Illicit Discharge Detection and Elimination:
Field and Lab Assessment Protocols

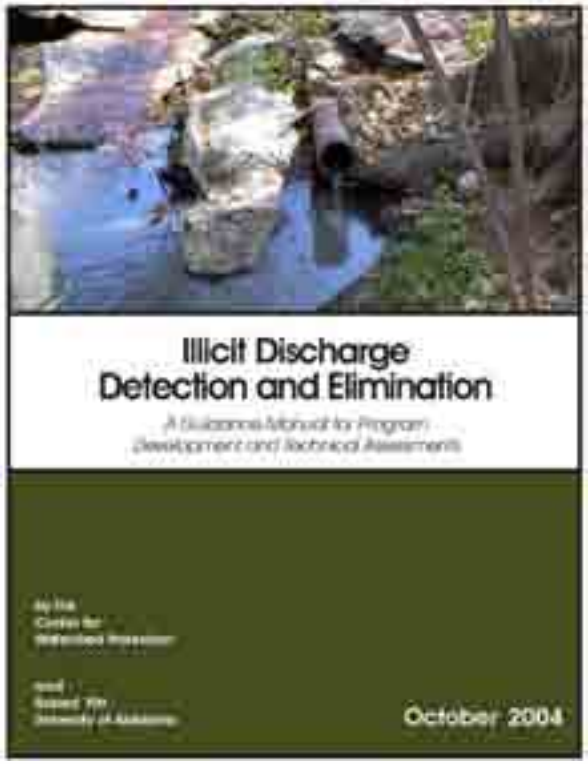
Center for Watershed Protection

Washington State permits require:

- Regulations to prohibit illicit discharges and connections
- Procedures to find and eliminate them
- Map of MS4
- Field assessments
- Staff training
- Public education and hotline

IDDE Guidance Manual
8 Program Components

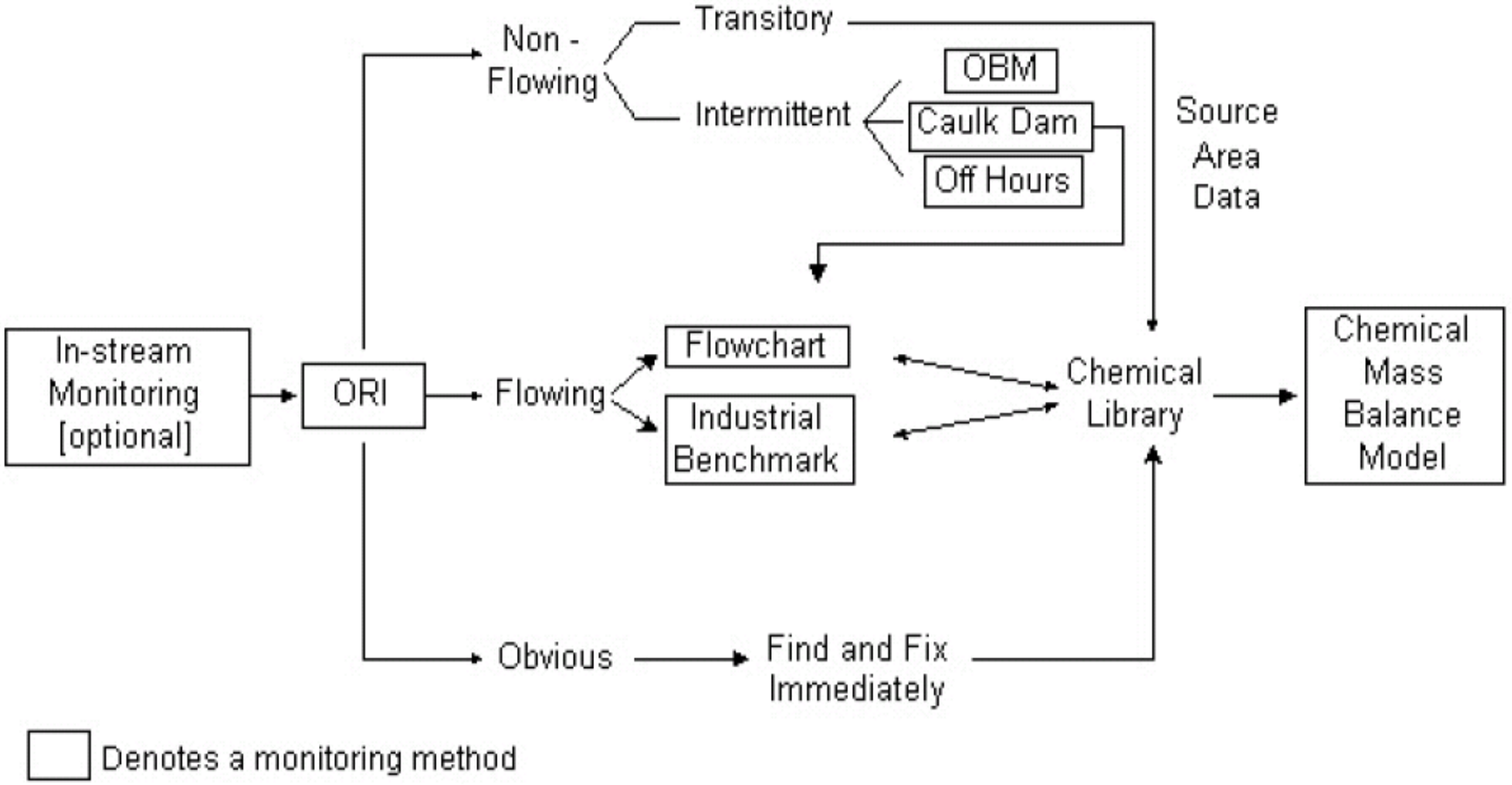
1. Audit Existing Resources & Programs
2. Establish Responsibility, Authority & Tracking
3. Complete a Desktop Assessment of Illicit Discharge Potential
4. Develop Program Goals & Implementation Strategies
5. **Search for Illicit Discharge Problems in the Field**
6. Isolate & Fix Individual Discharges
7. Prevent Illicit Discharges
8. Evaluate the Program



Dry Weather Outfall Screening Procedure

- Visual inspection of the outfall
- Qualitative assessment of any flow present, including examination of water color, odor, turbidity, floatables, & sedimentation
- Follow-up grab sample for quantitative analysis, either using more sophisticated field

IDDE Monitoring Framework



Hone Your Detective Skills

Cross-Train Your Staff

1964

Outfall Reconnaissance Inventory (ORI)
Map, Mark & Photograph Outfalls

- Assign unique ID to each outfall
- Physically mark each outfall
- Use a GPS unit to record outfall locations
- Take a photograph


Source: Robert Pitt, University of Alabama

Outfall Reconnaissance Inventory/ Sample Collection Field Sheet

Section 1: Background Data

Subwatershed: Scotts Level Branch		Outfall ID: SC-1	
Today's date: 4/03/03		Time (Military): 9:45	
Investigators: PES, EWB		Form completed by: EWB	
Temperature (°F): 50	Rainfall (in.): Last 24 hours: 0.1	Last 48 hours: 1	
Latitude: 39.17.27	Longitude: 76.41.50	GPS Unit: SLL	GPS LMK #: LMK 1
Camera: KODAK		Photo #s: 1	

Land Use in Drainage Area (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☒ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional
- Other: _____
- Known Industries: _____

Notes (e.g., origin of outfall, if known):

Outfall Reconnaissance Inventory (ORI)
Record Basic Characteristics

- Dimensions of pipe or ditch
- Material – concrete, metal, plastic, etc.
- Whether or not outfall is flowing

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☒ Closed Pipe	☒ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☒ Circular ☐ Eliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: 42	In Water: ☐ No ☒ Partially ☐ Fully With Sediment: ☒ No ☐ Partially ☐ Fully
☐ Open drainage	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ In-Stream	(applicable when collecting samples)				
Flow Present?	☒ Yes ☐ No *If No, Skip to Section 5*				
Flow Description (If present)	☐ Trickle ☒ Moderate ☐ Substantial				

Outfall Reconnaissance Inventory (ORI)
Simple Monitoring at Flowing Outfalls

- Flow
- pH
- Temperature
- Ammonia


Flow
11. 20. 2002


LaMOTTE
5.0
5.5
7.0
7.5
WIDE RANGE pH
CODE 2194
6.0
6.5
8.0
8.5
1. FILL TUBE TO MARK WITH WATER.
LaMOTTE
WIDE RANGE pH TEST KIT
MODEL P-3085
CHESTERTOWN • MARYLAND • 21620
LaMOTTE
WR Ind


Insta TEST
50 Test Strips
Total Chlorine
Insta TEST
50 Test Strips
Wide Range
pH & Total Chlorine
Insta TEST
50 Test Strips
LaMOTTE

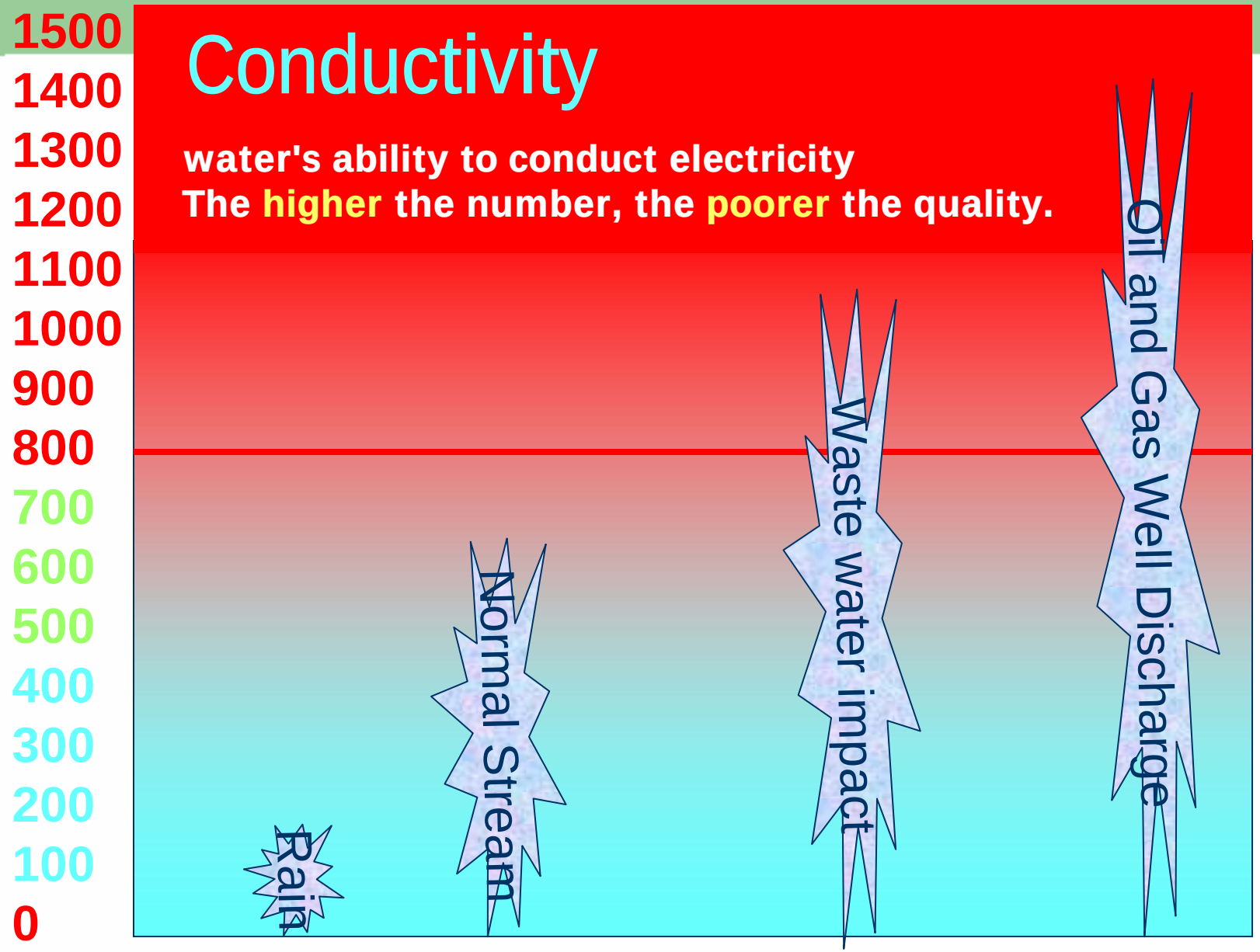
pH testers


272
21.9 °C
ORP
pH
3P
CAL
MCLR
MS
MR
MYRON L COMPANY
ULTRAMETER

Conductivity meter (and you get a thermometer!)

Conductivity

water's ability to conduct electricity
The higher the number, the poorer the quality.

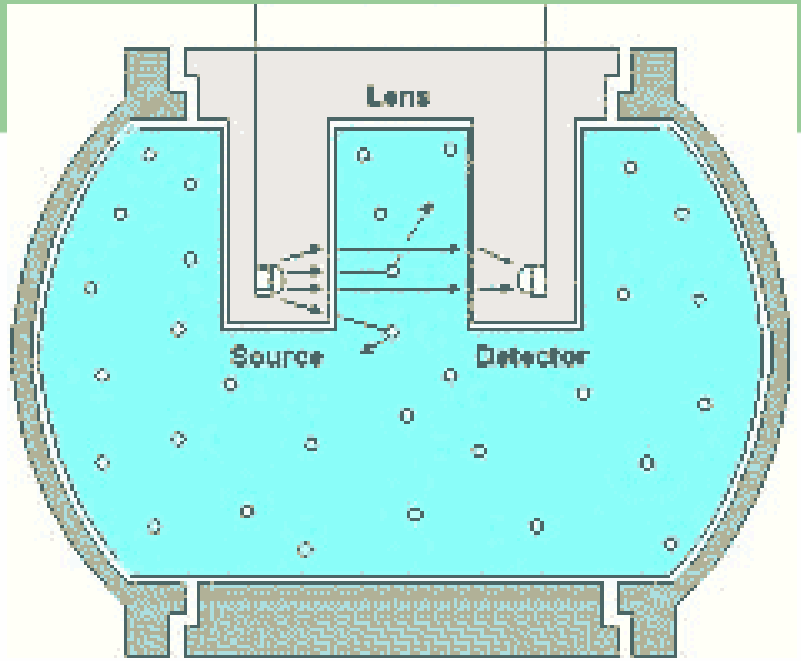


Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☒Flow #1	Volume	1 L	Liter	Bottle
	Time to fill	4.0	Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature		58.2	°F	Thermometer
pH		7.2	pH Units	Test strip/Probe
Ammonia		0.1	mg/L	Test strip

Outfall Reconnaissance Inventory (ORI)
Physical Indicators for Flowing Outfalls

- Odor
- Color
- Turbidity
- Floatables



Turbidity meter, imhoff cones, and secchi disk for measuring suspended solids & water clarity

Suds/ Foam

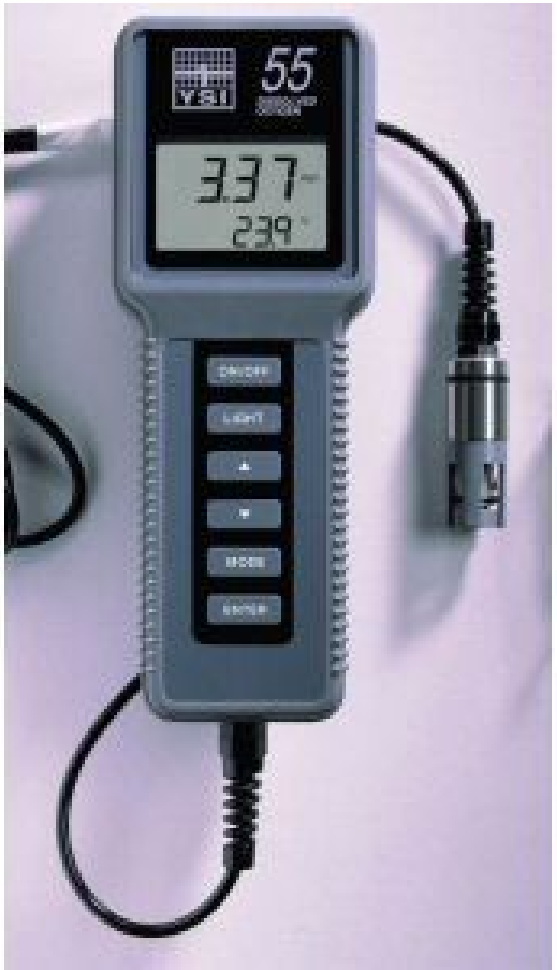
Oil Sheen

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☒ Yes ☐ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☒	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☒ Other: Slight Chemical	☒ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Digital dissolved oxygen probes



Many jurisdictions bypass the quantitative tests and immediately go “up the trunk” to find the source of the discharge

Outfall Reconnaissance Inventory (ORI)
What to do when obvious illicit discharge encountered?

- STOP the ORI
- Track the source
- Contact appropriate water pollution agency
- Photo document, estimate flow, and collect a sample – if safe

Photo Source: R. Frymire

Outfall Reconnaissance Inventory (ORI)

Physical Indicators for Flowing and Non-Flowing Outfalls

- Outfall Damage
- Deposits/Stains/Colors
- Abnormal Vegetation
- Poor Pool Quality
- Pipe Benthic Growth
- Odors, Residue
- Oil and/or Grease

Pool Quality

Benthic Indicators

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☒ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☒	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☒ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	Apparent suds may be natural from organic matter.

Outfall Reconnaissance Inventory (ORI)
Section 6-8

Section 6: Overall Outfall Characterization

☐ Unlikely	☒ Potential (presence of two or more indicators)	☐ Suspect (one or more indicators with a severity of 3)	☐ Obvious

Section 7: Data Collection

1.	Sample for the lab?	☐ Yes	☒ No			
2.	If yes, collected from:	☐ Flow	☐ Pool			
3.	Intermittent flow trap set?	☒ Yes	☐ No	If Yes, type:	☒ OBM	☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

- **Illicit Discharge Severity?**
- **Sample taken at outfall?**
- **Note unusual conditions near the outfall**

ORI Cost Considerations

- Equipment (relatively minor)
- Crew size (2 to 3 people per crew)
- Stream miles (~ 2-3 miles per crew per day)
- Pre- and post-processing data management (~ 3 person-days for for each day spent in field)

Customizing the ORI

- Open channels
- Submerged or tidally influenced outfalls
- Cold climate/ ice
- Other local indicators (e.g., biological)

The ORI Cannot:

- Find all discharges (can sometimes lead to a “false positive” as well)
- Detect intermittent flows that leave no trace
- Quantify impacts definitively (no direct measure of relative problem)
- Define sources (except for some obvious indicators)

Top Problems in Identifying Inappropriate Discharge Sources

- The source of the discharge makes identification difficult
  - Periodic nature
  - Illegal dumping / one-time dischargers
  - Illegal connections
  - Inflow/infiltration from sanitary sewers
  - After-hours discharges

Posted on Sun, Sep. 02, 2007

Chemical accident kills hundreds of fish

KAREN CIMINO

Betsy Anderson and her husband, Mel Battle, were walking on the Little Sugar Creek Greenway on Saturday morning when they noticed that nothing in the creek was moving.

"There were just dead fish all over the place," Anderson said.

Hundreds of them died, from Carolinas Medical Center toward Freedom Park, after chemicals that were being used in pressure-washing leaked into the creek, according to Charlotte-Mecklenburg Stormwater Management officials.

Charlotte-Mecklenburg police and the Charlotte Fire Department were alerted early Saturday; a hazardous-materials team tested the water and determined there was no immediate threat to the public, to workers or to nearby businesses, said Rob Brisley, spokesman for the Charlotte Fire Department.

The fish weren't so fortunate.

CMC had hired ValleyCrest Landscape Maintenance to pressure-wash new concrete on its property. ValleyCrest violated city and state laws by using an acidic chemical compound as part of its pressure-washing, said Rusty Rozzelle, water quality program manager with Charlotte-Mecklenburg Stormwater Management.

The acidic chemical lowered the pH levels in the water to 6 (7 to 9 is normal for the creek), killing the fish.

ValleyCrest agreed to remove the dead fish and could face up to a $10,000 fine, Rozzelle said.

ValleyCrest officials could not be reached for comment Saturday evening. CMC cooperated with authorities to determine the cause, said Debra Pierce, vice president of marketing for CMC.

Commercial pressure-washing is not a violation of drought-related city or county water restrictions, Rozzelle said. But the drought is an aspect of the incident: Low water levels in the creek added to the problem, Rozzelle said. The water flow was not sufficient to dilute the washing chemicals.

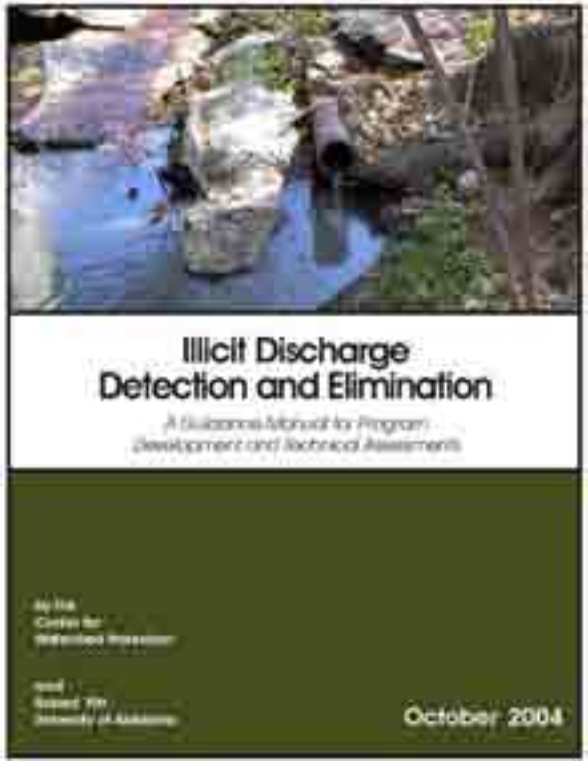
The pressure-washing lasted 11 hours, dumping the chemical from a stormwater drain near a CMC parking deck that faces the creek. Around noon Saturday, upstream from the drain, the water was clear and fish were alive; downstream, the water was clouded and the fish were dead.

Top Problems in Identifying Inappropriate Discharge Sources

- The MS4 infrastructure complicates the tracking of a discharge up the system
  - Accessibility (building, stream, outfall, traffic)
  - Complexity of network
  - Natural influences (tidal, groundwater)
  - Size of drainage basin
  - Multiple sources w/in system

Top Problems in Identifying Inappropriate Discharge Sources

- The IDDE program does not have the resources available to determine the potential source of the discharge
  - Maps are not accurate
  - Slow complaint response
  - Insufficient expertise
  - Slow laboratory analysis
  - Unreliable equipment
  - Use of unreliable indicators



Outfall Reconnaissance Inventory (ORI)
Data Management and Quality Control

- Field Quality Control
  - Binder containing field sheets
  - Crew leader:
    - Confirm all reaches and outfalls surveyed
    - Consistency of forms
- Office Quality Control
  - Data entered into spreadsheet
  - Check quality of data

Post-Screening Prioritization

ORI, combined with other existing data, can help determine:

- Extent of the problem
- If problems are “clustered”
- Indicators of intermittent discharges
- Relative ranking of problem outfalls

Detailed Field Sampling / Lab Analysis

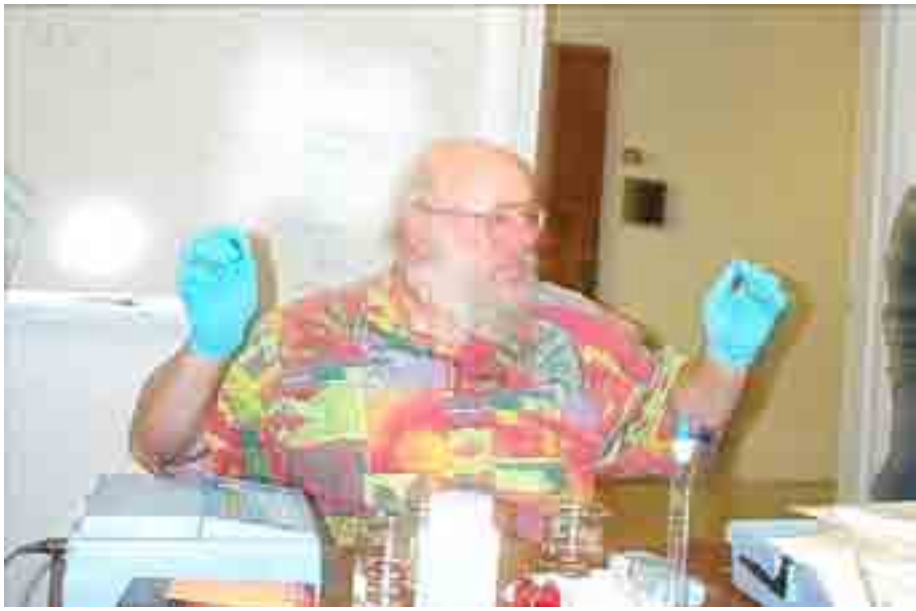
- More detailed sampling that includes:
  - Sampling to ID problem outfalls not apparent from physical indicators alone
  - Source identification
  - Potential intermittent monitoring

Factors to Consider

- Fraction flowing (from ORI)
- Number with physical indicators, and severity
- Indicators at dry outfalls
- Other existing monitoring data
- In-stream goals
- History of complaints

Forensics

- Run chemical tests
- Choose specific indicators depending on local “fingerprints” or based on land use in area

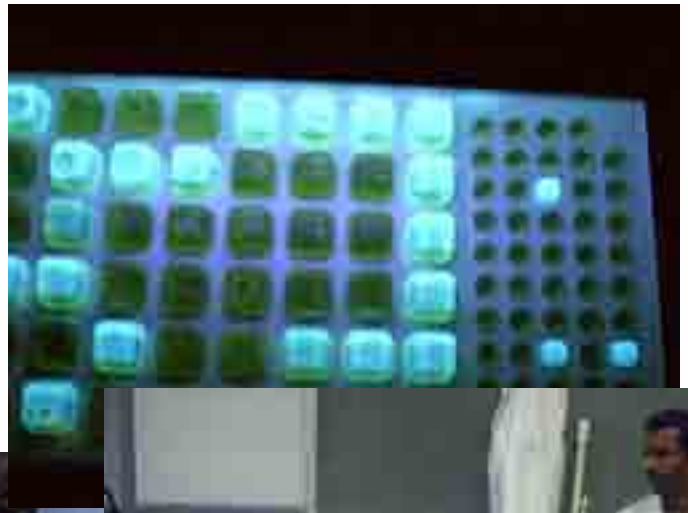


Key Features for Ideal Indicators

- Distinguishes a particular source
- “Tight” statistical distribution
- Precise measurement
- Safe
- Relatively inexpensive
- Simple to conduct

Key Lab Considerations

- Equipment cost
- Staff training
- Number of samples
- Safety
- Disposal



Typical Physical Indicators

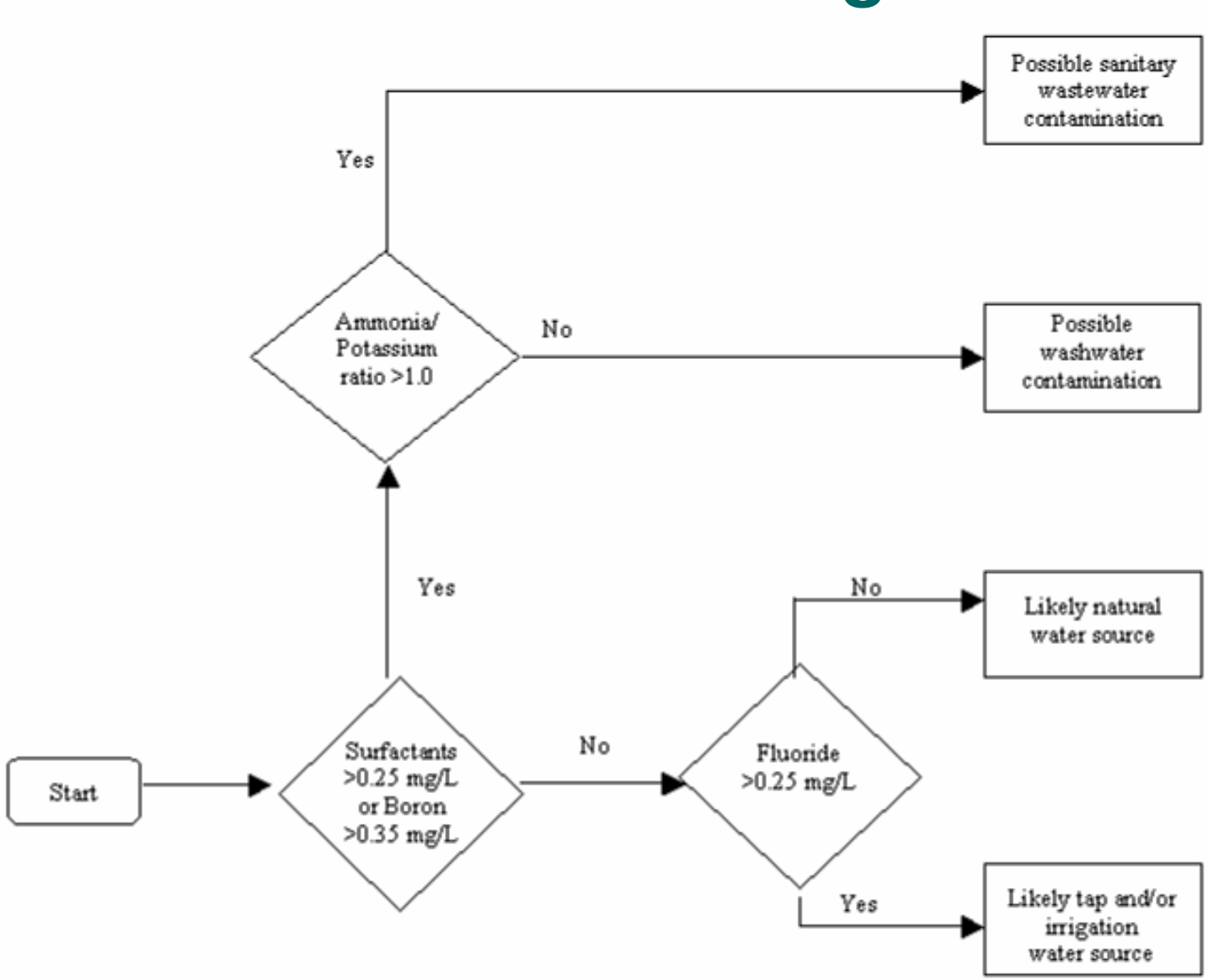
- Color
- Odor
- Deposits and stains
- Floatable matter
- Temperature
- Turbidity
- Changes in flow
- Vegetation change
- Structural damage
- Grease / oil

Typical Chemical Indicators

- pH
- Chlorine
- Specific conductivity
- Ammonia / ammonium
- Surfactants
- Fecal coliform
- Fluoride
- Copper
- Florescence
- Phenols

- Potassium
- Detergents
- Dissolved oxygen
- Hardness
- Iron

Flow Chart to Identify Illicit Discharges in Residential Drainage Areas



Benchmark Concentrations to Identify Industrial Discharges

Benchmark	Concentration	Notes
Ammonia (mg/L)	**≥50**	• Existing “Flow Chart” Parameter • Concentrations higher than the benchmark can identify a few industrial discharges
Potassium (mg/L)	**≥ 20**	• Existing “Flow Chart” Parameter • Excellent indicator of a broad range of industrial discharges
Color (Units)	**≥ 500**	• Supplemental parameter that identifies a few specific industrial discharges
Conductivity (µS/cm)	**≥ 2,000**	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources
Hardness (mg/L as $CaCO_3$)	**≤10** **≥ 2,000**	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources
pH (Units)	**≤ 5**	• Only captures a few industrial discharges • High pH values may also indicate an industrial discharge but residential wash waters can have a high pH as well
Turbidity (NTU)	**≥ 1,000**	• Supplemental parameter that identifies a few specific industrial discharges

Chemical Fingerprint Library

- Shallow Groundwater
- Spring Water
- Tap water
- Irrigation
- Sewage
- Septic Tank Discharge
- Common Industrial Discharges
- Commercial Car Wash
- Commercial Laundry

Most programs measure fecal coliform bacteria “colony-forming units” per 100 milliliters of raw water, or E. coli counts

Fingerprints of Major Sources

Sewage

- E. Coli
- Detergents (various)
- High Ammonia/ Potassium Ratio

Wash Water

- Detergents (various)

Shallow Groundwater

- Hardness, pH

Tap Water

- Fluoride
- Sometimes Hardness

Septage

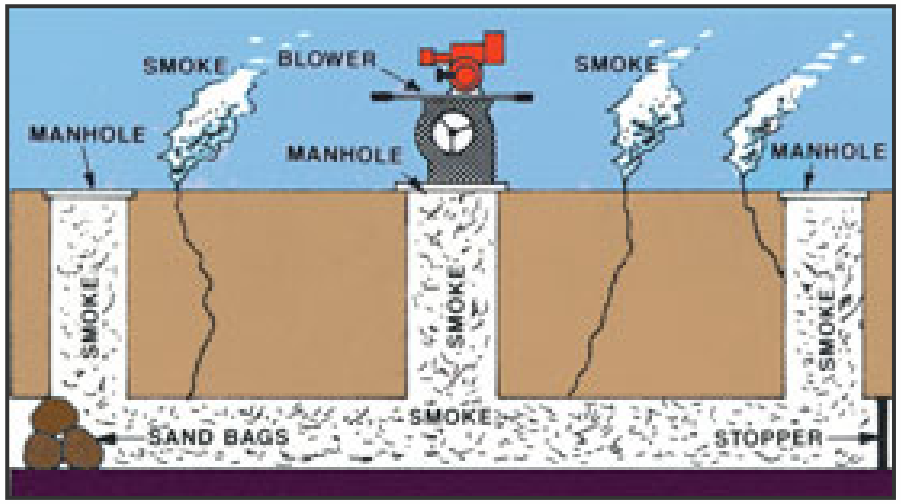
- E. Coli
- Fluorescence
- High Ammonia/Potassium

Special Indicators for Intermittent Discharges

- Optical brightener monitoring
- Toxicity testing
- Outfall damming
- Take a sample from the pool

Finding and Fixing

- Move up the pipe
- Use smoke or dye testing once narrowed
- Use enforcement or repair



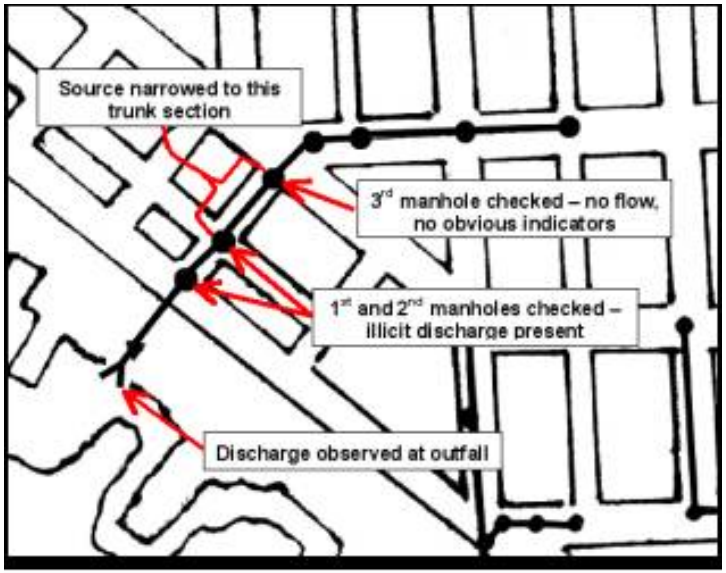


Figure 50: Example Investigation Following the Source up the Storm Drain System