Illicit Discharge Detection and Elimination (IDDE) 201:

Conducting IDDE Investigations

U.S. EPA Stormwater Webcast Series

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Presentation Overview

- IDDE 101 Review
- Desktop Assessments
- Field Assessments
- IDDE Case Study
- Post-Screening Prioritization
- Detailed Sampling and Analysis

IDDE 101 Review

Nikos… what is an *Illicit Discharge*?

What is an Illicit Discharge?

- A discharge to an MS4 that is not composed entirely of storm water except permitted discharges and fire fighting related discharges

  40 CFR 122.26(b)(2)

  - Unique frequency, composition & mode of entry
  - Interaction of the sewage disposal system & the storm drain system
  - Produced from “generating sites”

IDDE 101 Review

Nikos… what can you tell me about *Discharge Frequencies*?

Discharge Frequency

- **Continuous discharges**
  - Occur ***most or all of the time***
- **Intermittent discharges**
  - Occur over a ***shorter period of time*** (e.g., a few hours per day or a few days per year)
- **Transitory discharges**
  - ***Occur rarely***, usually in response to a singular event such as an industrial spill, ruptured tank, sewer break, transport accident or illegal dumping episode

IDDE 101 Review

Nikos… what are some common *Discharge Flow Types*?

Discharge Flow Types

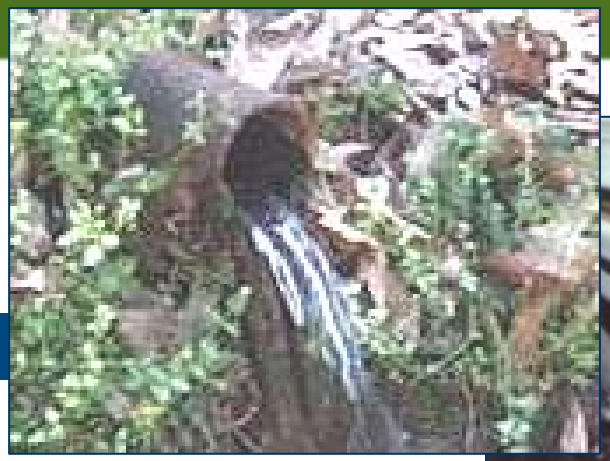
- Sewage & septage flows
- Washwater flows
- Liquid wastes
- Tap water *
- Landscape irrigation flows *
- Groundwater & spring water flows *

* Not typically considered illicit

IDDE 101 Review

Nikos… what are some typical *Modes of Entry* for illicit discharges into storm sewers?

Mode of Entry



- ***Direct entry***
  - Sewage, industrial, commercial cross-connection
  - Straight pipe
- ***Indirect entry***
  - Groundwater seepage
  - Spills
  - Dumping
  - Outdoor washing activities
  - “Nuisance” or non-target water

IDDE 101 Review

Nikos… what are *Generating Sites*?

Land Use & Potential Generating Sites

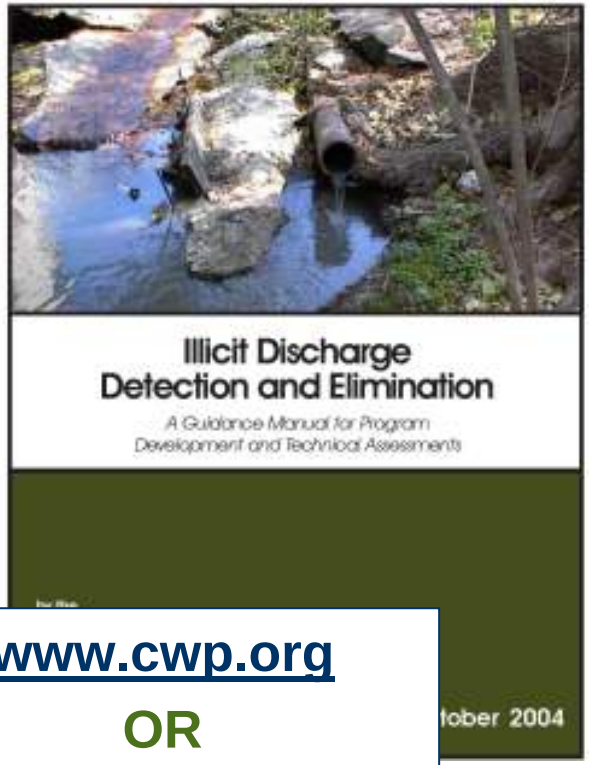
- Residential
- Commercial
- Industrial
- Institutional
- Municipal

IDDE Program Components

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

IDDE Guidance Manual

- Joint EPA-funded project between CWP and University of Alabama
- Eight Program Elements
- Desktop Methods
- Field and Lab Protocols
- Model Ordinance
- Technical Appendices



www.cwp.org

OR

www.epa.gov/npdes

Conducting IDDE Investigations

1. Pre-Screening Prioritization
2. Outfall Reconnaissance Inventory (ORI)
3. Post-Screening Prioritization
4. Detailed Sampling and Analysis

Pre-Screening Prioritization

Conducting a Desktop Assessment of Illicit Discharge Potential:

- Delineate subwatersheds
- Compile mapping and data
- Compute discharge screening factors
- Characterize IDP across subwatersheds
- Generate maps to support field investigation

Screening Factors

- Past Discharge Complaints
- Poor Dry Weather Water Quality
- Density of Generating Sites
- Density of Industrial NPDES Permits
- Stormwater Outfall Density
- Age of Subwatershed Development
- Former Combined Sewers
- Older Industrial Operations
- Aging or Failing Sewers
- Density of Older Septic Systems
- Past Sewer Conversions

Select the factors that apply most to your community

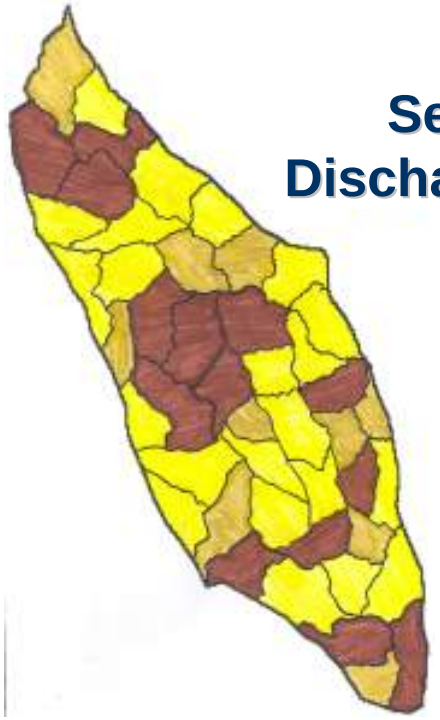
Prioritizing Subwatersheds Using IDP Screening Factors

Subwatershed	Past discharge complaints	Poor dry weather WQ	Density of SW outfalls	Average age of dev.	Raw IDP score	Normalized IDP score
Subwatershed A	8 (2)	30% (2)	14 (2)	40 (2)	8	2
Subwatershed B	3 (1)	15% (1)	10 (2)	10 (1)	5	1.25
Subwatershed C	13 (3)	60% (3)	16 (2)	75 (3)	11	2.75
Subwatershed D	1 (1)	25% (1)	9 (1)	15 (2)	5	1.25
Subwatershed E	5 (1)	15% (1)	21 (3)	20 (1)	6	1.5

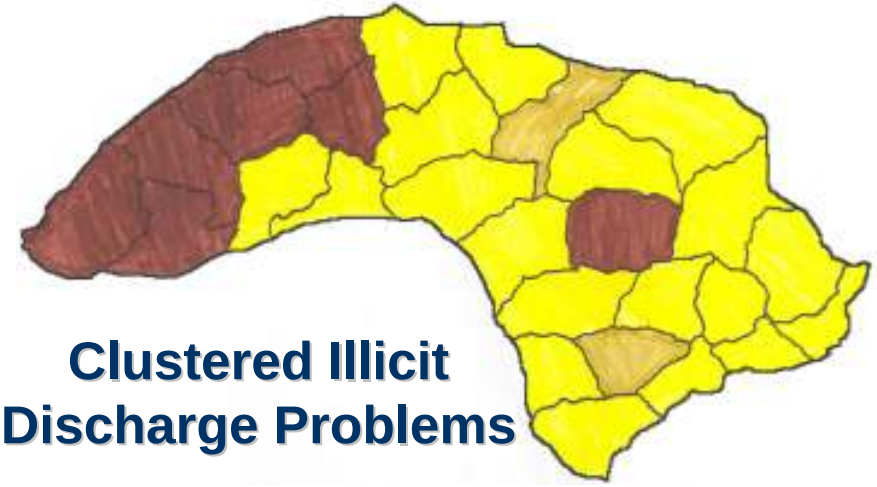
Basis for Assigning Scores…	1	2	3
Past discharge complaints/reports (total # logged)	< 5	5 - 10	> 10
Dry weather water quality (# times bacteria stds exceeded)	< 25%	25 - 50%	> 50%
Storm water outfall density (# outfalls / stream mile)	< 10	10 - 20	20
Average age of development (years)	< 25	25 - 50	> 50

Communities with…

Minimal Illicit Discharge Problems



Severe Illicit Discharge Problems



Clustered Illicit Discharge Problems

Key:

- Low IDP risk
- Medium IDP risk
- High IDP risk

Conditions Driving Program Setup

- Minimal problems
  - Consider combining outfall surveys with a broader stream assessment program
- Clustered problems
  - Focus on confined subwatersheds, reaches, or specific industries where history of suspect discharges exist
- Severe problems
  - Recognize that IDDE program will need significant commitment (staff, equipment, budget) for improvements to be realized

Questions?

Outfall Reconnaissance Inventory (ORI)

Conduct rapid field screening of all outfalls:

- Map, mark & photograph outfalls
- Record basic characteristics
- Look for physical indicators
- Conduct simple monitoring at flowing outfalls

Outfall Reconnaissance Investigation Field Sheet

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: _____	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Grey ☐ 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.) ☐ 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)

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

Are Physical Indicators 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: _____	

Section 6. Overall Outfall Characterization

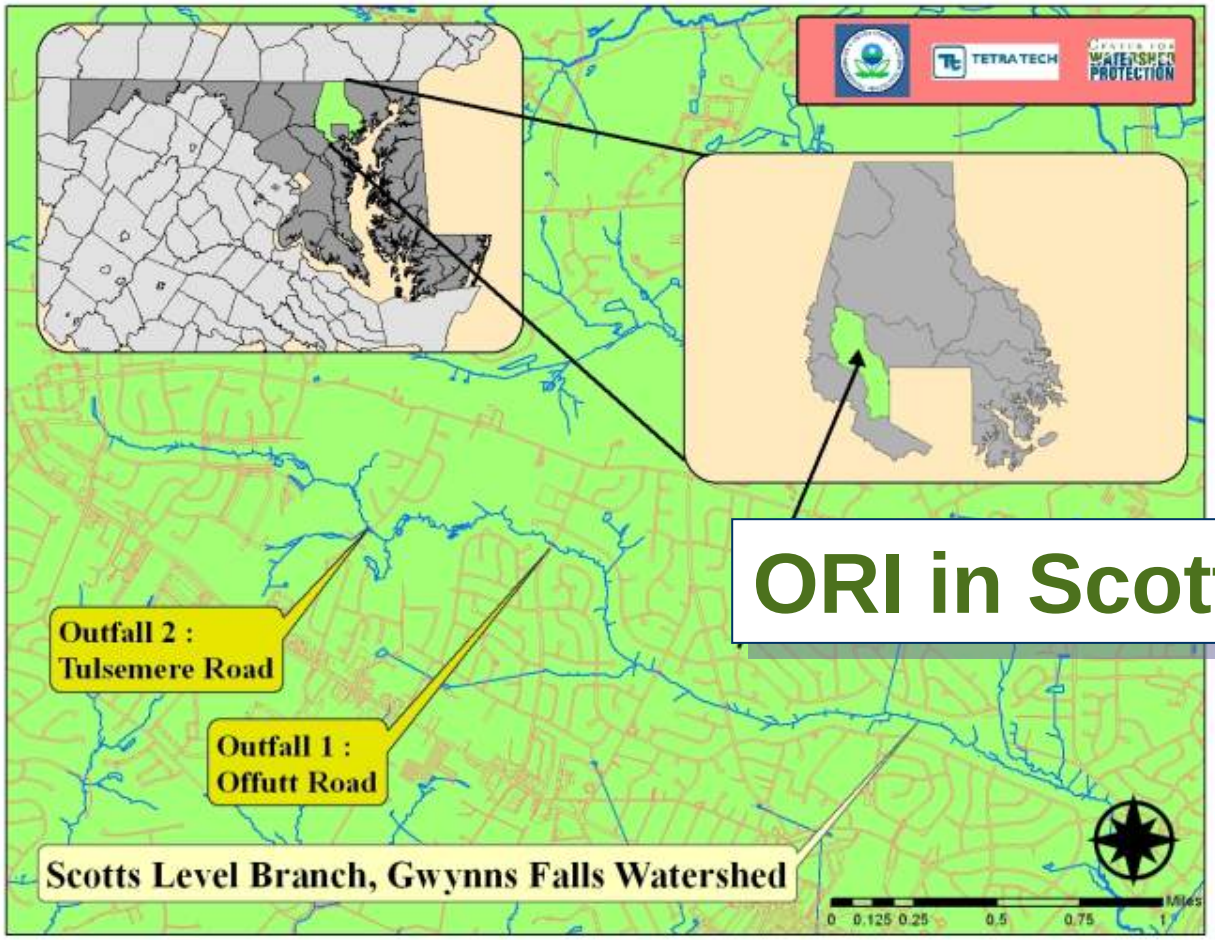
☐ **No indication of illicit discharges** ☐ **Some likelihood of illicit discharge (i.e., presence of 2 or more indicators)** ☐ **Almost certain a discharge exists (i.e., 1 or more indicator with a severity of 3)**

Section 7. Data Collection

1. Sample For The Lab? ☐ Yes ☐ No
2. If Yes, Collected From: ☐ Flow ☐ Pool
3. Obm Trap Set? ☐ Yes ☐ No

Check your webcast resources

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



ORI in Scotts Level Branch

With Paul Sturm and Kris Varsa

Outfall Reconnaissance Inventory (ORI)
The Basics

- Safety considerations
- Time of year considerations
- Supplies
- Staffing requirements

SAFETY CONSIDERATIONS VIDEO

Hone Your Detective Skills

May need to work back up floodplain to find outfall

TIMING CONSIDERATIONS VIDEO

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

Outfall Reconnaissance Inventory (ORI)
Record Basic Characteristics

Dimensions, Material, & Presence of Flow






Outfall Reconnaissance Inventory (ORI)
Physical Indicators for Flowing & Non-Flowing

- Outfall Damage
- Deposits/Stains
- Abnormal Vegetation
- Poor Pool Quality
- Pipe Benthic Growth

DRY OUTFALL VIDEO

Outfall Reconnaissance Inventory (ORI)
Simple Monitoring at Flowing Outfalls

- Flow
- pH
- Temperature
- Ammonia

Outfall Reconnaissance Inventory (ORI)
Physical Indicators for Flowing Outfalls

- Odor
- Color
- Turbidity
- Floatables

FLOWING OUTFALL VIDEO

Outfall Reconnaissance Inventory (ORI)
Overall Outfall Characterization

- Outfall designation:
  - Unlikely illicit discharge
  - Potential illicit discharge
  - Suspect illicit discharge
  - Obvious illicit discharge
- Data collected
- Non-illicit discharge concerns

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

Outfall Reconnaissance Inventory (ORI)
Cost Considerations

- Equipment (relatively minor)
- Crew size (2 to 3 people per crew)
- Stream miles (~ 2 to 3 miles per crew per day)
- Pre- and post-processing data management (~ 1 to 3 person-days for each day spent in field)

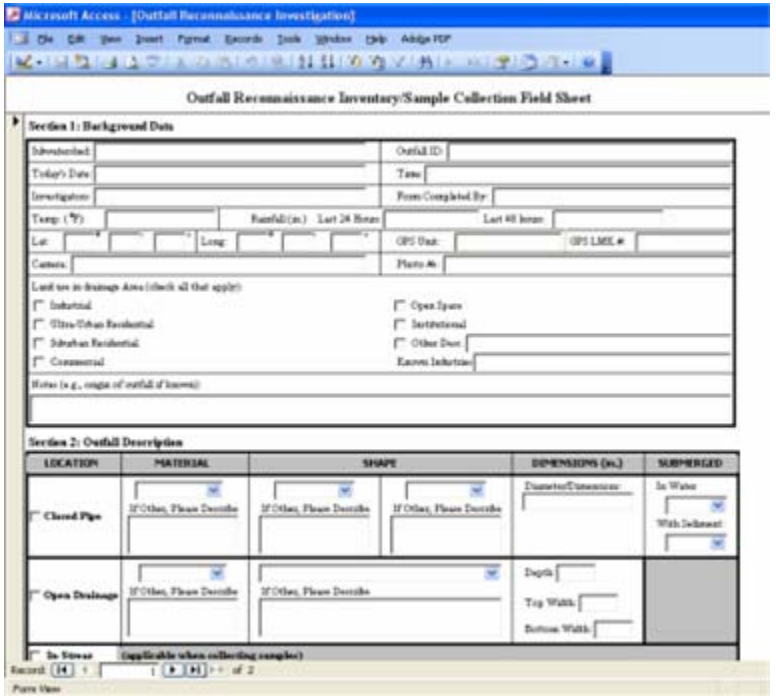
Outfall Reconnaissance Inventory (ORI)
Data Management and Quality Control

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



Customizing the ORI

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

Photo Source: R. Frymire

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)

Questions?

Cuyahoga County Board of Health's Illicit Discharge Detection and Elimination Program

Harry Stark, RS, MPA

Cuyahoga County Board of Health

Map of Cuyahoga County

Cuyahoga County

- It is the most populous county in Ohio with a population of 1,393,978
- The County is 1,246 square miles in size
- 787 miles is water

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CCBH General Health District

- Serving over 830,000 residents
- Represent
  - 35 cities (except Cleveland, Shaker Hts., and Lakewood)
  - 19 villages
  - 2 townships

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Board of Health's Watershed Protection Unit

- Stormwater Program
- Household Sewage Program
- Semi Public Sewage Program
- Beaches/Nowcast
- Marinas
- Water Quality Program
- Educational Outreach
- Watershed Planning Projects
- FOG (Fats, Oils, Greases)

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CCBH Involvement on Phase II

- Household Sewage Treatment Systems (HSTS)
- Water Quality Sampling
- Limited Guidance from Ohio EPA
- Communities looking for assistance
- Principal Member of Northeast Ohio Storm Water Task Force Committee

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Off-lot Discharging HSTS

- Approved in the State of Ohio
  - Outdated rules / no legislation
  - No general NPDES permit for household septic systems from the Ohio EPA
- One of only a handful of states that approves these systems without a permitting mechanism in place
- Are now illicit sources of discharges under Phase II Stormwater

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CCBH Regional Stormwater Program

- MS4 Outfall Inventory
- Dry Weather Inspections/Sampling
- Source Tracking
- Educational Outreach/Involvement
- Good Housekeeping
- Currently have 53 contracts with communities to perform activities
- Currently performing activities in 4 Counties

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IDDE Manual

- Grant from Ohio Environmental Education Fund
  - Printing of document
  - Regional Meetings
- Technical Advisory Committee
  - Engineers
  - Health Departments
  - Watershed Organizations
  - Sewer District
  - Ohio EPA

CCBH Program
Outfall Inventory / Mapping

- 45 communities completed to date
- Over 4,000 MS4 outfalls have been identified
- Utilize the procedures identified in the IDDE Guidance Manual for Ohio for identifying the MS4 outfalls

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Outfall Inventory / Mapping

- Review all known data
- Field surveys
  - Walk surface waterways
  - Locate designated MS4 outfalls
    - Each outfall has a unique 8 character identification code
    - Photograph,
    - GPS coordinates
    - Other information on field form

Field staff recording information

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- Shape of outfall
- Size of outfall
- Material
- Condition
- Location description
- Location (downstream)
- ID of outfall
- Stream
- Watershed
- Outfall type

Field staff measuring outfall

General Location Information	
Receiving Stream:	
Stream Segment:	
Watershed:	
Community:	
County:	
Parcel:	
State Plane N:	
State Plane E:	
CRGS N:	
CRGS E:	Outfall Photograph
Latitude:	
Longitude:	
Elevation (ft):	
Location Description:	
Storm Sewer Map Information	
Outfall on Map: ☐ Yes ☐ No	
Map ID/Number:	
Map Source:	
Outfall Located on (facing downstream)	Location Map
Pipe Characteristics	
Pipe Shape: ☐ Circular ☐ Elliptical ☐ Egg ☐ Rectangular ☐ Other, describe:	
Pipe Height (in):	
Pipe Width (in):	
Pipe Material: ☐ RCP ☐ PVC ☐ VCP ☐ Cast Iron ☐ CMP ☐ Other, describe:	
Pipe Condition: ☐ Good ☐ Poor ☐ Fair ☐ N/A	
Height from Invert to Stream Flow Level (ft):	Additional Details
Outfall Type/Ownership	Comments
Outfall Type:	
Owner:	
Authority:	
Other ID:	
NPDES Permit:	

Database form of outfall information

ACMB0010

General Location Information	
Receiving Stream:	Abrams Creek - Main Branch
Stream Segment:	
Watershed:	
Community:	Middleburg Heights
County:	Cuyahoga
Parcel:	
State Plane N:	626143.08407
State Plane E:	2164568.54333
CRGS N:	47120
CRGS E:	60910
Latitude:	41.3830923166667
Longitude:	-81.7854995666667
Elevation (ft):	
Location Description:	Big Creek Parkway

Storm Sewer Map Information		
Outfall on Map:	☒ Yes	☐ No
Map ID/Number:	048-065	
Map Source:	CRGS	
Outfall Located on (facing downstream)		

Pipe Characteristics

Pipe Shape:
- ☑ Circular
- ☐ Elliptical
- ☐ Egg
- ☐ Rectangular
- ☐ Other, describe:

Pipe Height (in): 24

Pipe Width (in):

Pipe Material:
- ☑ RCP
- ☐ PVC
- ☐ VCP
- ☐ Cast Iron
- ☐ CMP
- ☐ Other, describe:

Pipe Condition:
- ☑ Good
- ☐ Poor
- ☐ Fair
- ☐ N/A

Height from Invert to Stream Flow Level (ft):

Outfall Type/Ownership	
Outfall Type:	Public Storm - MS4
Owner:	
Authority:	
Other ID:	
NPDES Permit:	

Outfall Photograph

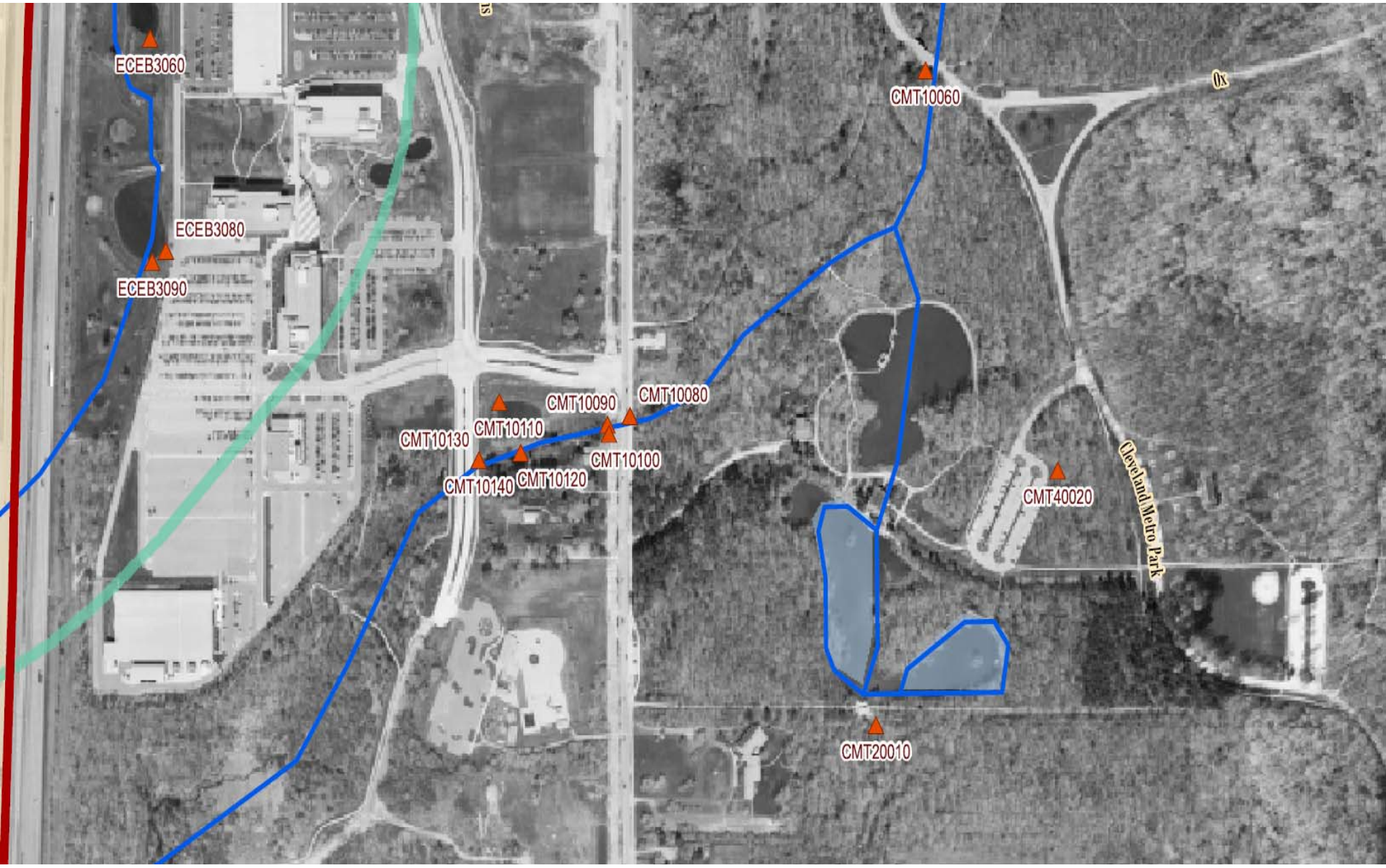
Location Map

Additional Details

Comments

Concrete headwall

MS4 outfalls mapped for community



Dry Weather Inspections and Developing Priority Areas

- Developed a protocol for our IDDE program
  - Regional/watershed based approach
  - Locate priority areas
  - Identify Hot Spots
    - Older areas
    - Problems in the past
    - Commercial/industrial areas

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Inspections of outfalls

- Visual inspections of outfalls once inventoried
- Dry weather - 72 hours no rainfall (0.1”)
- Notify public during field component
- Look for obvious signs of pollution, flow of water

Visual inspection of MS4 outfall

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Water Sampling and Testing

- Utilize water testing as a tool
- Allows communities to prioritize problem areas, target resources and where to start their elimination projects.
- Certain parameters can serve as indicators of an illicit discharge:
  - Fecal coliform
  - pH
  - Ammonia
  - Conductivity
  - Dissolved Oxygen
  - Phosphorus

Field staff taking water sample

	Receiving Stream:	Location Description:
	Community:	

Inspection Information	
Project:	
Inspection Date:	Time: Type:
Agency:	
Department:	
Crew Leader:	
Crew Member:	
Crew Member:	
Time of Last Rain:	☐ < 24 Hrs. ☐ < 48 Hrs. ☐ < 72 Hrs. ☐ > 72 Hrs.
Pipe Flow:	☐ None ☐ < 1/4 Pipe. ☐ < 1/2 Pipe ☐ < 3/4 Pipe ☐ Full ☐ Trickle
Pipe Submergence:	☐ None ☐ < 1/4 Pipe. ☐ < 1/2 Pipe ☐ < 3/4 Pipe ☐ Full
Comments:	

Inspection Image

Sampling Information	
Sample Collected:	☐ Yes ☐ No
Sample ID:	
Description:	
Est. Flow (Gpm):	
Est. Method:	
Comments:	
Sampling Strategy:	

Analytical Results	
Lab Analysis ID:	
Analyzed By:	
Fecal Coliform:	(Colonies/100 ml)
E. Coli:	(Colonies/100 ml)
Ammonia (mg/l):	
Temperature (C):	
PH:	
Conductance (us):	
Phosphorus (mg/l):	
Dis. Oxygen (mg/l):	
Other Parameters/Results	

Recommendations

Action Required: ☐ No ☐ Perform Problem Source Investigation

Comments:

Inspection Form

Tracing Source of an Illicit Discharge

- Once an illicit discharge is located at an MS4 outfall, tracing is our next step:
  - Visual Inspections
  - Dye Testing
  - Televising
  - Water Quality Monitoring
    - Bacterial Source Tracking
  - Smoke testing

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CCBH Field Investigations

- Look for obvious signs during dry weather work. Looking for the obvious violations first, then can work in the future on intermittent flows.
- Use on a regional basis (watershed/subwatershed basis) – look for areas with worse bacterial contamination to focus resources on those areas first.
- Utilize fecal coliform levels of 5,000 colonies per 100ml.

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CCBH Field Investigations

- To date 2,240 water samples have been taken.
  - 56% of MS4 outfalls have had dry weather flows identified
- 572 possible illicit discharge locations have been identified through water quality sampling
  - 14% of MS4 outfalls have possible illicit discharges
- Cuyahoga County has a lot of older development
  - Majority of problems to date, over 90%, has been associated with older infrastructure communities (inner ring suburbs)
  - Majority of problems to date, has been a mixture of both residential (approximately 75%) and commercial locations (approximately 25%).

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CCBH Source Tracking

- We utilize visual up pipe observations
  - We then utilize maps of the storm sewer system and determine where additional sampling is required and sample those areas,
  - This then pinpoints the areas with high bacterial counts, ammonia, etc
- Once locations have been identified, the information is given to communities who then deal with the elimination portion (we do assist)
- Have source tracked and identified over 50 illicit discharge locations to date – of which over half have been eliminated
- Lessons learned
  - time consuming,
  - not easy to identify locations where to sample in all cases depending upon the information available for that community or the field conditions and access to locations
  - Cooperation with communities

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Educational Outreach/Involvement

- School-age children program
- Public Officials program
- General public program
- Volunteer monitoring

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Good Housekeeping

- Good Housekeeping programs for communities
- Utilize Lake County Stormwater Utility Program
  - Includes program toolboxes for specific topics
    - Erosion and sediment control
    - Illicit Discharge
    - Construction site spill response
    - Parking lot / street sweeping

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CCBH Regional Stormwater Program

- Stress Regional Approach
- 55 Phase II designated communities within Cuyahoga County, all separate MS4 permits
- Ohio strong home rule state
- Working with communities across community boundaries and county boundaries

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CCBH Regional Stormwater Program

- Allows for better use of our resources
  - Utilize our IDDE program on a regional basis – creates commonality on all aspects of programs.
  - Equipment / Man power
  - Dry weather and Sampling processes
    - Allows for better use of time when performing these activities by continued work on one waterway that traverses multiple communities rather than performing work community by community
    - Watershed Based Approach / Regional Approach: Looking at water quality problems and issues across boundaries.

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CCBH Regional Stormwater Program

- Creates dialogue (positive) between communities
  - Common model ordinances
  - Common Problems / Common Solutions
  - Develop common IDDE program

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Questions?

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

Prioritizing Subwatersheds and Survey Reaches

Metrics 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

Techniques to Interpret Indicator Data

- Flow Chart Method
- Single Parameter Screening
- Industrial Flow Benchmarks
- Chemical Mass Balance Model

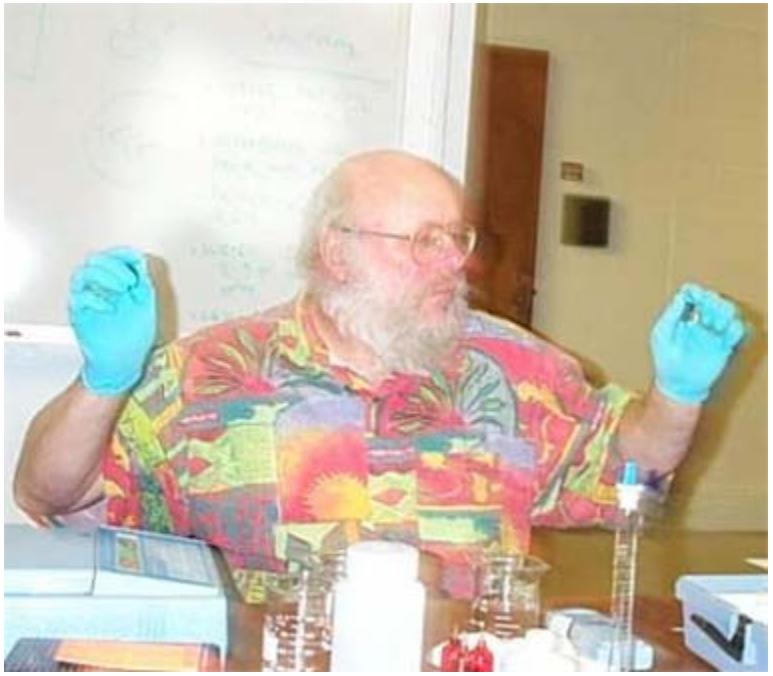
Using ORI Data to Characterize IDDE Problems

Extent	ORI Support Data
Minimal	• Less than 10% of total outfalls are flowing • Less than 20% of total outfalls with obvious, suspect, or potential designation
Clustered	• Two-thirds of flowing outfalls located within one-third of subwatersheds • More than 20% of subwatersheds have greater than 20% of outfalls with obvious, suspect, or potential designation
Severe	• More than 10% of outfalls are flowing • More than 50% of total outfalls with obvious, suspect, or potential designation • More than 20% of outfalls with obvious or suspect designation

Detailed Sampling and Analysis

Use **Indicator Monitoring** to:

- Identify problem outfalls not apparent from physical indicators alone
- Test suspect or problem outfalls to confirm if illicit discharge
- Determine flow type
- Analyze intermittent discharges



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

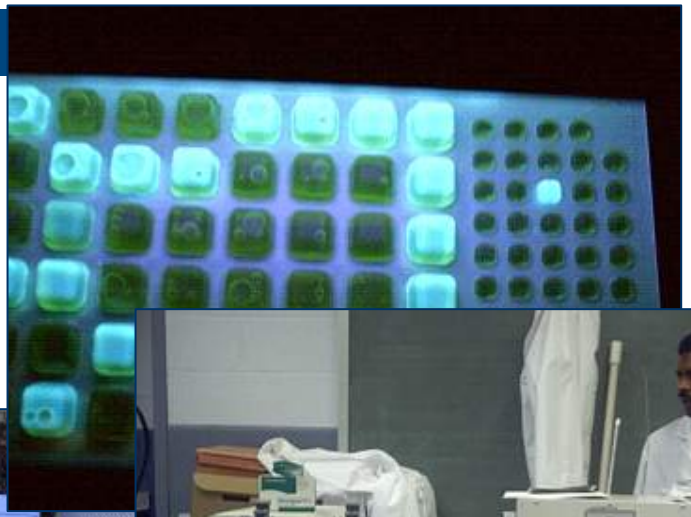


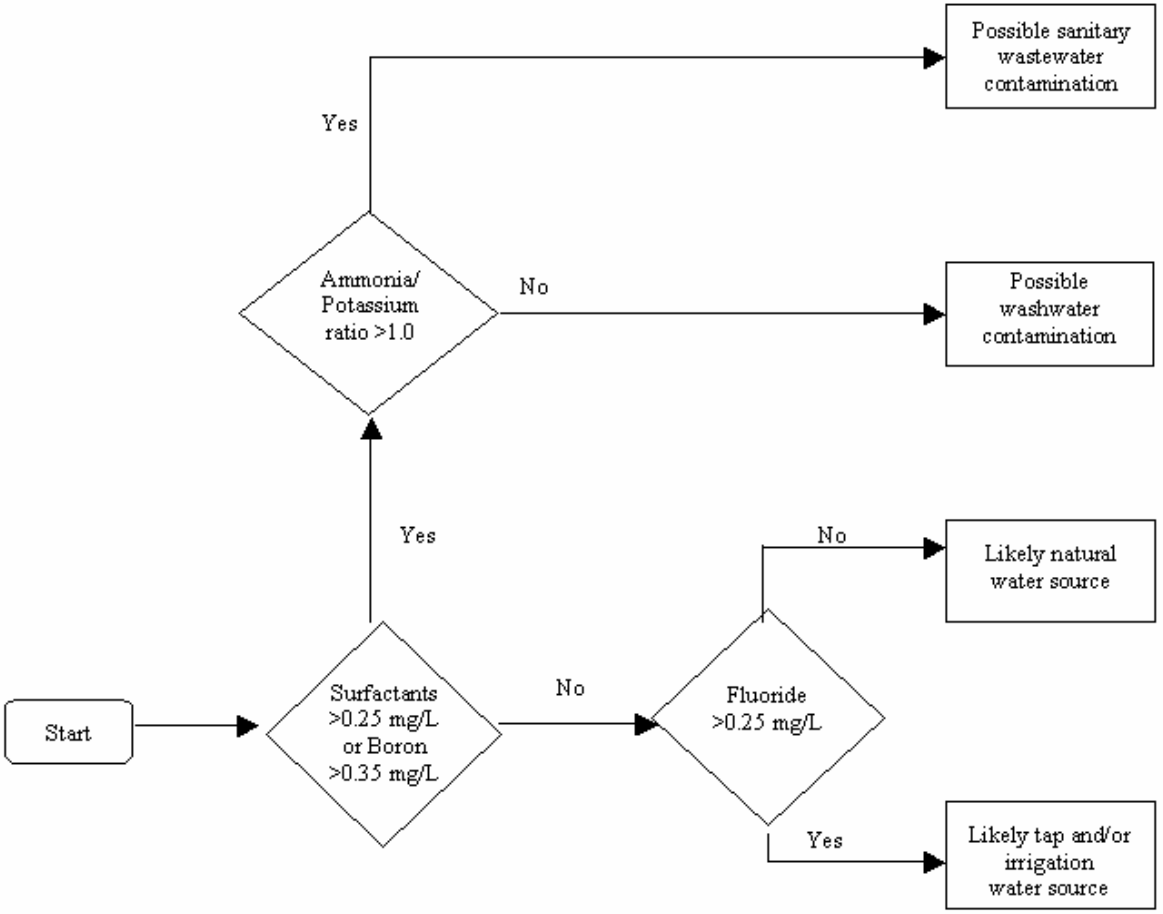
Photo Source: Robert Pitt

Simple and Inexpensive Analytical Methods

- Comparative colorimetric methods (apparent color, detergents after extraction)
- Simple probes (pH, conductivity, ion selective potassium)
- Spectrophotometric (fluoride, ammonia, boron)

Can be used in the field, but usually much easier, safer, and more efficient in lab

Flow Chart to Identify Illicit Discharges in Residential Drainage Areas



Single Parameter Screening

- Detergents
  - Best single parameter to detect illicit discharge
  - Analysis conducted in controlled lab setting
- Ammonia
  - Concentrations >1mg/L is positive indicator of sewage
  - Analysis in field using portable spectrophotometer

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

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

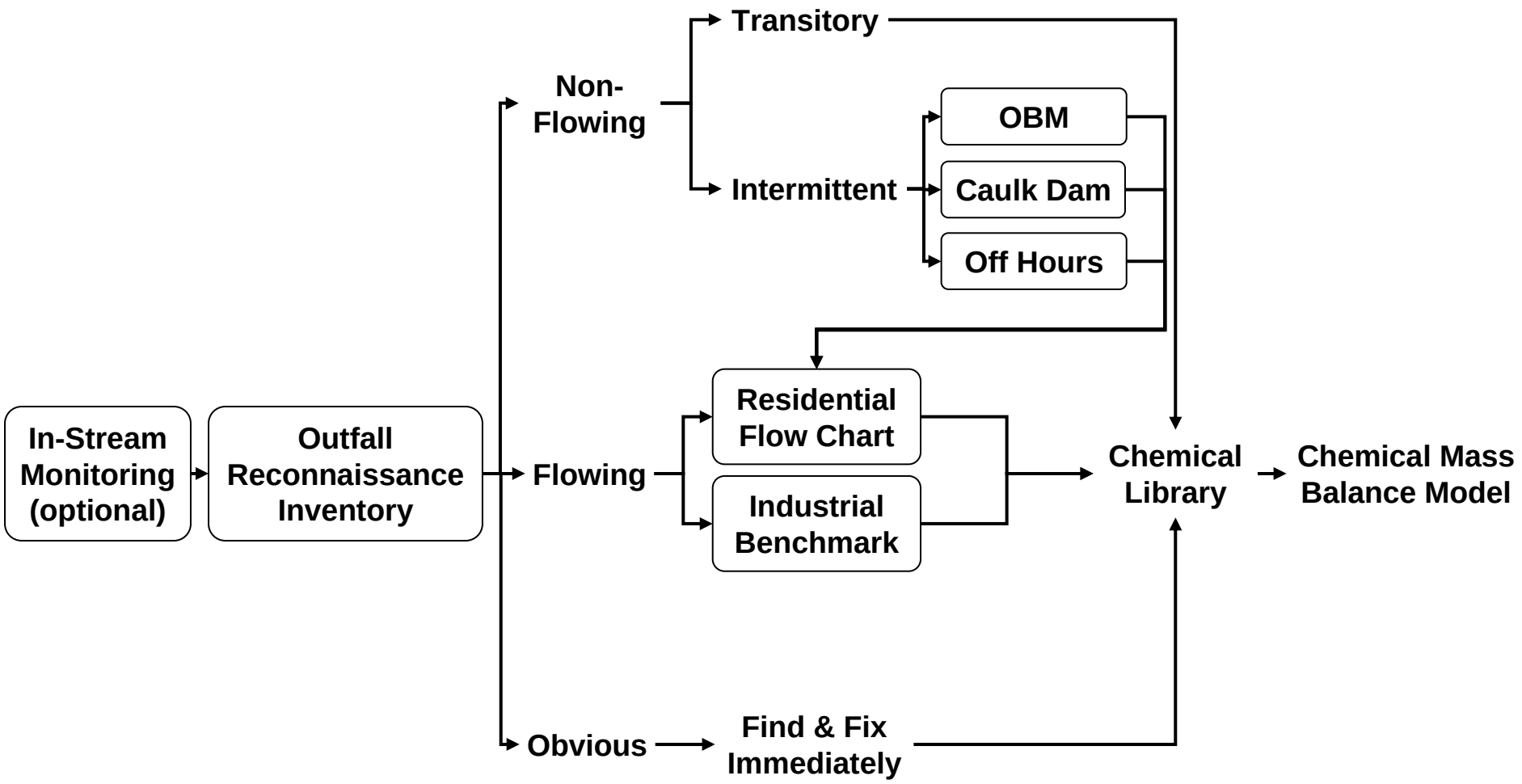
Septage

- E. Coli
- Fluorescence
- High Ammonia/Potassium

Special Indicators for Intermittent Discharges

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

IDDE Monitoring Framework



Denotes a monitoring methods

Questions?