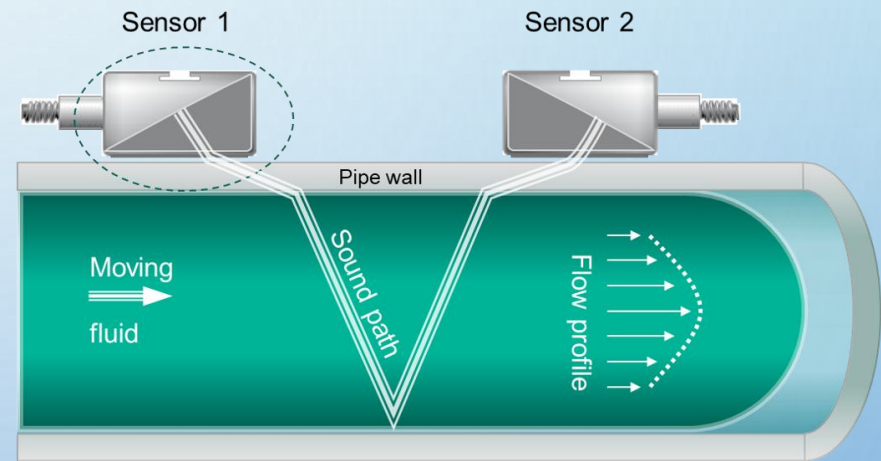
- GROUND MICROPHONES
- LISTENING STICKS
- PINPOINT LEAK SOUNDS

ACOUSTIC LISTENING DEVICES



ULTRASONIC FLOW METERS

- TEMPORARY FLOW MONITORING
- VERIFY MASTER METERS
- ASSIST WITH LEAK ISOLATION



GIS EQUIPMENT

- GPS RECEIVERS
- TABLETS
- MOBILE MAPPING
- ASSET VERIFICATION

DIAMOND MAPS

- ASSET INVENTORY
- VALVE LOCATIONS
- WORK ORDERS
- LEAK TRACKING

METHODS USED FOR LEAK DETECTION

COMPARING WATER PRODUCED VS SOLD

- TRACK MONTHLY TRENDS AND INVESTIGATE GROWING GAPS

DISTRICT METERING AREAS

- USE MASTER METERS TO NARROW LEAK SEARCHES

VALVE ISOLATION TECHNIQUES

- IDENTIFY AREA
- CLOSE VALVES
- MONITOR FLOWS
- NARROW SEARCH AREA
- CONFIRM LEAK

TAYLOR COASTAL LEAK DETECTION OVERVIEW

- IDENTIFY AREA
- CLOSE VALVES
- MONITOR FLOWS
- NARROW SEARCH AREA
- CONFIRM LEAK

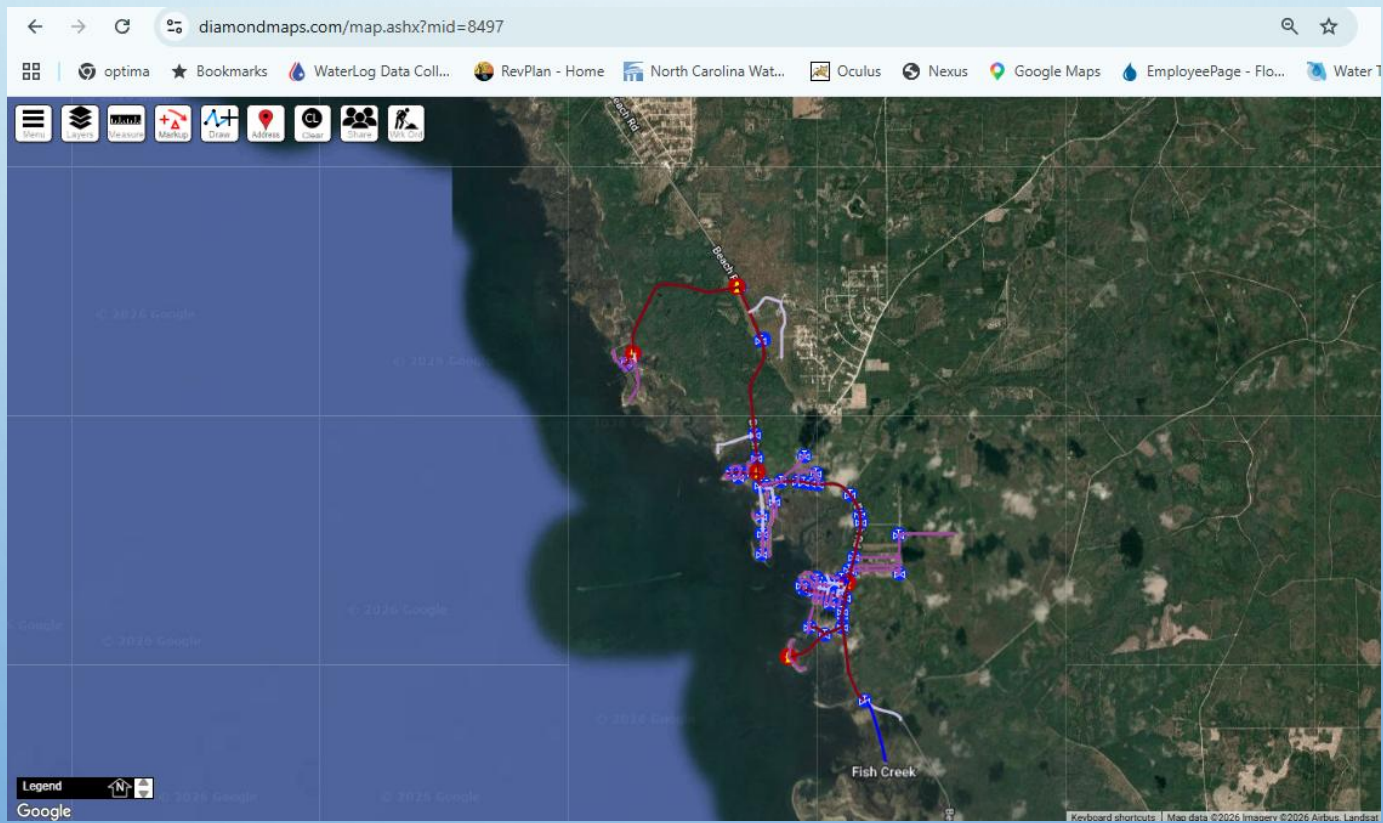
TAYLOR COASTAL BACKGROUND

- STAFF SUSPECTED A SIGNIFICANT LEAK. FRWA PROMPTLY PROVIDED ASSISTANCE TO LOCATE THE LEAK.

INITIAL INVESTIGATION

- REVIEWED DIAMOND MAPS, SYSTEM LAYOUT, PRODUCTION HISTORY, AND MASTER METER LOCATIONS.

Diamond Maps



IDENTIFYING THE PROBLEM AREA

- FOUR MASTER METERS USED. CEDAR ISLAND SHOWED APPROXIMATELY 80 GPM CONTINUOUS FLOW.

LEAK ISOLATION PROCESS

- DIAMOND MAPS + FLOW METER + GPS + MAGNETIC LOCATOR + VALVE ISOLATION

LOCATING THE LEAK

- 2-INCH WATER MAIN LEAK IN A REMOTE UNDEVELOPED AREA.



WATER LOSS IMPACT

- 80 GPM
- 115,200 GALLONS/DAY
- 61 DAYS
- ~7 MILLION GALLONS LOST

WATER LOSS IMPACT

Leak Rate	125,000 gallons/day
Duration	61 days
Total Water Lost	7,625,000 gallons
Water Revenue Not Generated	≈ \$56,206

PRODUCTION BEFORE REPAIR

- 115,000–175,000
- GPD DURING LEAK PERIOD

Day of the Month	by Operator (Place "X")	Hours Plant in Operation	Net Quantity of Finished Water Produced, gal.	Concentration at End of Disinfection Segment 1, mg/L	Concentration at End of Disinfection Segment 2, mg/L
1	X	24	135,000	1.8	1.8
2	X	24	158,000	2.0	2.0
3	X	24	148,000	2.0	2.0
4	X	24	104,000	1.20	1.20
5	X	24	135,000	2.60	2.60
6	X	24	124,000	2.4	2.4
7	X	24	126,000	2.8	2.8
8	X	24	119,000	3.0	3.0
9	X	24	126,000	3.2	3.2
10	X	24	169,000	3.0	3.0
11	X	24	82,000	3.0	3.0
12	X	24	125,000	2.6	2.6
13	X	24	125,000	3.2	3.2
14	X	24	130,000	3.0	3.0
15	X	24	128,000	3.4	3.4
16	X	24	140,000	2.8	2.8
17	X	24	155,000	2.6	2.6
18	X	24	159,000	2.4	2.4
19	X	24	136,000	2.2	2.2
20	X	24	130,000	2.2	2.2
21	X	24	135,000	1.8	1.8
22	X	24	132,000	2.0	2.0
23	X	24	144,000	4.5	4.5
24	X	24	129,000	1.8	1.8
25	X	24	139,000	2.0	2.0
26	X	24	21,000	1.4	1.4
27	X	24	136,000	1.8	1.8
28	X	24	141,000	2.2	2.2
29	X	24	144,000	2.0	2.0
30	X	24	160,000	1.8	1.8
31	X	24	172,000	1.8	1.8
Total			4,115,000		
Average			132,000		

PRODUCTION AFTER REPAIR

- APPROXIMATELY 27,000 GPD
- AFTER LEAK ISOLATION

Day of the Month	or Visited by Operator (Place "X")	Hours Plant in Operation	Net Quantity of Finished Water Produced, gal	Lowest Residual Disinfectant Concentration at End of Disinfection Segment 1, mg/l	Lowest Residual Disinfectant Concentration at End of Disinfection Segment 2, mg/l
1	X	24	29,000	1.80	1.80
2	X	24	31,000	2.60	2.60
3	X	24	27,000	2.20	2.20
4	X	24	32,000	2.00	2.00
5	X	24	35,000	2.40	2.40
6	X	24	23,000	2.00	2.00
7	X	24	31,000	1.80	1.80
8	X	24	34,000	1.80	1.80
9	X	24	33,000	1.60	1.60
10	X	24	32,000	1.40	1.40
11	X	24	30,000	2.40	2.40
12	X	24	29,000	2.40	2.40
13	X	24	22,000	2.40	2.40
14	X	24	30,000	2.00	2.00
15	X	24	33,000	1.80	1.80
16	X	24	31,000	1.80	1.60
17	X	24	33,000	2.00	2.00
18	X	24	32,000	1.80	1.80
19	X	24	49,000	1.40	1.40
20	X	24	13,000	2.00	2.00
21	X	24	31,000	1.60	1.60
22	X	24	32,000	2.40	2.40
23	X	24	33,000	2.40	2.40
24	X	24	34,000	1.20	1.20
25	X	24	69,000	3.20	3.20
26	X	24	59,000	2.60	2.60
27	X	24	29,000	2.80	2.80
28	X	24	33,000	2.80	2.80
29	X	24	30,000	2.60	2.60
30	X	24	31,000	2.80	2.60
31	X	24	32,000	2.40	2.40
Total			1023,000		
Average			33,000		
Maximum			69,000		

PUMP RUNTIME IMPACT

- NORMAL: 2 HOURS DAILY
- LEAK: 10 HOURS DAILY
- EXTRA RUNTIME: 488 HOURS FOR DURATION OF LEAK
- $\approx$ 244 DAYS OF WEAR

FINANCIAL CONSEQUENCES

- POWER COSTS
- CHEMICAL COSTS
- EQUIPMENT WEAR
- FUTURE CAPITAL COSTS



LESSONS LEARNED

- ASSET MANAGEMENT WORKS
- WATER AUDITS MATTER
- PROACTIVE LEAK DETECTION SAVES MONEY

QUESTIONS

- DISCUSSION