INTERMEDIATE/ADVANCED DRY WEATHER FIELD SCREENING WORKSHOP 2021

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SESSION I

- Expanding on the Basics
- Illicit Discharge Detected, NOW WHAT?
- Methods for Isolating & Fixing Illicit Discharges
- Advanced Source Detection Methods- Part 1
- Field Presentation

IDDE BASICS: REVIEW

- **Illicit discharges**: *a discharge into an ms4 that is not composed entirely of stormwater.*

- **Mode of Entry into MS4**
  - **Direct**: The discharge is directly connected to the storm drain pipe through a sewage pipe, shop drain, or other kind of pipe:
    - ***Sewage/waste* cross-connections, straight pipes, industrial/commercial cross-connections.**
  - **Indirect:** Flows generated outside the storm drain system enter through storm drain inlets or by infiltrating through the joints of the pipe (or cracked manholes).
    - ***Groundwater seepage, accidents/spills, dumping, outdoor washing, non-target irrigation.***

DISCHARGE FREQUENCY

- **The frequency of dry weather discharges can be classified as:**
  - **Continuous**
    - Occur most or all of the time
    - Are easier to detect
    - Typically produce the greatest pollutant load
  - **Intermittent**
    - Occur over a shorter period of time
    - Are harder to detect
  - **Transitory**
    - Occur rarely
    - Usually in response to a singular event
    - Are extremely hard to detect

The frequency determines how you can hope to monitor.

In the Basic Training we went over **HOW** to conduct Dry Weather Field Screening

And Now:

What to do **IF** you **FIND** an illicit discharge…

…or **Suspect** you've found one

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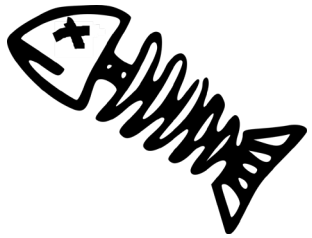
Upon Finding a Potential Illicit Discharge: Things to consider…

✓ **Was there evidence of harm to the natural environment?**

- Fish kills
- Vegetation stresses/kills
- Sterilization



✓ **Was there evidence of hazardous waste or a direct threat to public health?**

- Hydrocarbon's present? (If so, call the fire department)
- Toxic/unknown chemicals? (intense odors/colors) (Again, call fire department)
- Sewage? (Water Utilities Departments)

✓ If so…, do you know what to do?

REMINDERS OF PHYSIO-BIO-CHEM INDICATORS:

- ***Physical indicators***
  - *Flow,* color, odor, turbidity, sewage, sheens, and scum; outfall condition; outfall classifications
- ***Biological indicators***
  - Vegetation, algae, bacteria, fish kills, aquatic life
- ***Chemical indicators***
  - Water temperature, tier I parameters, tier II parameters

A combination of these indicators will be a sure sign something is wrong.

PHYSICAL: COLOR

INFLUENCED BY THE PRESENCE OR ABSENCE OF SUBSTANCES SUCH AS METALLIC SALTS, ORGANIC MATTER, DISSOLVED OR SUSPENDED MATERIALS

Water Colors	Possible Sources
Tan to brown	Runoff from rainfall event, construction, or soil erosion
Blue green/ brown green	Plankton bloom, sewage, fertilizer runoff, vehicular wash water or "tracing dye"
Milky white	Paint, lime, milk, or grease
Milky or dirty dishwater gray	Gray water or wastewater, musty odor present
Black	Septic wastewater, sulfuric acid spill or a turnover of oxygen depleted water. Hydrogen sulfide odor usually present.
Dark red, purple, blue, black	Industry - fabric dye, paper ink
Orange-red	Leachate from iron deposits; Tracing dye; Deposits on stream beds often associated with oil well operations such as brine waterdischarges; oily sheen or petroleum odor may be present
Bright yellow green	Anti-freeze, tracing dye or algal bloom

PHYSICAL: ODOR

ODOR IS SUBJECTIVE AND CAN CHANGE OVER TIME AS THE DISCHARGE DILUTES OR CHANGES CHEMICALLY, GOOD FIRST INDICATOR BUT ONLY IN TANDEM WITH OTHER.

Odor	Possible Sources
Musty	Raw or partially treated sewage, livestock waste, algae
Rotten egg/ Hydrogen Sulfide	Raw sewage, sulfuric acid, anaerobic water
Sewage/fecal	Raw sewage
Chlorine	Broken drinking water line, sprinkler runoff, swimming pool backwash water, wastewater treatment plant discharge, industrial discharges
Sharp, pungent odor	Chemicals or pesticides
Gasoline, spent petroleum	Industrial discharge, illegal dumping of wastes or waste water.

- **REMINDER:** Never inhale the air directly off the top of a sample

PHYSICAL: FLOATABLES

- **Contaminated flows may contain floatable solids or liquids.**
  - **Sewage**, oil sheen, and suds/foam are examples of floatable indicators
    - *Trash and debris, although more typically known as "floatables," are not generally indicators of illicit flow.*
  - **Sheens** can be naturally-produced or synthetic; oil sheens are often mistaken for naturally-produced sheen.
    - *Sheen from bacteria forms a sheet-like film that breaks if disturbed.*
  - **Suds** should be rated based on their foaminess and staying power.
    - *Suds that travel several feet before breaking up should be considered as a possible illicit discharge.*
    - ***In some cases, foam and suds can give off an odor***
      - A strong organic or sewage-like odor can indicate a sanitary sewer leak or overflow.
      - A fragrant or sweet-smelling odor can indicate the presence of laundry water or similar wash waters.

SEWAGE EXAMPLES

Sewage fungus

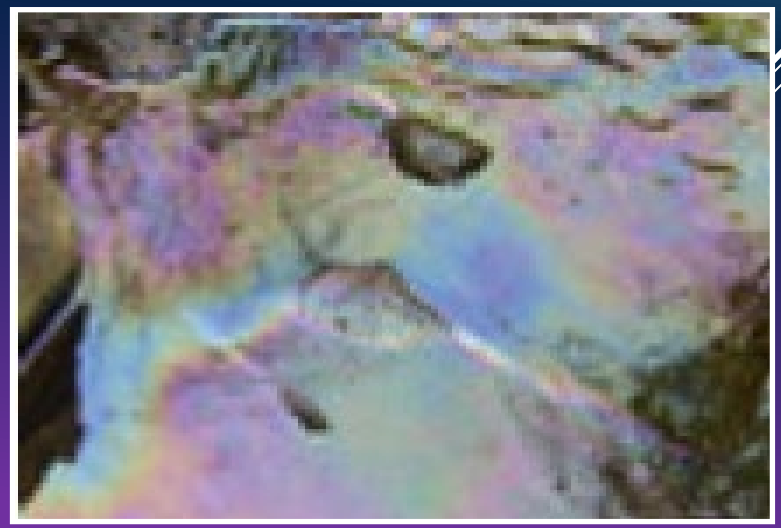
Temporary “septic system”

SHEEN EXAMPLES

Natural sheen

VS

Synthetic sheen



SUDS EXAMPLES

Low severity suds (natural)

VS

High severity suds (laundromat)

BIOLOGICAL INDICATORS

Biological Indicators	Things to Consider
Vegetation	Increased or inhibited plant growth, as well as dead and decaying plants, near storm water outfalls is often a sign of pollution.
Algae	An overabundance of nutrients can cause elevated plant growth or algae blooms. During an algae bloom, the water body typically becomes a pea-green color; however, the color depends on the dominant species of algae present.
Bacteria	The amount and types of bacteria present can be extremely significant. Bacteria can be associated with inadequately treated sewage, improperly managed waste from livestock, failing septic systems, pets in urban areas, and wildlife (e.g., birds nesting under a bridge). Although some types of bacteria are visible to the naked eye – such as sewage fungus or natural sheen, counts for indicators like *E. coli* are done in the laboratory.
Fish Kills	Fish kills can be caused by a wide variety of factors including a decrease in dissolved oxygen, infectious disease, a rise in water temperature, toxic algae blooms, parasites, and bacterial or viral infections. The loss of a single fish is typically a natural occurrence and is not usually a cause for concern.

BIOLOGICAL EXAMPLES

Bright red bacterial growth

Fish Kill

Sporalitis filamentous bacteria

Algal Bloom

Invasive Vegetation Overgrowth

Dense blook of green algae “Cladophora”

Environmental Effects: Fish Kills

- **Reporting a Kill—Make note of the following items if possible:**
  - Take pictures
  - Location, date, and time
  - Color, clarity, and any odor
  - Recent weather
  - Relative water temp to ambient air temperature
  - pH, chlorine, Dissolved Oxygen (DO), turbidity, conductivity, and Total Dissolved Solids (TDS)
  - Number, size, and species of affected organisms
  - Condition and behavior of animals or organisms

  Written report to TPWD & TCEQ <u>within 5 days of the kill</u>

- **TPWD Notification Guidelines— Call Kills and Spills Team (KAST)**
- **24 hour Communications Centers - (512) 389-4848 or (281) 842-8100**
  - TPWD staff will relay the information directly to the Regional Biologist
- **TCEQ Region 4 Reporting—Notification Guidelines**
  - **Fish Kills = Automatic Enforcement Action *(30 TAC §327)***
  - **During business hours**
    - Call TCEQ R4 main number, (817) 588-5800, ask to speak with person answering calls for the Water Section
  - **Outside business hours**
    - Emergency/Spill Hotline at (800) 832-8224

CHEMICAL INDICATORS: PARAMETERS

At least 15 different indicator parameters can confirm the presence or origin of an illicit discharge.

1. Ammonia
2. Boron
3. Chlorine
4. Color
5. Conductivity
6. Detergents
7. *E. coli*, enterococci, and total coliform
8. Fluorescence
9. Fluoride
10. Hardness
11. pH
12. Potassium
13. Surface tension
14. Surfactants
15. Turbidity

- **In most cases only a small subset of indicator parameters (e.g. 3-5) is required to adequately characterize an illicit discharge.**

2-TIERED APPROACH TO "CONCERN"

- **Tier 1 parameters should be checked at every field inspection.**

Tier I Parameters	Level of Concern
Ammonia-nitrogen	1.0 mg/L
Chlorine	0.2 mg/L
Conductivity	1500 µS/cm
Copper	0.2 mg/L
Detergent	0.2 mg/L
pH	<6.0 su or >9.0 su

- **Tier 2 parameters do not need to be tested at every field inspection unless you see an obvious reason to do so.**

Tier II Parameters	Level of Concern
*Bacteria (Fecal coliform; *E. coli*)	400 col/100 mL 394 col/100 mL
*Dissolved oxygen	Exceptional: 4.0 mg/L High/Intermediate: 3.0 mg/L Limited: 2.0 mg/L Minimal: 1.5 mg/L
Fluoride	0.5 mg/L
Lead	0.1 mg/L
Nickel	0.2 mg/L
Nitrogen, nitrate, nitrite	1.0 mg/L
Phosphates	0.5 mg/L

Chemical Indicators…of what?

Tier I Parameters	Potential Sources
Ammonia-Nitrogen	Microbial decomposition of animal and plant proteins, sanitary wastewater, raw or partially-treated sewage, petroleum refining and chemical industries, synthetic fibers and dyes, drugs, pesticides, and fertilizer
Chlorine	Used to indicate inflow from potable water sources; used as disinfectant in water and wastewater treatment processes
Conductivity	Used to measure total dissolved solids (TDS); TDS can increase as a result of wastewater discharges, irrigation, and overuse of fertilizers
Copper	Can indicate waste from manufacture of electrical components, coins, bronze, and brass products
Detergent	Can indicate a discharge from wash water or laundry
pH	Extreme pH values (low or high) may indicate commercial or industrial flows

Tier II Parameters	Potential Sources
Bacteria (Fecal coliform; *E. coli*)	Can be found in the feces of human and other warm blooded animals from direct discharge
Dissolved Oxygen (DO)	Low DO can indicate sewage problem or excessive nutrient load; as water temperature increases, DO generally decreases
Fluoride	Potable water
Lead	Used in construction material for tank linings, piping, and other equipment for corrosive gasses and liquids
Nickel	Used in making stainless steel and other alloys, coinage, armor plates
Nitrogen Nitrate/Nitrite	High levels of nitrate may indicate biological waste or runoff from heavily fertilized areas; nitrites are often used as corrosion inhibitors in industrial process and cooling water and are used in food as preservatives
Phosphates	Found in fertilizer and industrial waste

How do you interpret the hit?

- Three (useful) Methods:

1. Flow Chart Method

   *Recommended for residential, or typical (domestic) wastewater

2. Industrial Flow Benchmarks

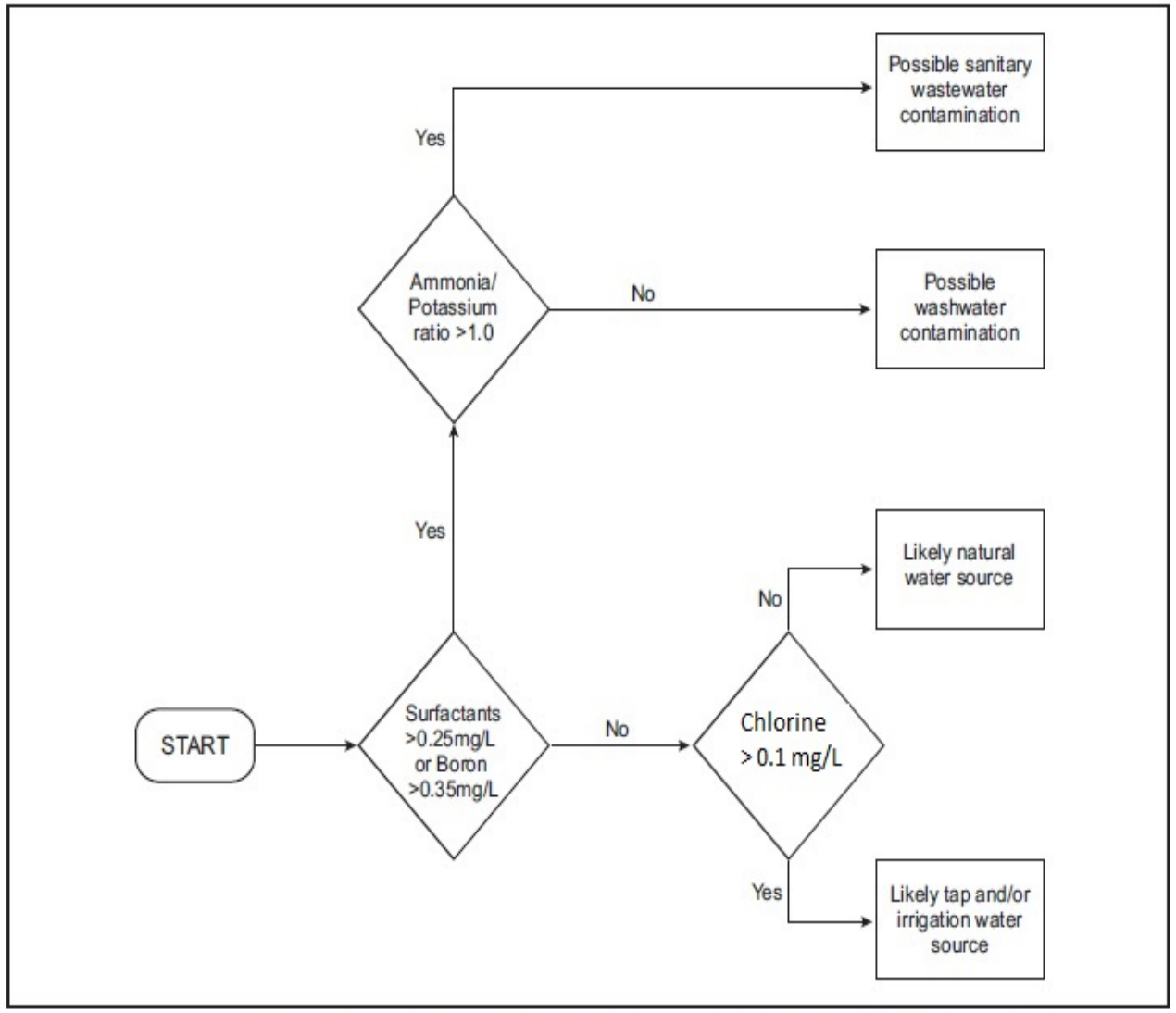
   *Wide range of potential indicators, but 7 help

3. Single Parameter Screening

   *Useful though not very specific

   *However, gives you something to “follow” (trace)

(1) Flow Chart Method (Residential)



Flow Chart to Identify Illicit Discharges in Residential Watersheds

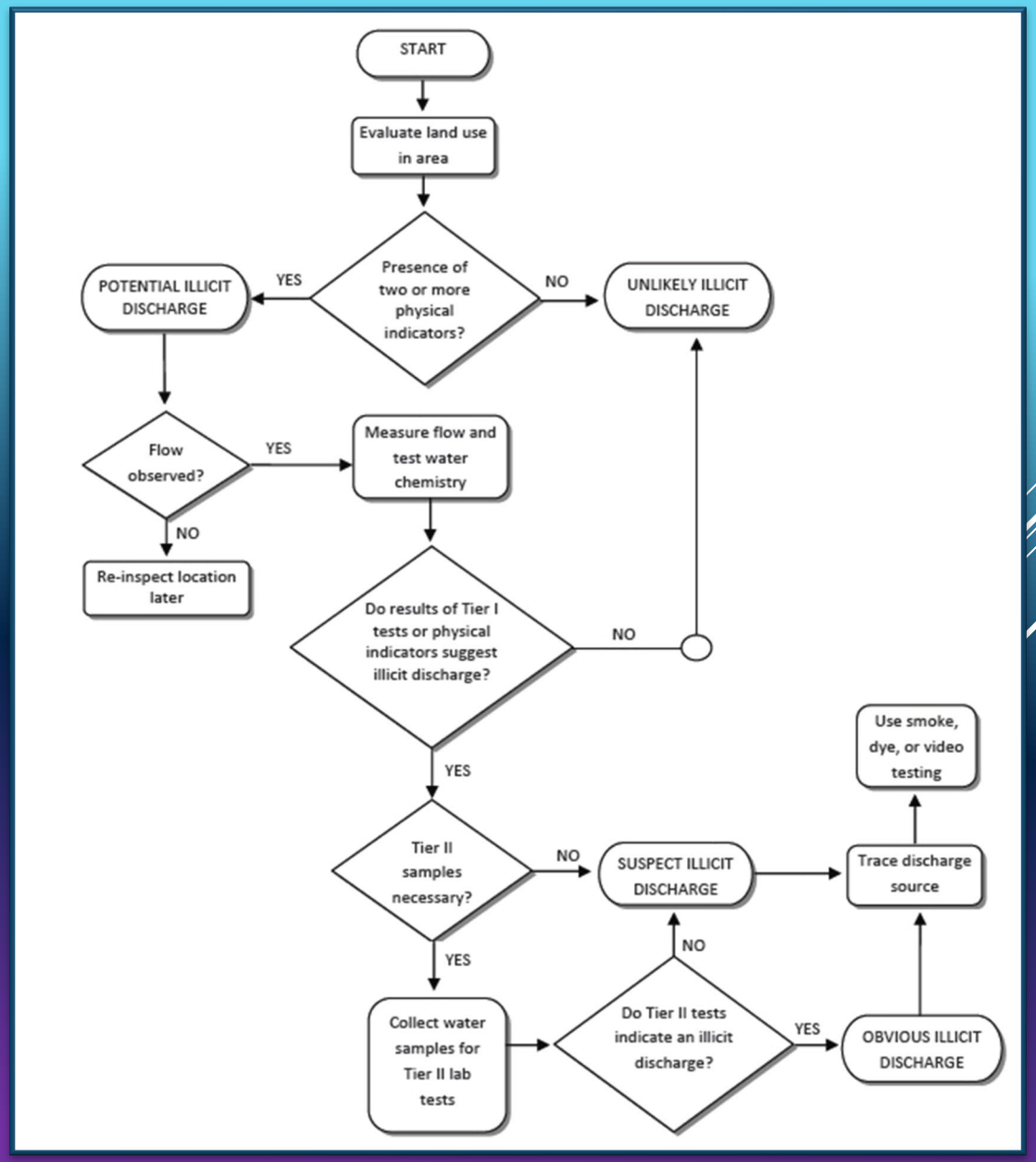
Step 1: Separate clean flow from contaminated flows using surfactants (=Sanitary/Wash water)

Step 2: Separate wash water from wastewater (Ammonia/Potassium Ratio; or just look at Ammonia and consider bacteria test)

Step 3: Separate tap water from natural water (Chlorine or Fluoride)

If the watershed is highly industrialized, best to move on to the Industrial Flow Benchmarks Method

A Good Flowchart for all IDDE Investigations



(2) Industrial Flow Benchmarks Method

- **Seven indicators**
  - ammonia, color, conductivity, hardness, pH, potassium and turbidity.
  - can be used to identify liquid wastes and other industrial discharges
- These are not a complete list but can help to make sense of some of the results.
- Following slide has a strong list of various chemical and physical properties of industrial non-Stormwater discharges associated with various SIC-codes.

[redacted] Benchmark Concentrations to Identify Industrial Discharges

Indicator Parameter	Benchmark Concentration	Notes
Ammonia	≥50 mg/L	• Existing "Flow Chart" Parameter • Concentrations higher than the benchmark can identify a few industrial discharges.
Color	≥500 Units	• Supplemental parameter that identifies a few specific industrial discharges. Should be refined with local data.
Conductivity	≥2,000 µS/cm	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources.
Hardness	≤10 mg/L as CaCO3 ≥2,000 mg/L as CaCO3	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources.
pH	≤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.
Potassium	≥20 mg/L	• Existing "Flow Chart" Parameter • Excellent indicator of a broad range of industrial discharges.
Turbidity	≥1,000 NTU	• Supplemental parameter that identifies a few specific industrial discharges. Should be refined with local data.

(3) Single Parameter Sampling

- Surfactants (Detergents) are the best single parameter for illicit discharges (sewage and wash water).

- Ammonia-Nitrogen is also very good indicator (sewage)
  - Dilution can be a problem, and not all ammonia hits will be wastewater

- Wide range of potential pollutants mean that you won't necessarily be certain of the source, with a single parameter sample, but can certainly give you a usable indicator for drainage area investigations (i.e.: tracing to the source!).

- Not "knowing" the source doesn't mean you shouldn't try to find it!
  - Where there's "smoke" there's probably fire.

The Investigation is ALL ABOUT:

→ Isolating and Fixing

- ✓ The illicit discharge has already reached your MS4
- ✓ You have identified it, might have an idea of what could be causing it
- ✓ The best thing we can hope for is to stop the discharge, and prevent it from happening again

Basic Methods for Isolating & Fixing Illicit Discharges

- **Isolating:**
  - Pollution reporting hotline (if not found in DWFS/monitoring)
  - Trunk investigations
  - Drainage area investigations
  - On-site discharge investigations
- **Fixing:**
  - Correction
  - Enforcement

Illicit Discharge Investigations

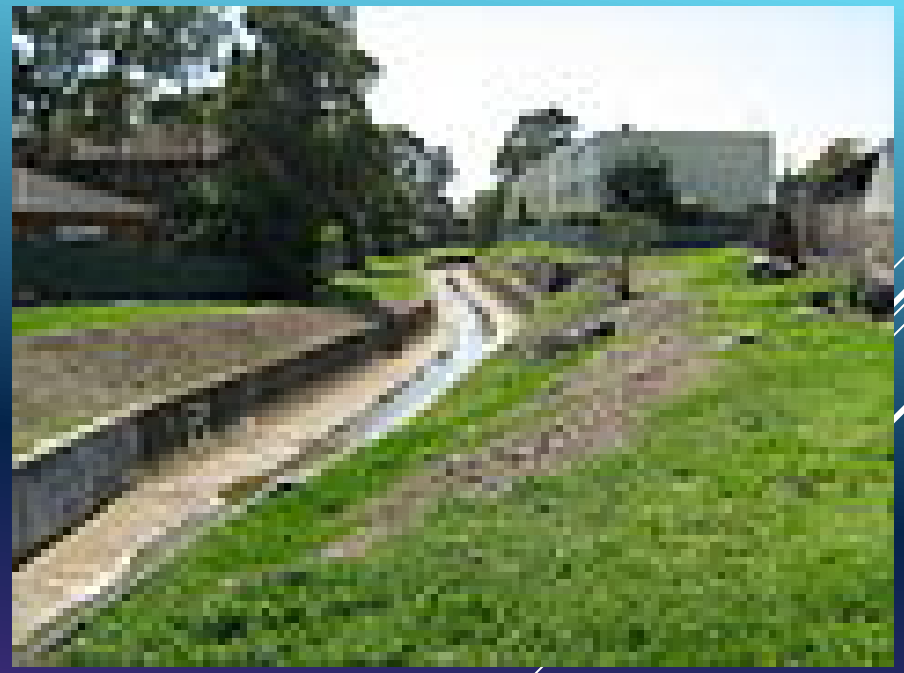
- (1) Storm drain network investigations
- (2) Drainage area investigations
- (3) On-site investigations
- (4) Septic/sanitary system investigations

- Goal is always to **narrow down the source** of the discharge to a single storm sewer pipe/conveyance, building cluster, or individual site

- **ALWAYS DOCUMENT, DOCUMENT, DOCUMENT:**
  - Dates, times, locations, personnel, observations, pictures, results of analyses, etc.

(1) Storm Drain Network Investigations

- **AKA: "Trunk Investigations"**
  - Goal is to narrow down the source of the discharge to a single storm sewer pipe
  - Investigation starts at the outfall, but where you go next is an important consideration
  - Field crew decides how to explore the upstream pipe network (3 variations):
- (1) Work progressively **up the trunk from the outfall** and test manholes along the way
  - Can begin immediately when an illicit discharge is detected at an outfall
  - Only a map of the storm drain system is required
- (2) **Split the trunk into equal segments** and **test manholes** at strategic points of the storm drain system
  - Requires a little more preparation to examine the storm drain system
  - Find the most strategic manholes to sample.
- (3) Work progressively **down the trunk** (from the headwaters of the storm drain network and move downstream)
  - Harder to determine headwaters, but can be done with research



Trunk Investigation Example

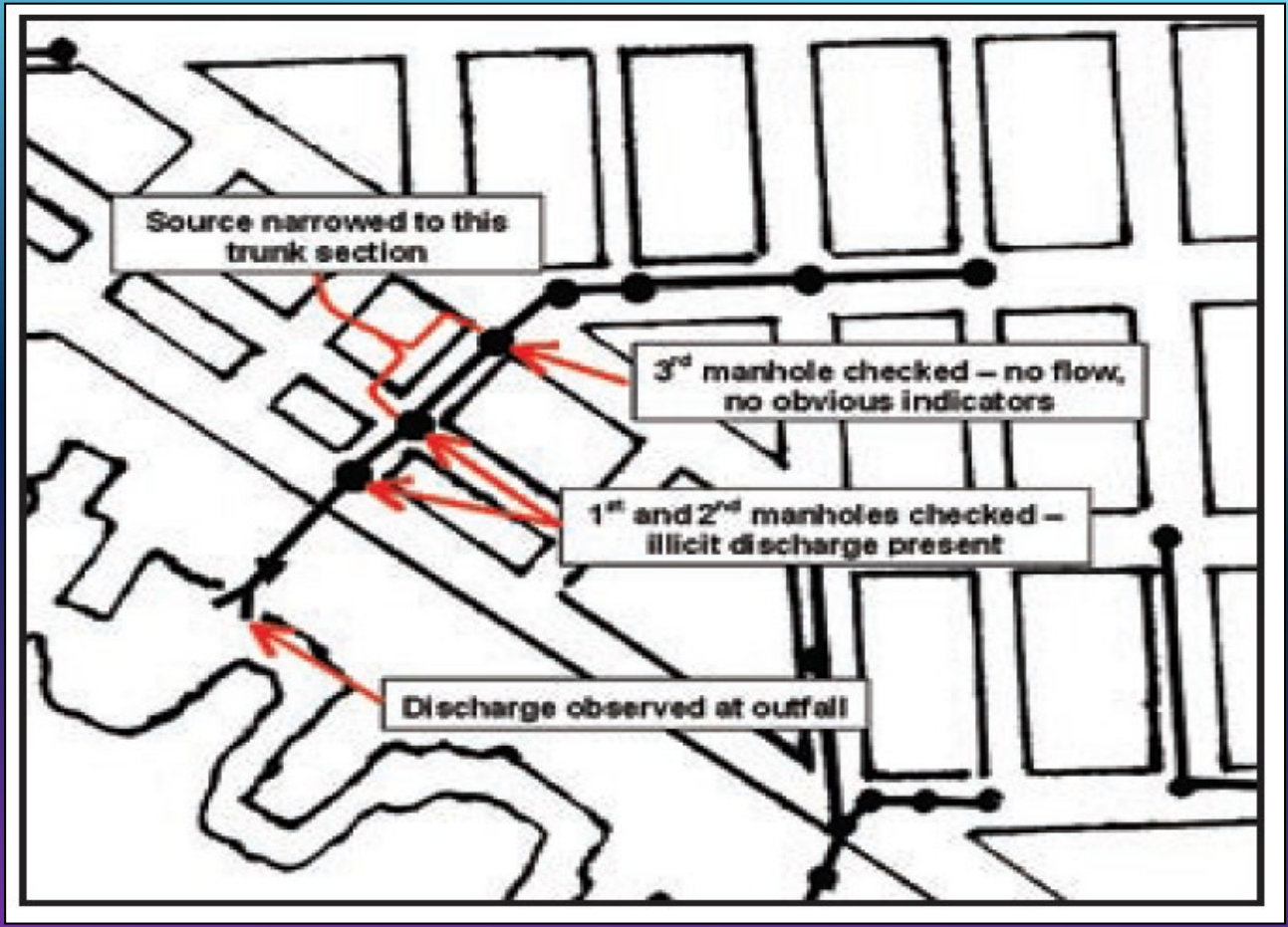


Table 53: Methods to Attack the Storm Drain Network

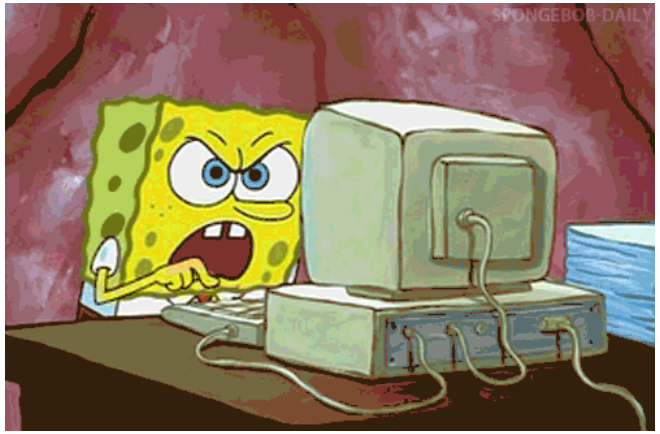
Method	Nature of Investigation	Drainage System	Advance Prep Required
Follow the discharge up	Narrow source of an individual discharge	Small diameter outfall (< 36") Simple drainage network	No
Split into segments	Narrow source of a discharge identified at outfall	Large diameter outfall (> 36"), Complex drainage Logistical or traffic issues may make sampling difficult.	Yes
Move down the storm drain	Multiple types of pollution, many suspected problems—possibly due to old plumbing practices or number of NPDES permits	Very large drainage area (> one square mile).	Yes

“Trunk Investigation” (key elements)

- Visual inspection at manholes
- Indicator sampling (water quality probes, kit analyses, lab analyses) at manholes
  - Look for hits on what you’ve already found (whatever triggered the investigation)
  - If no hit, **mark off the manhole and it’s feeder pipe** (on your handy **drainage map**)
- Safety first!
  - It is likely a confined space, are you qualified/prepared to enter?
  - If not: Do NOT enter, use a sampling pole or peristaltic pump
  - Use your PPE (gloves, reflective vests, boots, etc.)
  - **Protect the yourselves AND the public** (use traffic cones, consider time-0f-day for traffic changes, have someone alerting/watching traffic, know the weather forecast!)
- Sandbagging or damming the trunk can help to create a pool to sample from (useful in very low flow conditions)

(2) Drainage Area Investigations

1. **Start in the office**
   - Parcel by parcel search of potential pollutant sources in drainage basin
   - Land use investigations
   - SIC code review
   - Permit review
   - As-built review
   - Aerial photography analysis
   - Infrared aerial photography analysis
   - Property ownership certification



2. **Progress to field work**

- NOTE: Most appropriate in **complicated sewer networks**, and useful when there is a discharge that seems specific to a particular type of land-use/generating site

(3) On-Site Investigations

- Once the likely storm drain segment is isolated (from 1&2)
  - Descend on the site!

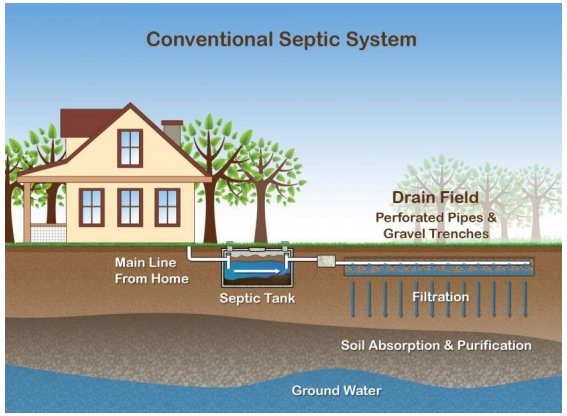
- On-site investigations can involve the more **advanced** smoke/dye-testing from buildings/homes/facilities in the drain segment
  - Video is useful to find source flows, cross-connections, or broken pipes
  - These ADVANCED METHODS will be discussed in Advanced DWFS Training

- Can be an opportunity to conduct MSGP inspections (to identify poor SWPPP practices) or unpermitted dischargers

- KEEP LOOKING until you find it
  - If you can't find it, consider more specific sampling OR alternate search method

(4) Septic System Investigations

- **Most useful in low density residential watersheds**
  - Most common illicit discharges are septic systems and illegal dumping
- **If OSSFs(On-site Sewage Facilities) are present/prevalent in drainage area**
  - Get your Designated Representative involved
  - Consider alternative investigatory methods; look for:
    - Surface breakouts of septic fields
    - Straight pipe discharges from bypassed septic systems
    - Broken sprinkler heads
    - Obvious waste residue (toilet paper, fecal matter, foams)



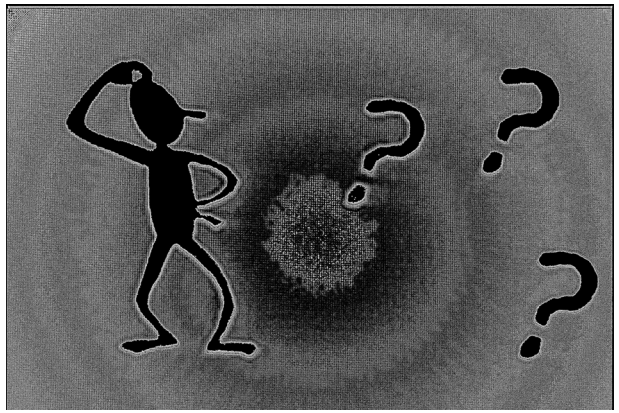
- **Septic systems are a classic case of "out of sight and out of mind."**
  - Many owners take their septic systems for granted, until they back up or break out on the surface of their lawn.
  - Subsurface failures, which are the most common, go unnoticed.
  - In addition, inspections, pump outs, and repairs can be costly, so many homeowners tend to put off the expense until there is a real problem

“Fixing” the Discharge

- ✓ Make a plan
- ✓ Make it fast
- ✓ Make it smart
- ✓ Make it work!!
- ✓ Time is of the essence.
  - Transitory discharges may not persist for long

FIXING THE DISCHARGE

- **Four** questions should be answered for each isolated illicit discharge:
  1. **Who** is responsible?
  2. **What** methods will be used to repair?
  3. **How long** will the repair take?
  4. **How** will removal be **confirmed**?



- All of these should be identified & documented (ASAP)

- But first… gain access!
  - If the isolated discharge comes from private property, attempt to contact owner and request entry
  - If entry is denied, gather evidence and submit an Affidavit of Probable Cause
    - aka: Access Warrant

Fixing the Discharge

Generally, the answers (to the 4 questions) will depend on the type of discharge:

- **An internal plumbing connection** (e.g., the discharge from a washing machine is directed to the building's storm lateral; the floor drain in a garage is connected to the building's storm lateral)
- **A service lateral cross-connection** (e.g., the sanitary lateral from a building is connected to the MS4)
- **An infrastructure failure within the sanitary sewer or MS4** (e.g., a collapsed sanitary line is discharging into the MS4)
- **An indirect transitory discharge resulting from leaks, spills, or overflows.**

Fixing the Discharge

Responsibility

- Financial responsibility for source removal will typically fall on property owners, MS4 operators, or a combination of the two

Repair

- Methods for removing illicit discharges usually involve a combination of **education** and **enforcement,** but sometimes it just takes a plumber.
- Other times, in the case of dilapidated infrastructure, it takes a large effort on the part of the MS4!

Timeline

- Identify an acceptable timeline (hazards to public health should be repaired rapidly)

Confirmation

- What will it take to show that this discharge has been fixed?
  - More sampling? Documentation of repairs completed?
  - Answer: Likely Both!

KEY REMINDERS

- Most illicit discharge corrective actions involve some form of infrastructure modification or repair.
- Structural repairs are used to eliminate a wide variety of **direct discharges**
  - Sewage cross-connections, straight pipes, industrial cross-connections, and commercial cross-connections.
  - Fixes range from simple plumbing projects, to in-pipe repairs, to excavation and replacement of sewer lines.
  - In some cases, structural repairs are necessary when **indirect** discharges, such as sewage from a sewer break or pump station failure enter the MS4 through an inlet, or flows directly into receiving waters.
- Most **transitory** discharges are corrected simply with spill containment and clean-up procedures.

Repairing/Fixing the Discharge

Methods to Fix Illicit Discharges		
Type of Discharge	**Source**	**Removal Action(s)**
Sewage	Break in right-of-way	Repair by municipality
	Commercial or industrial direct connection	Enforcement
	Residential direct connection	Enforcement; Incentive or aid
	Infrequent discharge (e.g., RV dumping)	Enforcement; Spill response
	Straight pipes/septic	Enforcement; Incentive or aid
Wash water	Commercial or industrial direct connection	Enforcement; Incentive or aid
	Residential direct connection	Enforcement; Incentive or aid
	Power wash/car wash (commercial)	Enforcement
	Commercial wash down	Enforcement
	Residential car wash or household maintenance-related activities	Education
Liquid wastes	Professional oil change/car maintenance	Enforcement; Spill response
	Heating oil/solvent dumping	Enforcement; Spill response
	Homeowner oil change and other liquid waste disposal (e.g., paint)	Warning; Education; Fines
	Spill (trucking)	Spill response
	Other industrial wastes	Enforcement; Spill response

Fixing the Discharge: Enforcement v. Education

- An escalating enforcement approach is often warranted and is usually a reasonable process to follow
  - Voluntary compliance should be used for first-time, minor offenders
    - Property owners are often unaware of a problem and are willing to fix it when **educated**.
  - More serious violations (or continued non-compliance) may warrant a more aggressive, enforcement-oriented approach.
- The authority and responsibility for correction and enforcement should be clearly defined in ordinances (or SOPs)
  - If your city prefers to write citations, so be it!
  - Follow your Standard Operating Procedures

15 Minute Break

ADVANCED SOURCE DETECTION METHODS

- Smoke testing
- Dye testing
- Optical brighteners
- Video testing

SMOKE TESTING

- Smoke testing is the industry standard and an efficient, cost-effective way to locate and identify leaks and the source of storm water infiltration problems in the sanitary sewer system.
- It works by **introducing smoke** into the (storm) sewer system and observing **where** the **smoke surfaces**.
  - Generally, a waste-water technique, but applicable to storm
- Can detect structural damages and leaking joints in sewer pipes and overflow points
- Notifying the public about the date and purpose of smoke testing before starting is critical.

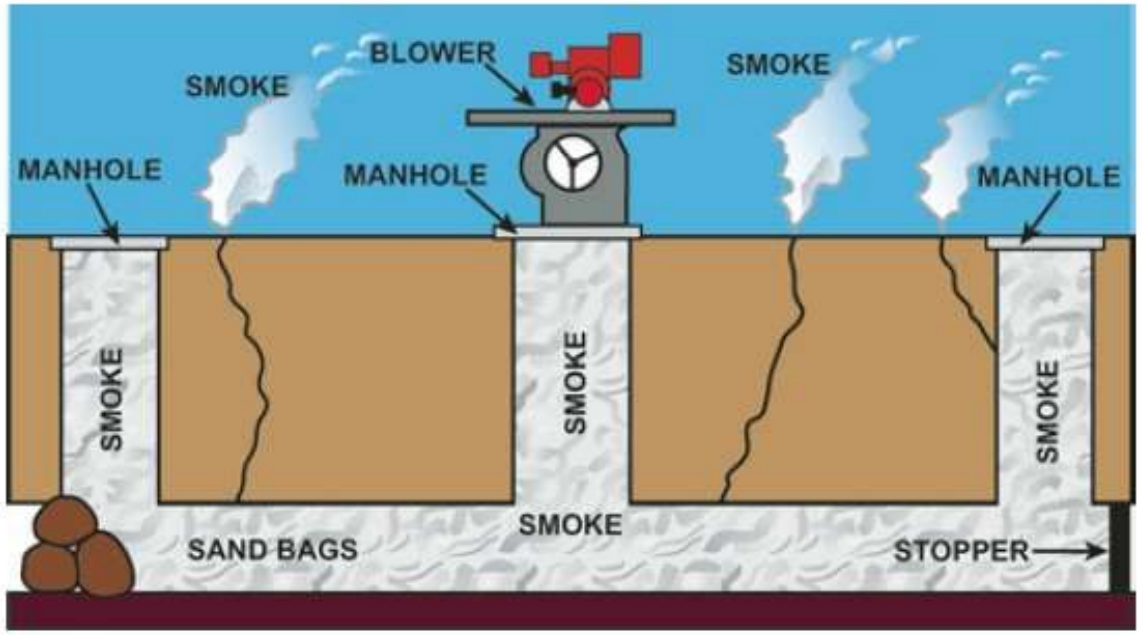
Residents should be notified at least two weeks prior to testing.

HOW DOES A SMOKE TEST WORK?

- A non-toxic smoke is blown into manholes.
- The smoke makes it way through all the connected pipes in the sanitary sewer, helping to locate:
  - Pipe leaks
  - Broken Manholes
  - Cracks
  - Uncapped Lines and Etc……
- During testing, unknown sections of pipe such as clean outs, roof downspouts, sump pumps and even unknown connections of pipe can be discovered.

SMOKE TESTING FACTS

- Smoke is **non-toxic** and **non-hazardous,** but can cause respiratory irritation, which can be a problem for some residents
- Leaves **no** residuals or stains
- Has no effects on plants or animals
- During smoke test, homeowners may see smoke coming out of grass, utility boxes, cracked pavement and more.



Smoke Testing System Schematic

DYE TESTING

Dye testing uses a brightly colored, fluorescent substance to detect:

- ⟶ leaks in the sewage system
- ⟶ locate illegal sewer connections
- ⟶ trace cross connections
- ⟶monitor flow studies
- ⟶ analyze septic systems
- ⟶ track groundwater movement.

Dye Testing Methods

➢ If a residential property is suspect

- Dye can be placed in the house clean-out and washed downline using a nearby hose (seek permission from the property owner first).
- If dye surfaces in the storm drain system, then the problem most likely exists in the service line for this private property.
- The property owner should be informed of the situation and served a notice to make necessary repairs.

➢ When a commercial property needs to be tested

- Dye should be flushed down a restroom toilet or washed down the janitor's sink (speak to manager or owners first).
- Flush quickly and repeatedly to prevent staining.
- If dye surfaces in the storm system, it is most likely the commercial business responsibility to fix the problem.
- Inform the manager or owner and serve a notice to make repairs.

Dye Testing Methods

- **To dye test a sanitary sewer line**
  - Choose a sanitary manhole upstream of the storm water outfall **or** upstream of where the sanitary line crosses the storm line **or** upstream of the area of concern.
  - Choose the upstream sanitary manhole that has no odor, color, or any other relevant observations that may signify a pollution source.
  - If dye surfaces in the storm drain system, the problem and responsibility most likely lies with the city or utility district.

DYE TESTING: WHERE'D THE DYE GO?

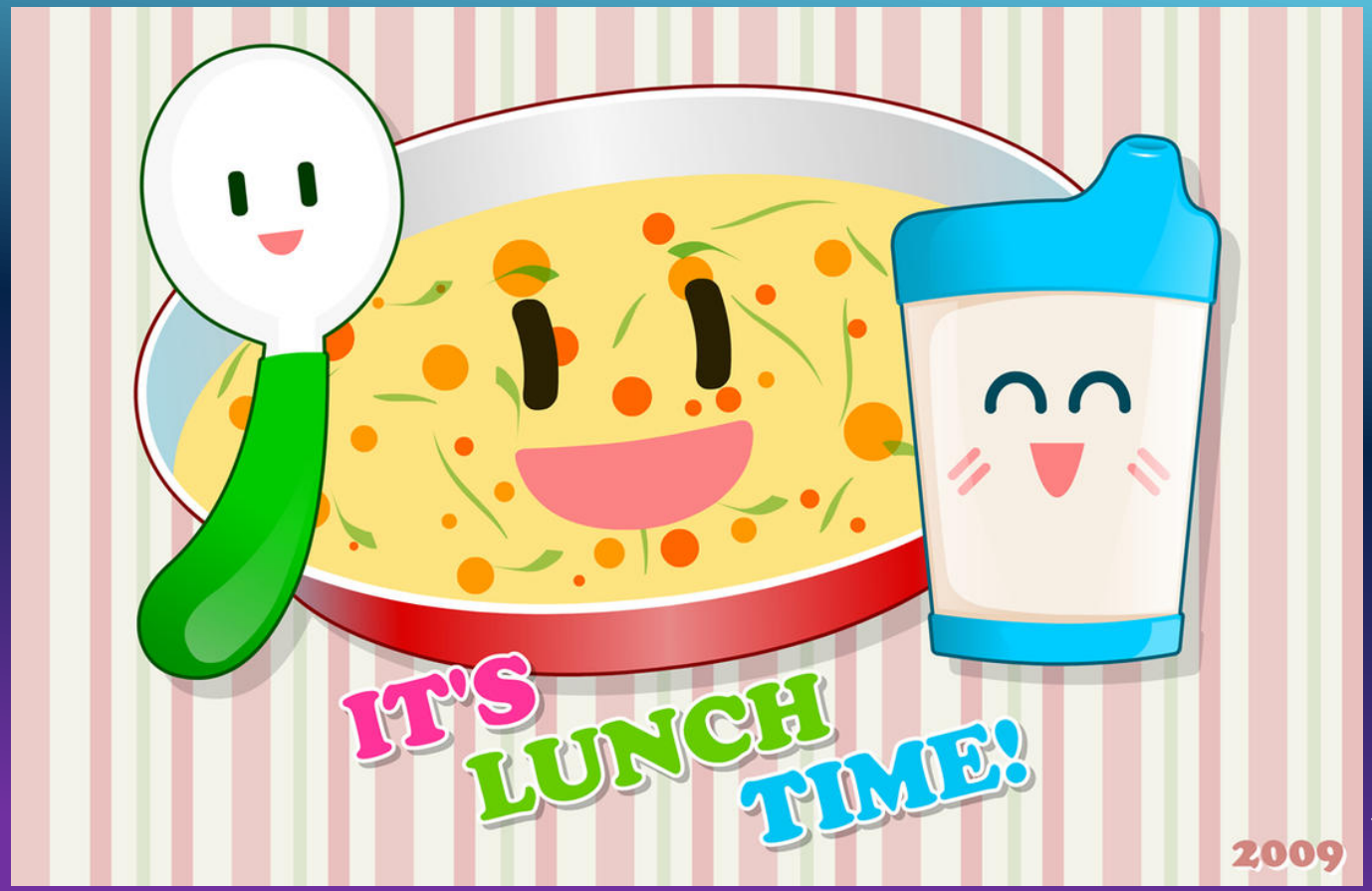
- If dye **does not** surface in the storm drain after a period of time
  - **Or** if the investigator cannot wait for the dye to surface
  - Secure charcoal packets any place where dye is expected to surface.
  - Leave the packets in place for a week or two then retrieve and analyze.
  - The analysis involves mixing the charcoal with KOH solution and then pouring into a vial to check for fluorescence.

- **Locating Missing Dye**
  - The investigation is not complete until the dye is found. **Some reasons for dye not appearing include:**
    - The building is hooked up to a septic system.
    - The sewer line is clogged.
    - There is a leak in the sewer line or lateral pipe.

- **Virtual Video, City of Arlington**
  - Smoke Testing

QUESTIONS?

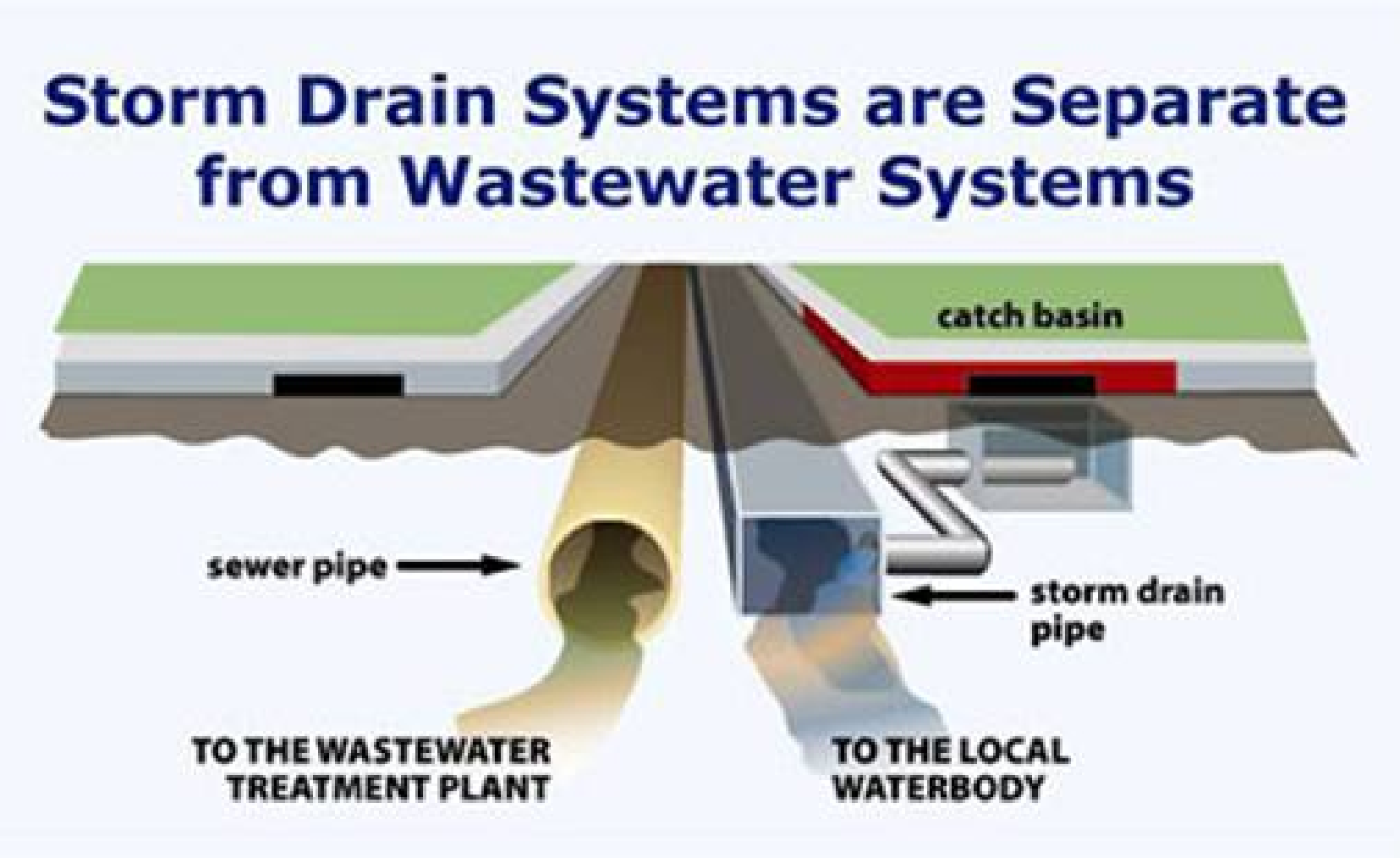
We will be back @ 1:15pm



SESSION 2

- The Stormwater/Wastewater Nexus
- Sanitary Sewer Maintenance Programs
- Additional Advanced Source Detection Methods
- Case Studies

WHAT IS THE WASTEWATER-STORMWATER NEXUS?



Stormwater-Wastewater Nexus

- The TCEQ TPDES permitting system is comprised of Stormwater AND Wastewater Permits
  - This is because they both contribute to surface water quality degradation, if not well managed/regulated.
  - The Stormwater program alone **will not** prevent Stormwater pollution.

The Stormwater-Wastewater Nexus

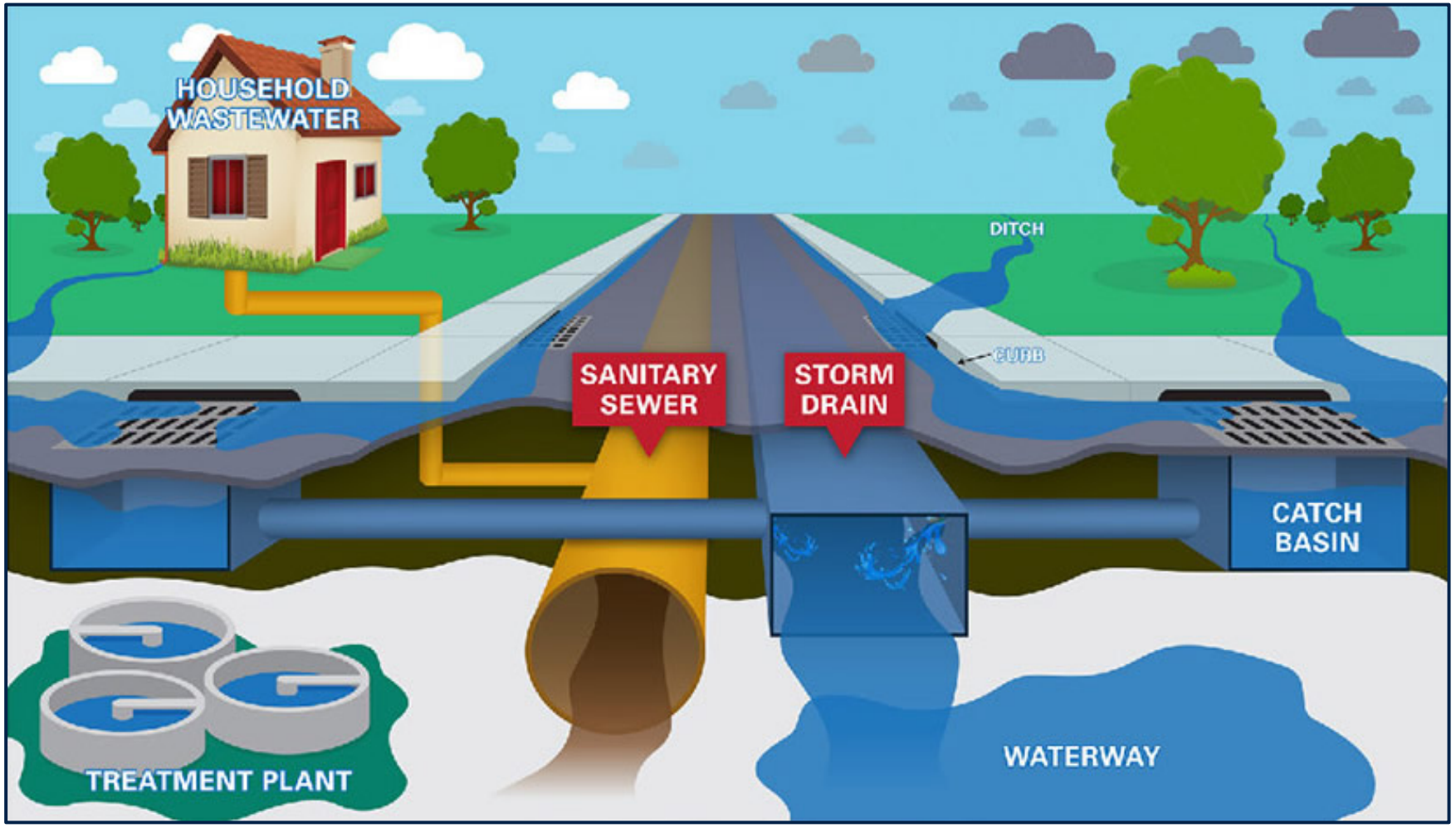
- A Stormwater conveyance system is **not** an MS4 if combined with wastewater
  - **Combined Sewer System**
- A failure of a (separate) Sanitary Sewer will result in a discharge of untreated wastewater into the environment.
- Stormwater is the conduit by which wastewater discharges will enter surface waters of the U.S. (run-off flushes everything it encounters)
- The components of wastewater are toxic, pathogenic, and a massive public (and environmental) health concern.

The Stormwater-Wastewater Nexus

- Illicit discharges of wastewater can enter the MS4 through a variety of paths:
  - Direct connections such as piping mistakenly (or deliberately) connected to storm drains
  - Indirect connections such as infiltration into the MS4 from cracked sanitary sewer pipes
- **Wastewater here defined as:**
  - Domestic:
    - Water that has constituents of human and/or animal metabolic wastes
    - Water that has the residuals from cooking, cleaning and/or bathing
- **Industrial/Commercial:**
  - Water that has been used for industrial/commercial operations, and is now contaminated
  - Discharges from these sources may contain pollutants at levels that could affect the quality of receiving waters OR interfere with **Publicly Owned Treatment Works** (POTWs) that receive those discharges
  - When a POTW is affected by illicit discharges, a **Sanitary Sewer Overflow** (SSO) can occur, which invariably enters the MS4

City Wastewater Systems

- Drains, Pipes, Lift Stations, Manhole Covers, Wastewater Treatment Plants (WWTP), all convey wastewater away from our homes and businesses.



CITY WASTEWATER SYSTEMS

- Wastewater infrastructure requires maintenance
  - All can fail for one reason or another!
  - But the failure is not **readily apparent** when these systems are designed and installed to be out of the public eye
    Underground networks, treatment plants tucked out of sight

- Wastewater conveyance systems are aging, constantly in need of update/repair, and networks are growing (new pipes, lift stations, WWTPs)

- Additionally, individuals and businesses have been known to make illicit connections to these systems, without knowledge of cities
  - The potential for improperly designed/installed connections constitutes a big problem

Sanitary Sewer System Maintenance Programs

- **CMOM: Capacity, Management, Operations, and Maintenance Programs keep these systems running smoothly**
  - Under certain conditions, poorly designed, built, managed, operated, and/or maintained systems can pose risks to public health, the environment, or both.
  - These risks arise from sanitary sewer overflows (SSOs) from the collection system
  - Or by compromised performance of the wastewater treatment plant.
  - Effective CMOM, and ensuring adequate capacity and rehabilitation, when necessary, are **critical**

- **I&I: Inflow and Infiltration is large concern**
  - A separate sanitary sewer system is designed to function at a permitted and designed capacity
  - Stormwater getting into the system will have the potential of overwhelming them, which can lead to an overflow at a treatment plant or elsewhere in the sewer network
  - Consequently, a failure (break in a line, open/cracked manhole, etc.) can lead to a direct discharge to the MS4

- **One failure might not have a large effect, but a large, unmaintained system is bound to have <u>many</u> failures; constant vigilance is required!**

I & I

- **There are three major components of wastewater flow in a sanitary sewer system:**
  - Base sanitary (or wastewater) flow
  - Groundwater **infiltration**
  - Rainfall derived inflow and infiltration (aka: **inflow**)

- **Virtually every sewer system has some infiltration and/or inflow.**
  - Small amounts of I&I are expected and tolerated.
  - I&I may be considered excessive when it is the cause of overflows or bypasses, or the cost to transport and treat exceeds the cost to eliminate it.
  - In cases where the I&I may not be considered “excessive” from a cost-to-eliminate perspective but causes health or environmental risks, **corrective actions are required**

APPLIED CMOM: SOURCE DETECTION

- Advanced Techniques described in today's training are integral to (and usually employed by) **CMOM** programs, by which they can determine where the system is failing or in need of upgrades/rehabilitation, with a **goal of preventing SSOs**
  - **Dye Testing**
    - Dye is added to wastewater drains in buildings, then the downstream sanitary sewer and adjacent storm sewers are monitored to see if the sewer network is properly connected
    - Will also show if there is any exfiltration, or cross-connections to MS4
  - **Video Testing**
    - Cameras are used to visually monitor wastewater lines for breaks, illicit connections, blockages, plant roots, etc.
  - **Smoke Testing**
    - Smoke is blown into sanitary sewers with the goal of identifying potential unsealed or inappropriate connections, as well as determining true layout of existing infrastructure

- **Stormwater professionals will seek to employ these tactics when trying to isolate a potential illicit wastewater discharge into the MS4 and trace it to its source.**

GETTING TO KNOW YOUR WATERSHED(S)

- **Know your watershed! (or waste-shed)**
- **If a previous Watershed Study hasn't been conducted, then you may:**
  - Delineate sub-watersheds or other drainage units within your community
  - Compile available mapping data for each drainage unit (e.g., land use, pipe networks, age, outfalls, infrastructure history)
  - Derive sub-watershed discharge screening factors (next slide) using GIS analysis
  - **Screen and rank illicit discharge potential** at the sub-watershed and community level
  - **Generate maps to support field investigations**

KNOW YOUR WATERSHED(S): LAND-USE

- **Residential** Generating Sites:
  - Failing OSSFs, oil dumping, vehicle washing, swimming pool discharges
- **Commercial** Generating Sites
  - Outdoor washing; disposal of food wastes; car fueling, repair, and washing; parking lot power washing; and poor dumpster management.
- **Industrial** Generating Sites:
  - Industrial process water or rinse water; loading and un-loading area washdowns; outdoor material storage (fluids)
- **Municipal/Institutional** Generating Sites:
  - All the above; road maintenance; disposal of rinse water, process water, wash water and contaminated, noncontact cooling water; Spills and leaks; ruptured pipes; and leaking underground storage tanks

- NOTE 1: **Density** of generating sites **increases** illicit discharge **potential**
- NOTE 2: Land-Use alone is **not always** the most **reliable** identification method, but it helps!
- NOTE 3: **Screening** is the best method to find discharges! (In addition to **citizen/staff reporting**

Additional Advanced Techniques: Optical Brighteners

- **Optical brighteners, or fabric whitening agents**
  - Good tracers because they indicate a presence of laundry effluent which is specific to humans
  - Also good for transitory flows
    - (an illicit gray-water connection will only flow when washer is being used)

- **OB's can be used to:**
  - Identify storm drain cross connections
  - Sewage system **Exfiltration**
  - Faulty septic systems
  - **PLUS** differentiate between human and animal waste

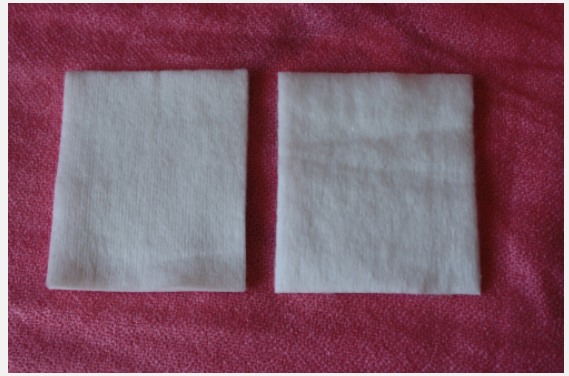
- **Equipment Needed:**
  - Individually wrapped, **untreated** cotton pads
  - Vinyl-coated "cages" to hold the pads
  - A 4–6-Watt fluorescent ultraviolet light box

OPTICAL BRIGHTENER TRACING: DEPLOYMENT METHOD

- **Optical brightener placement is best suited for pipes, storm drains and small streams(out of direct sunlight).**

  - Insert untreated cotton pad into the vinyl-coated cage and secure the cage shut using a zip tie or rubber band.

  - Secure the cage in the pipe, storm sewer, or stream using high test monofilament line tied to a rock, a manhole lid (with holes), aluminum (tent) spikes, or a nearby branch.



  - Collect bacterial samples (if needed) on the day of deployment.

  - Track the site ID, date of deployment, and various locations of cage(s).

  - Expose the cage device for approximately 7 days.
    - Leave out longer if heavy rainfall has occurred.
    - This time frame allows for at least one laundry event to take place.

  - If dry weather flow contains heavy sediment or debris, shorten the deployment time period.

  - Temporarily install a rain gauge at the site if possible.

OPTICAL BRIGHTENER TRACING: RETRIEVAL METHOD

- **Rinse the gauze pads in the receiving water** to remove excess sediment.
- **Squeeze excess water** from the pad and place pad in **clean zip lock baggie**.
- Label a piece of dark manila folder with the site ID or location, date of placement, amount of rainfall and the date of retrieval and staple to the gauze pad.
- Transport in a **dark container to minimize exposure to the sun.**
- Complete data sheets with the date of retrieval, number of days the pad was exposed to a flow and total rainfall.
- Return to office or lab and **dry pads by hanging them** on a **clean** monofilament line in a **dark area**.

OPTICAL BRIGHTENER TRACING: RETRIEVAL METHOD

- After the pads have dried, place the gauze pad (with attached label) **under a UV light to check for fluorescence**.
  - A UV light box is the simplest method for examining the pads, otherwise use a UV light strip in a darkened room.
- **Compare a "control" pad** (clean) to the dried pads and rate each as **Positive**, **Negative**, or **Inconclusive**.
  - A pad having a definite glow or fluorescence is positive for exposure to grey water.
  - A pad that looks like the control is negative for laundry wastewater.
  - Any pads with an inconclusive or questionable result should **have the location retested**.
  - Consider lengthening the new pad's exposure time.
  - **At least 10%** of the dried pads should be **re-read** by a second trained personnel **for Quality Control.**

Confirmation Techniques: Video Testing

- After the area of a possible pollution source is narrowed down (isolated)
  - The surrounding sanitary and/or storm sewer lines can be televised to locate the exact position of the break, infiltration, or cross connection.
- Useful when access to properties is constrained, such as residential neighborhoods.
- Video testing can also be expensive, unless the community already owns and uses the equipment for sewer inspections.
- This method is also much safer than having field personnel do confined space entries to look for pollution sources!

VIDEO TESTING: METHODS

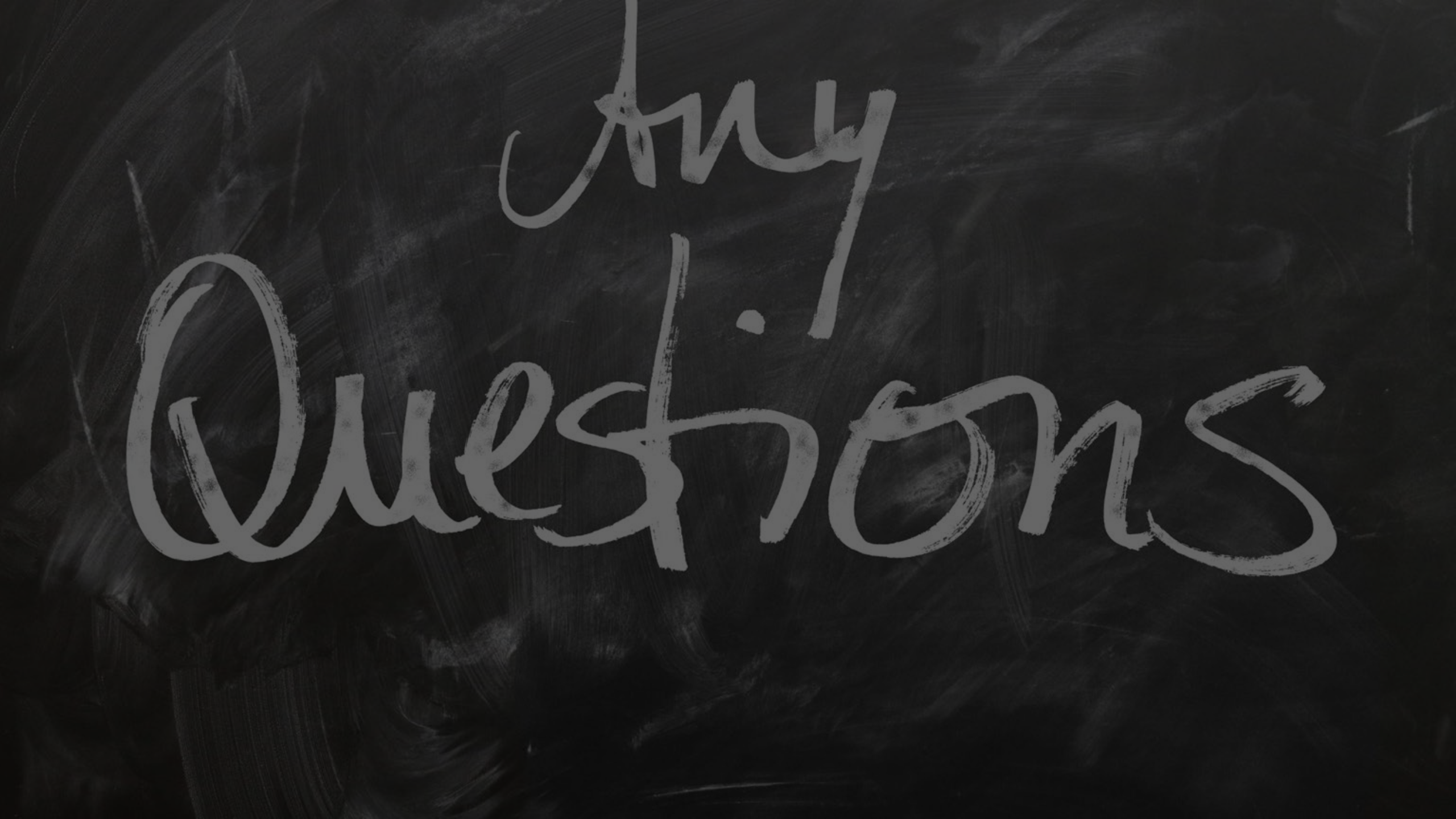
- Different types of video camera equipment are used, depending on the **diameter** and **condition** of the (storm) sewer being tested
- Requires CCTV (Closed Circuit Television) for viewing
- Cameras can be self-propelled or towed. Some specifications to look for include:
  - The camera should be capable of radial view for inspection of the top, bottom, and sides of the pipe and for looking up lateral connections.
  - The camera should be color.
  - Lighting should be supplied by a lamp on the camera that can light the entire periphery of the pipe.

A video record of the inspection should be made for future reference and repairs

CCTV-VIDEO PRESENTATION


Time for
a BREAK

IRVING
TEXAS


Any
Questions


That's all Folks!