Illicit Discharge Detection and Elimination

A Guidance Manual for Program Development and Technical Assessments

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Chapter 11: The Outfall Reconnaissance Inventory

This chapter describes a simple field assessment known as the Outfall Reconnaissance Inventory (ORI). The ORI is designed to fix the geospatial location and record basic characteristics of individual storm drain outfalls, evaluate suspect outfalls, and assess the severity of illicit discharge problems in a community. Field crews should walk all natural and man-made streams channels with perennial and intermittent flow, even if they do not appear on available maps (Figure 19). The goal is to complete the ORI on every stream mile in the MS4 within the first permit cycle, starting with priority subwatersheds identified during the desktop analysis. The results of the ORI are then used to help guide future outfall monitoring and discharge prevention efforts.

11.1 Getting Started

The ORI requires modest mapping, field equipment, staffing and training resources. A complete list of the required and optional resources needed to perform an ORI is presented in Table 30. The ORI can be combined with other stream assessment tools, and may be supplemented by simple indicator monitoring. Ideally, a Phase II community should plan on surveying its entire drainage network at least once over the course of each five-year permit cycle. Experience suggests that it may take up to three stream walks to identify all outfalls.

Figure 19: Walk all streams and constructed open channels

Best Times to Start

Timing is important when scheduling ORI field work. In most regions of the country, spring and fall are the best seasons to perform the ORI. Other seasons typically have challenges such as over-grown vegetation or high groundwater that mask illicit discharges, or make ORI data hard to interpret[9].

Prolonged dry periods during the non-growing season with low groundwater levels are optimal conditions for performing an ORI. Table 31 summarizes some of the regional factors to consider when scheduling ORI surveys in your community. Daily weather patterns also determine whether ORI field work should proceed. In general, ORI field work should be conducted at least 48 hours after the last runoff-producing rain event.

Field Maps

The field maps needed for the ORI are normally generated during the desktop assessment phase of the IDDE program described in Chapter 5. This section provides guidance on the basic requirements for good

[9] Upon initial program start-up, the ORI should be conducted during periods of low groundwater to more easily identify likely illicit discharges. However, it should be noted that high water tables can increase sewage contamination in storm drain networks due to infiltration and inflow interactions. Therefore, in certain situations, seasonal ORI surveys may be useful at identifying these types of discharges. Diagnosis of this source of contamination, however, can be challenging.

Table 30: Resources Needed to Conduct the ORI		
Need Area	**Minimum Needed**	**Optional but Helpful**
Mapping	• Roads • Streams	• Known problem areas • Major land uses • Outfalls • Specific industries • Storm drain network • SIC-coded buildings • Septics
Field Equipment	• 5 one-liter sample bottles • Backpack • Camera (preferably digital) • Cell phones or hand-held radios • Clip boards and pencils • Field sheets • First aid kit • Flash light or head lamp • GPS unit • Spray paint (or other marker) • Surgical gloves • Tape measure • Temperature probe • Waders (snake proof where necessary) • Watch with a second hand	• Portable Spectrophotometer and reagents (can be shared among crews) • Insect repellant • Machete/clippers • Sanitary wipes or biodegradable soap • Wide-mouth container to measure flow • Test strips or probes (e.g., pH and ammonia)
Staff	• Basic training on field methodology • Minimum two staff per crew	• Ability to track discharges up the drainage system • Knowledge of drainage area, to identify probable sources. • Knowledge of basic chemistry and biology

Table 31: Preferred Climate/Weather Considerations for Conducting the ORI		
Preferred Condition	**Reason**	**Notes/Regional Factors**
Low groundwater (e.g., very few flowing outfalls)	High groundwater can confound results	In cold regions, do not conduct the ORI in the early spring, when the ground is saturated from snowmelt.
No runoff-producing rainfall within 48 hours	Reduces the confounding influence of storm water	The specific time frame may vary depending on the drainage system.
Dry Season	Allows for more days of field work	Applies in regions of the country with a “wet/dry seasonal pattern.” This pattern is most pronounced in states bordering or slightly interior to the Gulf of Mexico or the Pacific Ocean.
Leaf Off	Dense vegetation makes finding outfalls difficult	Dense vegetation is most problematic in the southeastern United States. This criterion is helpful but not required.

field maps. First, ORI field maps do not need to be fancy. The scale and level of mapping detail will vary based on preferences and navigational skills of field crews. At a minimum, maps should have labeled streets and hydrologic features (USGS blue line streams, wetlands, and lakes), so field crews can orient themselves and record their findings spatially.

Field maps should delineate the contributing drainage area to major outfalls, but only if they are readily available. Urban landmarks such as land use, property boundaries, and storm drain infrastructure are also quite useful in the field. ORI field maps should be used to check the accuracy and quality of pre-existing mapping information, such as the location of outfalls and stream origins.

Basic street maps offer the advantage of simplicity, availability, and well-labeled road networks and urban landmarks. Supplemental maps such as a 1": 2000' scale USGS Quad sheet or finer scale aerial photograph are also recommended for the field. USGS Quad sheets are readily available and display major transportation networks and landmarks, “blue line” streams, wetlands, and topography. Quad maps may be adequate for less developed subwatersheds, but are not always accurate in more urban subwatersheds.

Recent aerial photographs may provide the best opportunity to navigate the subwatershed and assess existing land cover. Aerial photos, however, may lack topography and road names, can be costly, and are hard to record field notes on due to their darkness. GIS-ready aerial photos and USGS Quad sheets can be downloaded from the internet or obtained from local planning, parks, or public works agencies.

Field Sheets

ORI field sheets are used to record descriptive and quantitative information about each outfall inventoried in the field. Data from the field sheets represent the building blocks of an outfall tracking system allowing program managers to improve IDDE monitoring and management. A copy of the ORI field sheet is provided in Appendix D, and is also available as a Microsoft Word™ document. Program managers should modify the field sheet to meet the specific needs and unique conditions in their community.

Field crews should also carry an authorization letter and a list of emergency phone numbers to report any emergency leaks, spills, obvious illicit discharges or other water quality problems to the appropriate local authorities directly from the field. Local law enforcement agencies may also need to be made aware of the field work. Figure 20 shows an example of a water pollution emergency contact list developed by Montgomery County, MD.

Equipment

Basic field equipment needed for the ORI includes waders, a measuring tape, watch, camera, GPS unit, and surgical gloves (see Table 30). GPS units and digital cameras are usually the most expensive equipment items; however, some local agencies may already have them for other applications. Adequate ranging, water-resistant, downloadable GPS units can be purchased for less than $150. Digital cameras are preferred and can cost between $200 and $400, however, conventional or disposable cameras can also work, as long as they have flashes. Hand-held data recorders and customized software can be used to record text, photos, and GPS coordinates electronically in the field. While these technologies can eliminate field sheets and data entry procedures, they can be quite expensive. Field crews should always carry basic safety items, such as cell phones, surgical gloves, and first aid kits.

Staffing

The ORI requires at least a two-person crew, for safety and logistics. Three person crews provide greater safety and flexibility, which helps divide tasks, allows one person to assess adjacent land uses, and facilitates tracing outfalls to their source. All crew members should be trained on how to complete the ORI and should have a basic understanding of illicit discharges and their water quality impact. ORI crews can be staffed by trained volunteers, watershed groups and college interns. Experienced crews can normally expect to cover two to three stream miles per day, depending on stream access and outfall density.

11.2 Desktop Analysis to Support the ORI

Two tasks need to be done in the office before heading out to the field. The major ORI preparation tasks include estimating the total stream and channel mileage in the subwatershed and generating field maps. The total mileage helps program managers scope out how long the ORI will take and how much it will cost. As discussed before, field maps are an indispensable navigational aid for field crews working in the subwatershed.

Delineating Survey Reaches

ORI field maps should contain a preliminary delineation of **survey reaches**. The stream network within your subwatershed should be delineated into discrete segments of relatively uniform character. Delineating

WATER POLLUTION PHONE NUMBERS TO CALL WHEN A WATER QUALITY PROBLEM IS OBSERVED or TO OBTAIN FURTHER INFORMATION ABOUT WATER QUALITY ISSUES
Spring 2001

COUNTY AGENCIES

DEP: Department of Environmental Protection
- DEPC: Division of Environmental Policy & Compliance
- WMD: Watershed Management Division

DPS: Department of Permitting Services
- LDS: Land Development Services
- SWM: Stormwater Management
- WS: Wells & Septic

INTER-COUNTY AGENCIES

MNCPPC: Maryland-National Capital Park & Planning Commission

WSSC: Washington Suburban Sanitary Commission

DHCD: Department of Housing & Community Development

DPWT: Department of Public Works & Transportation

PROBLEM/QUESTION	AGENCY & TELEPHONE NUMBER	
ILLEGAL DUMPING HOTLINE	**DEPC:**	**240-777-7700** Daytime hours ←
	→ Nighttime hours	**240/777-DUMP (3867) or 240-777-7788**
Blocked storm drain, inlet or pipe or erosion from public storm drain	DPWT:	240/777-ROAD (7623) Highway Maintenance)
Discolored public drinking water, odor to drinking water		301/206-4002
Erosion, flooding, drainage problems between private properties	DHCD:	240/777-3600 (Code Enforcement)
Erosion - stream banks on park land	MNCPPC:	301/495-2535
Fire & Rescue Services (emergencies: 911)	(Non-Emergencies):	240/777-0744
Recycling Programs/Special pick up services	DPWT:	240/777-6400 or 6466
Sanitary sewer problems	WSSC:	301/206-4002
Sediment (mud) from construction site entering streams	LDS:	240/777-6366
Septic Leaks/ Septic Tanks	WS:	240/777-6300
Stormwater Management, pond safety and maintenance	DEPC:	240/777-7744
Stormwater Management and Sediment Control Plan Review issues	SWM:	240/777-6320
Stream Clean-ups	WMD:	240/777-7712
Swimming Pool Discharges	DEPC:	240/777-7770
Trash and debris in parks and streams	MNCPPC:	301/495-2535
Water main break	WSSC:	301/206-4002
Water pollution	DEPC:	240/777-7770
(discharging, dumping, chemical spills into streams or storm drains)	LDS:	240/777-6260
Water quality monitoring programs for schools (Stream Teams)	WMD:	240/777-7714
Wells and Well Inspections	WS:	240/777-6300

askDEP.com

Figure 20: Example of a comprehensive emergency contact list for Montgomery County, MD

survey reaches provides good stopping and starting points for field crews, which is useful from a data management and logistics standpoint. Each survey reach should have its own unique identifying number to facilitate ORI data analysis and interpretation. Figure 21 illustrates some tips for delineating survey reaches, and additional guidance is offered below:

- Survey reaches should be established above the confluence of streams and between road crossings that serve as a convenient access point.
- Survey reaches should be defined at the transition between major changes in land use in the stream corridor (e.g. forested land to commercial area).
- Survey reaches should generally be limited to a quarter mile or less in length. Survey reaches in lightly developed subwatersheds can be longer than those in more developed subwatersheds, particularly if uniform stream corridor conditions are expected throughout the survey reach.
- Access through private or public property should be considered when delineating survey reaches as permission may be required.

It should be noted that initial field maps are not always accurate, and changes may need to be made in the field to adjust survey reaches to account for conditions such as underground streams, missing streams or long culverts. Nevertheless, upfront time invested in delineating survey reaches makes it easier for field crews to perform the ORI.

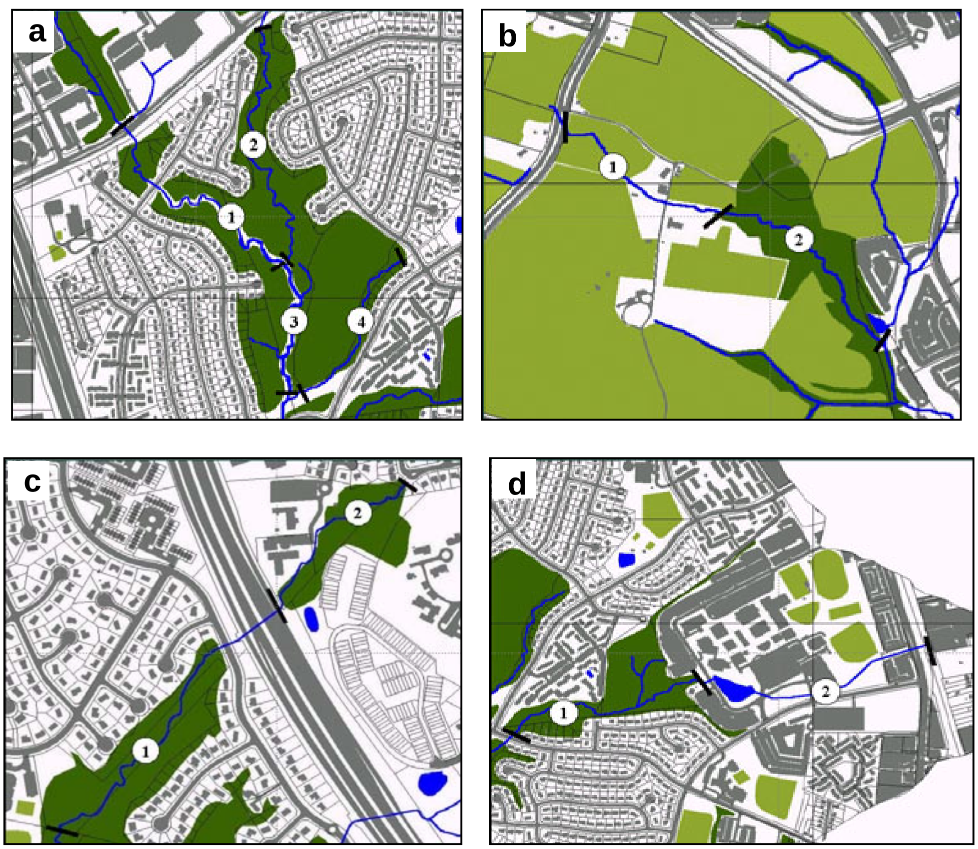


Figure 21: Various physical factors control how survey reaches are delineated. (a) Survey reaches based on the confluence of stream tributaries. (b) A long tributary split into ¼ mile survey reaches. (c) Based on a major road crossing (include the culvert in the downstream reach). (d) Based on significant changes in land use (significant changes in stream features often occur at road crossings, and these crossings often define the breakpoints between survey reaches).

11.3 Completing the ORI

Field crews conduct an ORI by walking all streams and channels to find outfalls, record their location spatially with a GPS unit and physically mark them with spray paint or other permanent marker. Crews also photograph each outfall and characterize its dimensions, shape, and component material, and record observations on basic sensory and physical indicators. If dry weather flow occurs at the outfall, additional flow and water quality data are collected. Field crews may also use field probes or test strips to measure indicators such as temperature, pH, and ammonia at flowing outfalls.
The ORI field sheet is divided into eight sections that address both flowing and non-flowing outfalls (Appendix D). Guidance on completing each section of the ORI field sheet is presented below.

Outfalls to Survey

The ORI applies to **all** outfalls encountered during the stream walk, regardless of diameter, with a few exceptions noted in Table 32. Common outfall conditions seen in communities are illustrated in Figure 22 As a rule, crews should only omit an outfall if they can definitively conclude it has no potential to contribute to a transitory illicit discharge. While EPA’s Phase I guidance only targeted major outfalls (diameter of 36 inches or greater), documenting all outfalls is recommended, since smaller pipes make up the majority of all outfalls and frequently have illicit discharges (Pitt *et al.*, 1993 and Lalor, 1994). A separate ORI field sheet should be completed for each outfall.

Table 32: Outfalls to Include in the Screening

Outfalls to Record	Outfalls to Skip
• Both large and small diameter pipes that appear to be part of the storm drain infrastructure • Outfalls that appear to be piped headwater streams • Field connections to culverts • Submerged or partially submerged outfalls • Outfalls that are blocked with debris or sediment deposits • Pipes that appear to be outfalls from storm water treatment practices • Small diameter ductile iron pipes • Pipes that appear to only drain roof downspouts but that are subsurface, preventing definitive confirmation	• Drop inlets from roads in culverts (unless evidence of illegal dumping, dumpster leaks, etc.) • Cross-drainage culverts in transportation right-of-way (i.e., can see daylight at other end) • Weep holes • Flexible HDPE pipes that are known to serve as slope drains • Pipes that are clearly connected to roof downspouts via above-ground connections

Ductile iron round pipe

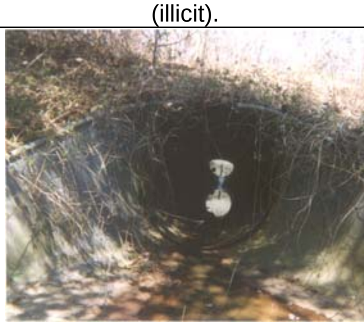
4-6” HDPE; Check if roof leader connection (legal)

Field connection to inside of culvert; Always mark and record.

Small diameter (<2”) HDPE; Often a sump pump (legal), or may be used to discharge laundry water (illicit).

Elliptical RCP; Measure both horizontal and vertical diameters.

Double RCP round pipes; Mark as separate outfalls unless known to connect immediately up-pipe



Culvert (can see to other side); Don’t mark as an outfall.

Open channel “chute” from commercial parking lot; Very unlikely illicit discharge. Mark, but do not return to sample (unless there is an obvious problem).

Small diameter PVC pipe; Mark, and look up-pipe to find the origin.

CMP outfall; Crews should also note upstream sewer crossing.

Box shaped outfall

CMP round pipe with two weep holes at bridge crossing. (Don’t mark weep holes)

Figure 22: Typical Outfall Types Found in the Field

Obvious Discharges

Field crews may occasionally encounter an obvious illicit discharge of sewage or other pollutants, typified by high turbidity, odors, floatables and unusual colors. When obvious discharges are encountered, field crews should STOP the ORI survey, track down the source of the discharge and immediately contact the appropriate water pollution agency for enforcement. Crews should photo-document the discharge, estimate its flow volume and collect a sample for water quality analysis (if this can be done safely). All three kinds of evidence are extremely helpful to support subsequent enforcement. Chapter 13 provides details on techniques to track down individual discharges.

11.4 ORI Section 1 - Background Data

The first section of the ORI field sheet is used to record basic data about the survey, including time of day, GPS coordinates for the outfall, field crew members, and current and past weather conditions (Figure 23). Much of the information in this section is self-explanatory, and is used to create an accurate record of when, where, and under what conditions ORI data were collected. Every outfall should be photographed and marked by directly writing a unique identifying number on each outfall that serves as its subwatershed “address” (Figure 24). Crews can use spray paint or another temporary marker to mark outfalls, but may decide to replace temporary markings with permanent ones if the ORI is repeated later. Markings help crews confirm outfall locations during future investigations, and gives citizens a better way to report the location of spills or discharges when calling a water pollution hotline. Crews should mark the spatial location of all outfalls they encounter directly on field maps, and record the coordinates with a GPS unit that is accurate to within 10 feet. Crews should take a digital photo of each outfall, and record photo numbers in Section 1 of the field sheet.

Section 1: Background Data

Subwatershed:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitutde:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	
Land Use in Drainage Area (Check all that apply):			
☐ Industrial		☐ Open Space	
☐ Ultra-Urban Residential		☐ Institutional	
☐ Suburban Residential		Other: ______	
☐ Commercial		Known Industries: ______	
Notes (e.g.., origin of outfall, if known):			

Figure 23: Section 1 of the ORI Field Sheet

Figure 24: Labeling an Outfall (a variety of outfall naming conventions can be used)

The land use of the drainage area contributing to the outfall should also be recorded. This may not always be easy to characterize at large diameter outfalls that drain dozens or even hundreds of acres (unless you have aerial photographs). On the other hand, land use can be easily observed at smaller diameter outfalls, and in some cases, the specific origin can be found (e.g., a roof leader or a parking lot; Figure 25). The specific origin should be recorded in the "notes" portion of Section 1 on the field sheet.

11.5 ORI Section 2 - Outfall Description

This part of the ORI field sheet is where basic outfall characteristics are noted (Figure 26). These include material, and presence of flow at the outfall, as well as the pipe's dimensions (Figure 27). These measurements are used to confirm and supplement existing storm drain maps (if they are available). Many communities only map storm drain outfalls that exceed a given pipe diameter, and may not contain data on the material and condition of the pipe.

Figure 25: The origin of this corrugated plastic pipe was determined to be a roof leader from the house up the hill.

Section 2 of the field sheet also asks if the outfall is submerged in water or obstructed by sediment and the amount of flow, if present. Figure 28 provides some photos that illustrate how to characterize relative submergence, deposition and flow at outfalls. If no flow is observed at the outfall, you can skip the next two sections of the ORI field sheet and continue with Section 5.

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: ____________________	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				

Figure 26: Section 2 of the ORI Field Sheet

Figure 27: Measuring Outfall Diameter

Submerged: More than ½ below water

Partially submerged: Bottom is below water

Fully submerged: Can't see outfall

Outfall fully submerged by debris

Fully submerged from downstream trees trapping debris

Partially submerged by leaf debris "back water"

Trickle Flow: Very narrow stream of water

Moderate Flow: Steady stream, but very shallow depth

Significant flow (Source is a fire hydrant discharge)

Figure 28: Characterizing Submersion and Flow

11.6 ORI Section 3 - Quantitative Characterization for Flowing Outfalls

This section of the ORI records direct measurements of **flowing outfalls**, such as flow, temperature, pH and ammonia (Figure 29). If desired, additional water quality parameters can be added to this section. Chapter 12 discusses the range of water quality parameters that can be used

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		RESULT	UNIT	EQUIPMENT
☐Flow #1	Volume		Liter	Bottle
	Time to fill		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			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Figure 29: Section 3 of the ORI

Field crews measure the rate of flow using one of two techniques. The first technique simply records the time it takes to fill a container of a known volume, such as a one liter sample bottle. In the second technique, the crew measures the velocity of flow, and multiplies it by the estimated cross sectional area of the flow.

To use the flow volume technique, it may be necessary to use a "homemade" container to capture flow, such as a cut out plastic milk container that is marked to show a one liter volume. The shape and flexibility of plastic containers allows crews to capture relatively flat and shallow flow (Figure 30). The flow volume is determined as the volume of flow captured in the container per unit time.
The second technique measures flow rate based on velocity and cross sectional area, and is preferred for larger discharges where containers are too small to effectively capture the flow (Figure 31). The crew measures and marks off a fixed flow length (usually about five feet), crumbles leaves or other light material, and drops them into the discharge (crews can also carry peanuts or ping pong balls to use). The crew then measures the time it takes the marker to travel across the length. The velocity of flow is computed as the length of the flow path (in feet) divided by the travel time (in seconds). Next, the cross-sectional flow area is measured by taking multiple readings of the depth and width of flow. Lastly, cross-sectional area (in square feet) is multiplied by flow velocity (feet/second) to calculate the flow rate (in cubic feet/second).

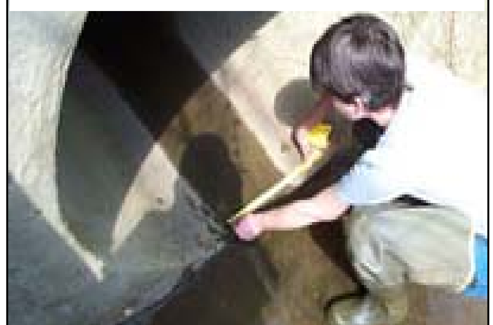
Crews may also want to measure the quality of the discharge using relatively inexpensive probes and test strips (e.g., water temperature, pH, and ammonia). The choice of which indicator parameters to measure is usually governed by the overall IDDE monitoring framework developed by the community. Some communities have used probes or test strips to measure additional indicators such as conductivity, chlorine, and hardness. Research by Pitt (for this project) suggests that probes by Horiba for pH and conductivity are the most reliable and accurate, and that test strips have limited value.

Figure 30: Measuring flow as volume per time

When probes or test strips are used, measurements should be made from a sample bottle that contains flow captured from the outfall. The exact measurement recorded by the field probe should be recorded in Section 3 of the field sheet. Some interpolation may be required for test strips, but do not interpolate further than the mid-range between two color points.

Step 1: Measure flow depth

Step 2: Measure flow width



Step 3: Time the travel of a light object (e.g., leaves) along a known distance to calculate velocity

Figure 31: Measuring flow (as velocity times cross-sectional area)

11.7 ORI Section 4 – Physical Indicators for Flowing Outfalls Only

This section of the ORI field sheet records data about four sensory indicators associated with **flowing outfalls --** odor, color, turbidity and floatables (Figure 32). Sensory indicators can be detected by smell or sight, and require no measurement equipment. Sensory indicators do not always reliably predict illicit discharge, since the senses can be fooled, and may result in a "false negative" (i.e., sensory indicators fail to detect an illicit discharge when one is actually present). Sensory indicators are important, however, in detecting the most severe or obvious discharges. Section 4 of the field sheet asks whether the sensory indicator is present, and if so, what is its severity, on a scale of one to three.

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 ☐ 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)

Figure 32: Section 4 of the ORI Field Sheet

Odor

Section 4 asks for a description of any odors that emanate from the outfall and an associated severity score. Since noses have different sensitivities, the entire field crew should reach consensus about whether an odor is present and how severe it is. A severity score of one means that the odor is faint or the crew cannot agree on its presence or origin. A score of two indicates a moderate odor within the pipe. A score of three is assigned if the odor is so strong that the crew smells it a considerable distance away from the outfall.

TIP

Make sure the origin of the odor is the outfall. Sometimes shrubs, trash or carrion, or even the spray paint used to mark the outfall can confuse the noses of field crews.

Color

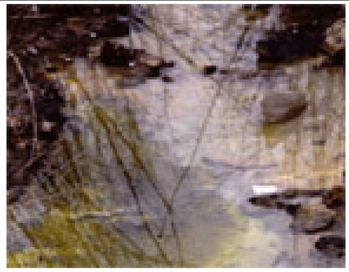
The color of the discharge, which can be clear, slightly tinted, or intense is recorded next. Color can be quantitatively analyzed in the lab, but the ORI only asks for a visual assessment of the discharge color and its intensity. The best way to measure color is to collect the discharge in a clear sample bottle and hold it up to the light (Figure 33). Field crews should also look for downstream plumes of color that appear to be associated with the outfall. Figure 34 illustrates the spectrum of colors that may be encountered during an ORI survey, and offers insight on how to rank the relative intensity or strength of discharge color. Color often helps identify industrial discharges; Appendix K provides guidance on colors often associated with specific industrial operations.

Turbidity

The ORI asks for a visual estimate of the turbidity of the discharge, which is a measure of the cloudiness of the water. Like color, turbidity is best observed in a clear sample bottle, and can be quantitatively measured using field probes. Crews should also look for turbidity in the plunge pool below the outfall, and note any downstream turbidity plumes that appear to be related to the outfall. Field crews can sometimes confuse turbidity with color, which are related but are not the same. Remember, turbidity is a measure of how easily light can penetrate through the sample bottle, whereas color is defined by the tint or intensity of the color observed. Figure 34 provides some examples of how to distinguish turbidity from color, and how to rank its relative severity.

Figure 33: Using a sample bottle to estimate color and turbidity

Color: Brown; Severity: 2
Turbidity Severity: 2



Chromium Spill
Color: Green; Severity: 3
Turbidity Severity: None

Highly Turbid Discharge
Color: Brown; Severity: 3
Turbidity Severity: 3

Sewage Discharge
Color: 3
Turbidity: 3

Paint
Color: White; Severity: 3
Turbidity: 3

Industrial Discharge
Color: Green; Severity: 3
Turbidity Severity: 3

Blood
Color: Red; Severity: 3
Turbidity Severity: None

Failing Septic System:
Turbidity Severity: 3

Turbidity in Downstream Plume
Turbidity Severity: 2
(also confirm with sample bottle)

High Turbidity in Pool
Turbidity Severity: 2
(Confirm with sample bottle)

Iron Floc
Color: Reddish Orange; Severity: 3
(Often associated with a natural source)

Slight Turbidity
Turbidity: 1
(Difficult to interpret this observation;
May be natural or an illicit discharge)

Construction Site
Discharge
Turbidity Severity: 3

Discharge of Rinse
from Floor Sanding
(Found during wet
weather)
Turbidity Severity: 3

Figure 34: Interpreting Color and Turbidity

Floatables

The last sensory indicator is the presence of any floatable materials in the discharge or the plunge pool below. Sewage, oil sheen, and suds are all examples of floatable indicators; trash and debris are generally not in the context of the ORI. The presence of floatable materials is determined visually, and some guidelines for ranking their severity are provided in Figure 35, and described below.

If you think the floatable is sewage, you should automatically assign it a severity score of three since no other source looks quite like it. Surface oil sheens are ranked based on their thickness and coverage. In some cases, surface sheens may not be related to oil discharges, but instead are created by in-stream processes, such as shown in Figure 36. A thick or swirling sheen associated with a petroleum-like odor may be diagnostic of an oil discharge.

Suds are rated based on their foaminess and staying power. A severity score of three is designated for thick foam that travels many feet before breaking up. Suds that break up quickly may simply reflect water turbulence, and do not necessarily have an illicit origin. Indeed, some streams have naturally occurring foams due to the decay of organic matter. On the other hand, suds that are accompanied by a strong organic or sewage-like odor may indicate a sanitary sewer leak or connection. If the suds have a fragrant odor, they may indicate the presence of laundry water or similar wash waters.

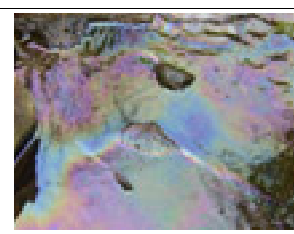
SUDS		
 Natural Foam Note: Suds only associated with high flows at the “drop off” Do not record.	 Low Severity Suds Rating: 1 Note: Suds do not appear to travel; very thin foam layer	 High severity suds Rating: 3 Sewage
OIL SHEENS		
 Low Severity Oil Sheen Rating: 1	 Moderate Severity Oil Sheen Rating: 2	 High Severity Oil Film Rating: 3

Figure 35: Determining the Severity of Floatables

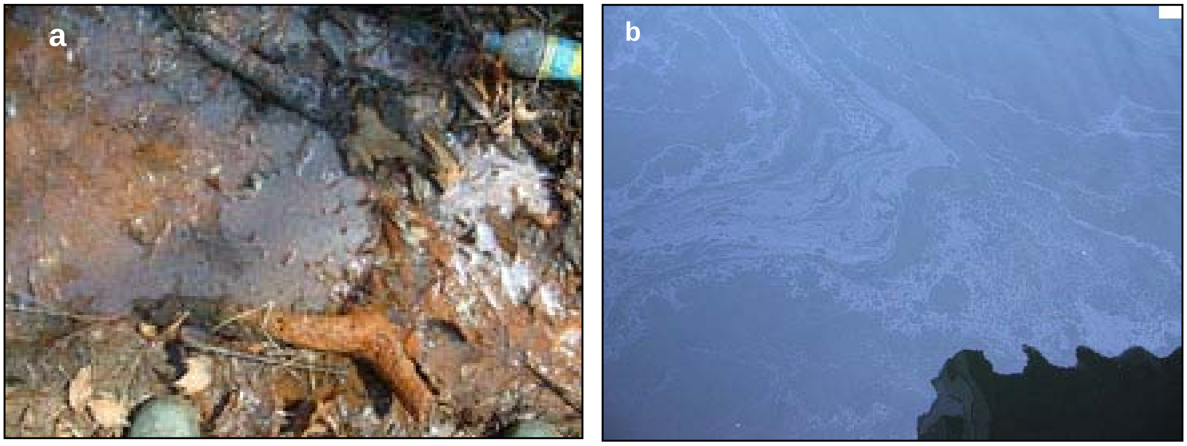


Figure 36: Synthetic versus Natural Sheen (a) Sheen from bacteria such as iron floc forms a sheet-like film that cracks if disturbed (b) Synthetic oil forms a swirling pattern

11.8 ORI Section 5 - Physical Indicators for Both Flowing and Non-Flowing Outfalls

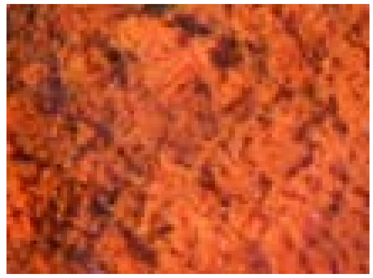
Section 5 of the ORI field sheet examines physical indicators found at both **flowing and non-flowing** outfalls that can reveal the impact of past discharges (Figure 37). Physical indicators include outfall damage, outfall deposits or stains, abnormal vegetation growth, poor pool quality, and benthic growth on pipe surfaces. Common examples of physical indicators are portrayed in Figures 38 and 39. Many of these physical conditions can indicate that an intermittent or transitory discharge has occurred in the past, even if the pipe is not currently flowing. Physical indicators are not ranked according to their severity, because they are often subtle, difficult to interpret and could be caused by other sources. Still, physical indicators can provide strong clues about the discharge history of a storm water outfall, particularly if other discharge indicators accompany them.

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:	

Figure 37: Section 5 of the ORI Field Sheet

Bacterial growth at this outfall indicates nutrient enrichment and a likely sewage source.



This bright red bacterial growth often indicates high manganese and iron concentrations. Surprisingly, it is not typically associated with illicit discharges.

Sporalitis filamentous bacteria, also known as “sewage fungus” can be used to track down sanitary sewer leaks.

Algal mats on lakes indicate eutrophication. Several sources can cause this problem. Investigate potential illicit sources.

Illicit discharges or excessive nutrient application can lead to extreme algal growth on stream beds.

The drainage to this outfall most likely has a high nutrient concentration. The cause may be an illicit discharge, but may be excessive use of lawn chemicals.

This brownish algae indicates an elevated nutrient level.

Figure 38: Interpreting Benthic and Other Biotic Indicators

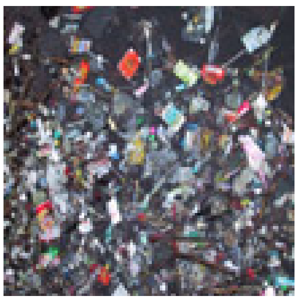
 Reddish staining on the rocks below this outfall indicate high iron concentrations.	 Toilet paper directly below the storm drain outlet.	 Watershed Protection??
 Trash is not an indicator of illicit discharges, but should be noted.	 Staining at the base of the outfall may indicate a persistent, intermittent discharge.	 Excessive vegetation may indicate enriched flows associated with sewage.
 Brownish stain of unclear origin. May be from degradation of the brick infrastructure.	 Cracked rock below the outfall may indicate an intermittent discharge.	 Poor pool quality. Consider sampling from the pool to determine origin.

Figure 39: Typical Findings at both Flowing and Non-Flowing Outfalls

11.9 ORI Sections 6-8 - Initial Outfall Designation and Actions

The last three sections of the ORI field sheet are where the crew designates the illicit discharge severity of the outfall and recommends appropriate management and monitoring actions (Figure 40). A discharge rating is designated as obvious, suspect, potential or unlikely, depending on the number and severity of discharge indicators checked in preceding sections.

It is important to understand that the ORI designation is only an initial determination of discharge potential. A more certain determination as to whether it actually is an illicit discharge is made using a more sophisticated indicator monitoring method. Nevertheless, the ORI outfall designation gives program managers a better understanding of the distribution and severity of illicit discharge problems within a subwatershed.

Section 7 of the ORI field sheet records whether indicator samples were collected for laboratory analysis, or whether an intermittent flow trap was installed (e.g., an optical brightener trap or caulk dam described in Chapter 13). Field crews should record whether the sample was taken from a pool or directly from the outfall, and the type of intermittent flow trap used, if any. This section can also be used to recommend follow-up sampling, if the crew does not carry sample bottles or traps during the survey.

The last section of the ORI field sheet is used to note any unusual conditions near the outfall such as dumping, pipe failure, bank erosion or maintenance needs. While these maintenance conditions are not directly related to illicit discharge detection, they often are of interest to other agencies and utilities that maintain infrastructure.

11.10 Customizing the ORI for a Community

The ORI method is meant to be adaptable, and should be modified to reflect local conditions and field experience. Some indicators can be dropped, added or modified in the ORI form. This section looks at four of the most common adaptations to the ORI:

- Open Channels
- Submerged/Tidally Influenced Outfalls
- Cold Climates
- Use of Biological Indicators

In each case, it may be desirable to revise the ORI field sheet to collect data reflecting these conditions.

Open Channels

Field crews face special challenges in more rural communities that have extensive open channel drainage. The ditches and channels serve as the primary storm water conveyance system, and may lack storm drain and sewer pipes. The open channel network is often very long with only a few obvious outfalls that are located far apart. While the network can have illicit discharges from septic systems, they can typically only be detected in the ORI if a straight pipe is found. Some adaptations for open channel systems are suggested in Table 33.

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)?

Figure 40: Sections 6-8 of the ORI Field Sheet

Submerged/Tidally Influenced Outfalls

The ORI can be problematic in coastal communities where outfalls are located along the waterfront and may be submerged at high tide. The ORI methods need to be significantly changed to address these constraints. Often, outfalls are initially located from offshore using canoes or boats, and then traced landward to the first manhole that is not tidally influenced. Field crews then access the storm drain pipe at the manhole and measure whatever indicators they can observe in the confined and dimly lit space. Table 33 recommends strategies to sample outfalls in the challenging environment of coastal communities.

Winter and Ice

Ice can be used as a discharge indicator in northern regions when ice forms in streams and pipes during the winter months (Figure 41). Because ice lasts for many weeks, and most illicit discharges are warm, astute field crews can interpret outfall history from ice melting patterns along pipes and streams. For example, exaggerated melting at a frozen or flowing outfall may indicate warm water from sewage or industrial discharge. Be careful, because groundwater is warm enough to cause some melting at below freezing temperatures. Also, ice acts like an intermittent flow trap, and literally freezes these discharges. Crews should also look for these traps to find any discolored ice within the pipe or below the outfall.

A final winter indicator is “rime ice,” which forms when steam freezes. This beautiful ice formation is actually a good indicator of sewage or other relatively hot discharge that causes steam to form (Figure 41).

Biological Indicators

The diversity and pollution tolerance of various species of aquatic life are widely used as an indicator of overall stream health, and has sometimes been used to detect illicit discharges. One notable example is the presence of the red-eared slider turtle, which is used in Galveston, Texas to find sewage discharges, as they have a propensity for the nutrient rich waters associated with sewage (Figure 42).

Table 33: Special Considerations for Open Channels/Submerged Outfalls	
OPEN CHANNELS	
Challenge	**Suggested Modification**
Too many miles of channel to walk	Stop walking at a given channel size or drainage area
Difficulty marking them	Mark on concrete or adjacent to earth channel
Interpreting physical indicators	For open channels with mild physical indicators, progress up the system to investigate further.
SUBMERGED/TIDALLY INFLUENCED OUTFALLS	
Challenge	**Suggested Modification**
Access for ORI – Tidal Influence	Access during low tide
Access for ORI – Always submerged	Access by boat or by shore walking
Interpreting physical indicators	For outfalls with mild physical indicators, also inspect from the nearest manhole that is not influenced by tides
Sampling (if necessary)	Sample “up pipe”

Figure 41: Cold climate indicators of illicit discharges

Figure 42: One biological indicator is this red-eared slider turtle

11.11 Interpreting ORI Data

The ORI generates a wealth of information that can provide managers with valuable insights about their illicit discharge problems, if the data are managed and analyzed effectively. The ORI can quickly define whether problems are clustered in a particular area or spread across the community. This section presents a series of methods to compile, organize and interpret ORI data, including:

1. Basic Data Management and Quality Control
2. Outfall Classification
3. Simple Suspect Outfall Counts
4. Mapping ORI Data
5. Subwatershed and Reach Screening
6. Characterizing IDDE Problems at the Community Level

The level of detail for each analysis method should be calibrated to local resources, program goals, and the actual discharge problems discovered in the stream corridor. In general, the most common conditions and problems will shape your initial monitoring strategy, which prioritizes the subwatersheds or reaches that will be targeted for more intensive investigations.

Program managers should analyze ORI data well before every stream mile is walked in the community, and use initial results to modify field methods. For example, if initial results reveal widespread potential problems, program managers may want to add more indicator monitoring to the ORI to track down individual discharge sources (see Chapter 12). Alternatively, if the same kind of discharge problem is repeatedly found, it may be wise to investigate whether there is a common source or activity generating it (e.g., high turbidity observed at many flowing outfalls as a result of equipment washing at active construction sites).

Basic Data Management and Quality Control

The ORI produces an enormous amount of raw data to characterize outfall conditions. It is not uncommon to compile dozens of individual ORI forms in a single subwatershed. The challenge is to devise a system to organize, process, and translate this data into simpler outputs and formats that can guide illicit discharge elimination efforts. The system starts with effective quality control procedures in the field.

Field sheets should be managed using either a three-ring binder or a clipboard. A small field binder offers the ability to quickly flip back and forth among the outfall forms. Authorization letters, emergency contact lists, and extra forms can also be tucked inside.

At the end of each day, field crews should regroup at a predetermined location to compare notes. The crew leader should confirm that all survey reaches and outfalls of interest have been surveyed, discuss initial findings, and deal with any logistical problems. This is also a good time to check whether field crews are measuring and recording outfall data in the same way, and are consistent in what they are (or are not) recording. Crew leaders should also use this time to review field forms for accuracy and thoroughness. Illegible handwriting should be neatened and details added to notes and any sketches. The crew leader should also organize the forms together into a single master binder or folder for future analysis.

Once crews return from the field, data should be entered into a spreadsheet or database. A Microsoft Access database is provided with this Manual as part of Appendix D (Figure 43), and is supplied on a compact disc with each hard copy. It can also be downloaded with Appendix D from http://www.stormwatercenter.net. Information stored in this database can easily be imported into a GIS for mapping purposes. The GIS can generate its own database table that allows the user to create subwatershed maps showing outfall characteristics and problem areas.

Once data entry is complete, be sure to check the quality of the data. This can be done quickly by randomly spot-checking 10% of the entered data. For example, if 50 field sheets were completed, check five of the spreadsheet or database entries. When transferring data into GIS, quality control maps that display labeled problem outfalls should be created. Each survey crew is responsible for reviewing the accuracy of these maps.

Outfall Classification

A simple outfall designation system has been developed to summarize the discharge potential for individual ORI field sheets. Table 34 presents the four outfall designations that can be made.

Table 34: Outfall Designation System Using ORI Data

Designation	Description
1: Obvious Discharge	Outfalls where there is an illicit discharge that doesn't even require sample collection for confirmation
2: Suspect Discharge	Flowing outfalls with high severity on one or more physical indicators
3: Potential Discharge	Flowing or non-flowing outfalls with presence of two or more physical indicators
4: Unlikely Discharge	Non-flowing outfalls with no physical indicators of an illicit discharge

Simple Suspect Outfall Counts

The first priority is to count the frequency of each outfall designation in the subwatershed or the community as a whole. This simple screening analysis counts the number of problem outfalls per stream mile (i.e., the sum of outfalls designated as having potential, suspected or obvious illicit discharge potential). The density of problem outfalls per stream mile is an important metric to target and screen subwatersheds.

Based on problem outfall counts, program managers may discover that a particular monitoring strategy may not apply to the community. For example, if few problem outfalls are found, an extensive follow-up monitoring program may not be needed, so that program resources can be shifted to pollution hotlines to report and control transitory discharges such as illegal dumping. The key point of this method is to avoid getting lost in the raw data, but look instead to find patterns that can shape a cost-effective IDDE program.

Mapping ORI Data

Maps are an excellent way to portray outfall data. If a GIS system is linked to the ORI database, maps that show the spatial distribution of problem outfalls, locations of dumping, and overall reach conditions can be easily generated. Moreover, GIS provides flexibility that allows for rapid updates to maps as new data are collected and compiled. The sophistication and detail of maps will depend on the initial findings, program goals, available software, and GIS capability.

Subwatershed maps are also an effective and important communication and education tool to engage stakeholders (e.g., public officials, businesses and community residents), as they can visually depict reach quality and the location of problem outfalls. The key point to remember is that maps are tools for understanding data. Try to map with a purpose in mind. A large number of cluttered maps may only confuse, while a smaller number with select data may stimulate ideas for the follow-up monitoring strategy.

Subwatershed and Survey Reach Screening

Problem outfall metrics are particularly valuable to screen or rank priority subwatersheds or survey reaches. The basic approach is simple: select the outfall metrics that are most important to IDDE program goals, and then see how individual subwatersheds or reaches rank in the process. This screening process can help determine which subwatersheds will be priorities for initial follow-up monitoring efforts. When feasible, the screening process should incorporate non-ORI data, such as existing dry weather water quality data, citizen complaints, permitted facilities, and habitat or biological stream indicators.

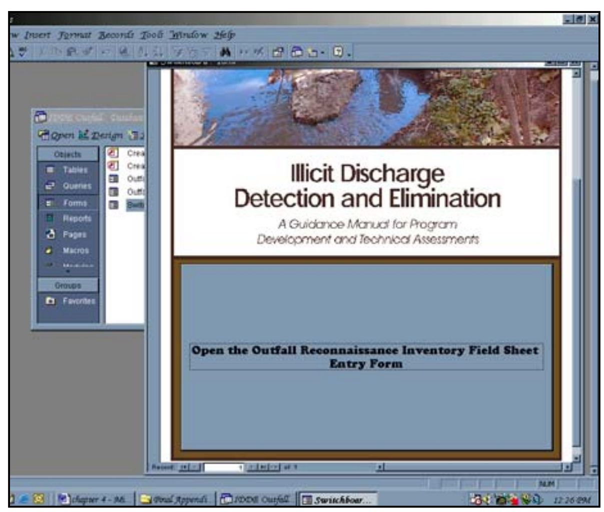


Figure 43: Sample screen from ORI Microsoft Access database

An example of how outfall metrics can screen subwatersheds is provided in Table 35. In this hypothetical example, four metrics were used to screen three subwatersheds within a community: number of suspect discharges, subwatershed population as a percent of the total community, number of industrial discharge permits, and number of outfalls per stream mile. Given these screening criteria, subwatershed C was selected for the next phase of detailed investigation.

Characterizing the IDDE Problem at the Community Level

ORI data should be used to continuously revisit and revise the IDDE program as more is learned about the nature and distribution of illicit discharge problems in the community. For example, ORI discharge designation should be compared against illicit discharge potential (IDP) predictions made during the original desktop analysis (Chapter 5) to refine discharge screening factors, and formulate new monitoring strategies.

In general, community illicit discharge problem can be characterized as minimal, clustered, or severe (Table 36). In the minimal scenario, very few and scattered problems exist; in the clustered scenario, problems are located in isolated subwatersheds; and in the severe scenario, problems are widespread.

Table 35: An Example of ORI Data Being Used to Compare Across Subwatersheds

	# of suspect discharges	Population as % of total community	# of industrial discharge permits	# of outfalls per stream/ conveyance mile
Subwatershed A	2	30	4	6
Subwatershed B	1	10	0	3
Subwatershed C	8	60	2	12

Table 36: Using Stream and ORI Data to Categorize 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 the flowing outfalls are located within one third of the subwatersheds • More than 20% of the communities subwatersheds have greater than 20% of outfalls with obvious, suspect or potential designation
Severe	• More than 10% of total outfalls are flowing • More than 50% of total outfalls with obvious, suspect or potential designation • More than 20% of total outfalls with obvious or suspect designation

11.12 Budgeting and Scoping the ORI

Many different factors come into play when budgeting and scoping an ORI survey: equipment needs, crew size and the stream miles that must be covered. This section presents some simple rules of thumb for ORI budgeting.

Equipment costs for the ORI are relatively minor, with basic equipment to outfit one team of three people totaling about $800 (Table 37). This cost includes one-time expenses to acquire waders, a digital camera and a GPS unit, as well as disposable supplies.

The majority of the budget for an ORI is for staffing the desktop analysis, field crews and data analysis. Field crews can consist of two or three members, and cover about two to three miles of stream (or open channel) per day. Three staff-days should be allocated for pre- and post-field work for each day spent in the field.

Table 38 presents example costs for two hypothetical communities that conduct the ORI. Community A has 10 miles of open channel to investigate, while Community B has 20 miles. In addition, Community A has fewer staff resources available and therefore uses two-person field crews, while Community B uses three-person field crews. Total costs are presented as annual costs, assuming that each community is able to conduct the ORI for all miles in one year.

Table 37: Typical Field Equipment Costs for the ORI

Item	Cost
100 Latex Disposable Gloves	$ 25
5 Wide Mouth Sample Bottles (1 Liter)	$ 20
Large Cooler	$ 25
3 Pairs of Waders	$ 150
Digital Camera	$ 200
20 Cans of Spray Paint	$ 50
Test Kits or Probes	$ 100-$500
1 GPS Unit	$ 150
1 Measuring Tape	$ 10
1 First Aid Kit	$ 30
Flashlights, Batteries, Labeling tape, Clipboards	$ 25
Total	**$ 785-$1185**

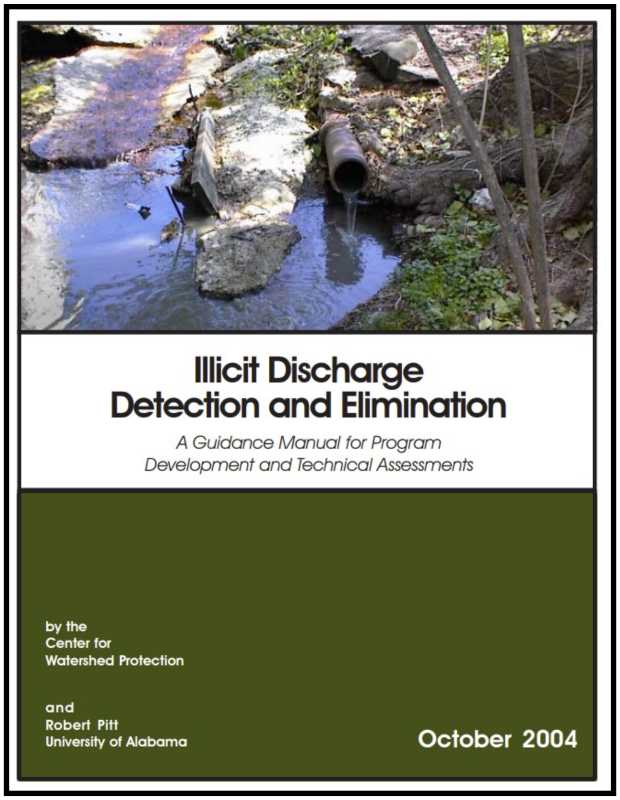
Table 38: Example ORI Costs		
Item	**Community A**	**Community B**
Field Equipment[1]	$700	$785
Staff Field Time[2]	$2,000	$6,000
Staff Office Time[3]	$3,000	$6,000
Total	**$5,700**	**$12,785**

[1] From Table 44
[2] Assumes $25/hour salary (2 person teams in Community A and three- person teams in Community B) and two miles of stream per day.
[3] Assumes three staff days for each day in field.

MCM 3 ORI Guidance: Dry Weather Conditions & How To Find and Use Daily Weather Data

(Prepared by the Stormwater Coalition, November, 2021)

Best Times to Start ORI Field Work*...text from the "IDDE" Manual referenced in NYSDEC MS4 Permit*



Chapter 11: The Outfall Reconnaissance Inventory

Chapter 11: The Outfall Reconnaissance Inventory

This chapter describes a simple field assessment known as the Outfall Reconnaissance Inventory (ORI). The ORI is designed to fix the geospatial location and record basic characteristics of individual storm drain outfalls, evaluate suspect outfalls, and assess the severity of illicit discharge problems in a community. Field crews should walk all natural and man-made streams channels with perennial and intermittent flow, even if they do not appear on available maps (Figure 19). The goal is to complete the ORI on every stream mile in the MS4 within the first permit cycle, starting with priority subwatersheds identified during the desktop analysis. The results of the ORI are then used to help guide future outfall monitoring and discharge prevention efforts.

11.1 Getting Started

The ORI requires modest mapping, field equipment, staffing and training resources. A complete list of the required and optional resources needed to perform an ORI is presented in Table 30. The ORI can be combined with other stream assessment tools, and may be supplemented by simple indicator monitoring. Ideally, a Phase II community should plan on surveying its entire drainage network at least once over the course of each five-year permit cycle. Experience suggests that it may take up to three stream walks to identify all outfalls.

Figure 19: Walk all streams and constructed open channels

Best Times to Start

Timing is important when scheduling ORI field work. In most regions of the country, spring and fall are the best seasons to perform the ORI. Other seasons typically have challenges such as over-grown vegetation or high groundwater that mask illicit discharges, or make ORI data hard to interpret[9].

Prolonged dry periods during the non-growing season with low groundwater levels are optimal conditions for performing an ORI. Table 31 summarizes some of the regional factors to consider when scheduling ORI surveys in your community. Daily weather patterns also determine whether ORI field work should proceed. In general, ORI field work should be conducted at least 48 hours after the last runoff-producing rain event.

Field Maps

The field maps needed for the ORI are normally generated during the desktop assessment phase of the IDDE program described in Chapter 5. This section provides guidance on the basic requirements for good

[9] Upon initial program start-up, the ORI should be conducted during periods of low groundwater to more easily identify likely illicit discharges. However, it should be noted that high water tables can increase sewage contamination in storm drain networks due to infiltration and inflow interactions. Therefore, in certain situations, seasonal ORI surveys may be useful at identifying these types of discharges. Diagnosis of this source of contamination, however, can be challenging.

Illicit Discharge Detection and Elimination: A Guidance Manual 91

Best Times to Start

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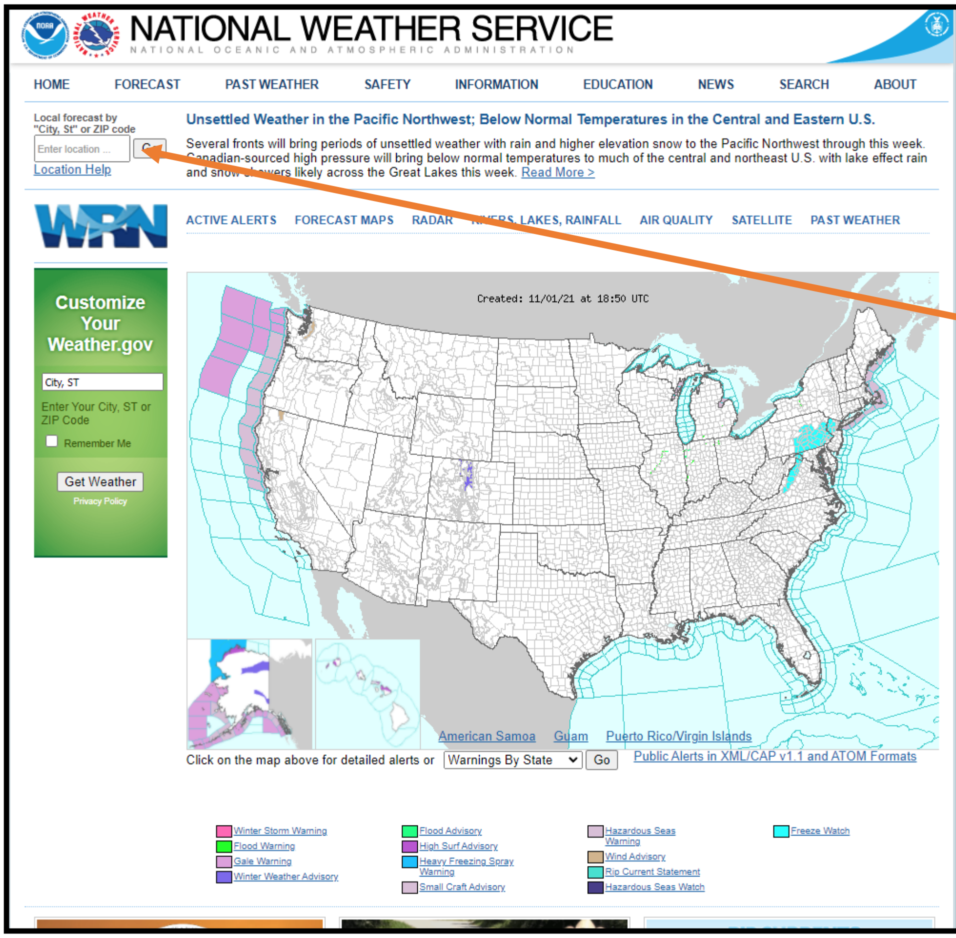
Guidance from Chiappetta (Coalition) & Kubek (Albany County DPW) ORI Training Handout—9/17/2017

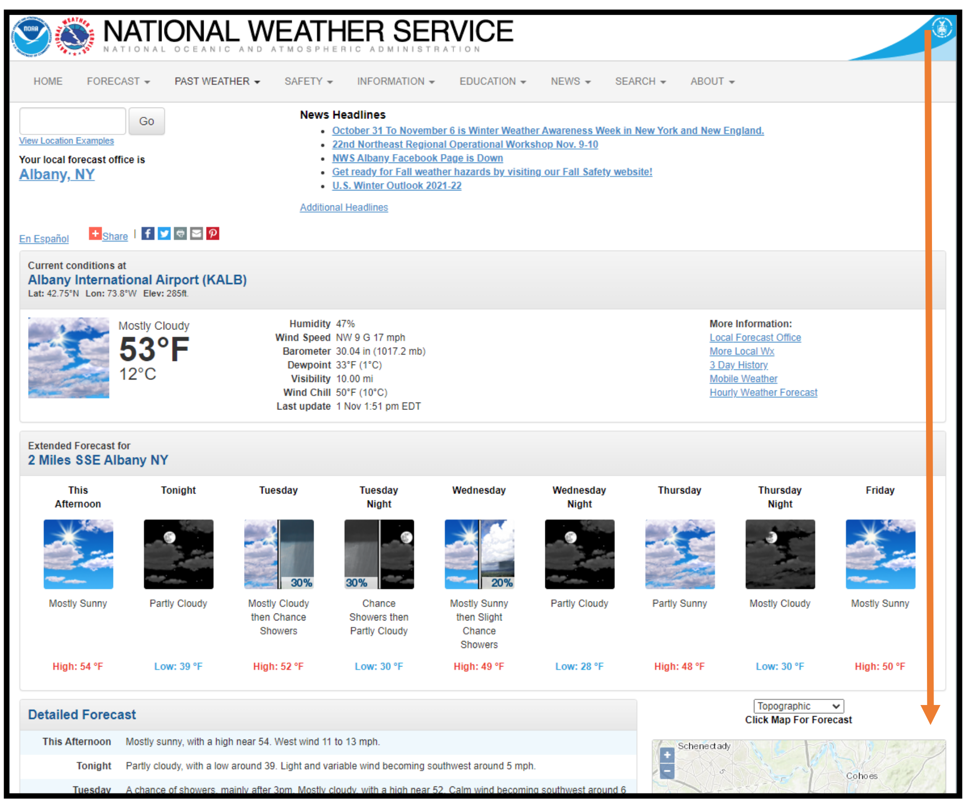
3. Check the weather
   a. In order to complete an ORI accurately, there needs to be dry weather for at least the last 48 hours. Some believe that it is not considered a rain event until at least 0.25 inches of rain has fallen. However, even that small amount of rain could lead to flowing outfalls. In this way, an outfall that may not have any illicit discharge may be running even though it did not rain a lot. This will slow down the inventory and only create more paperwork later. Although it is up to the surveyors discretion on whether or not to conduct water tests, I usually at least use the test strips when an outfall is flowing.

How to find precipitation data for previous 24 or 48 hours

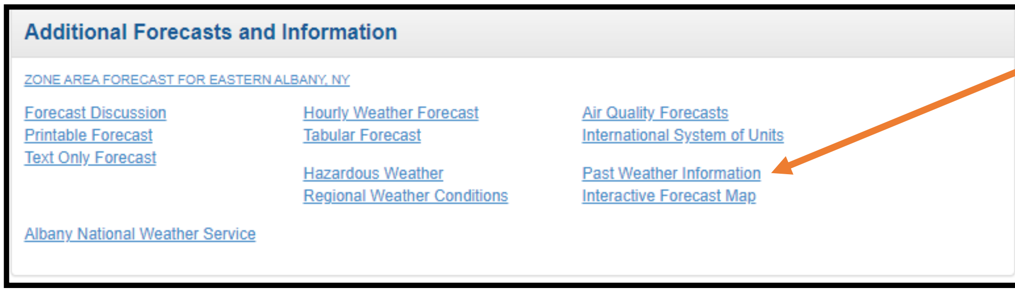


Step 1: Go to www.weather.gov

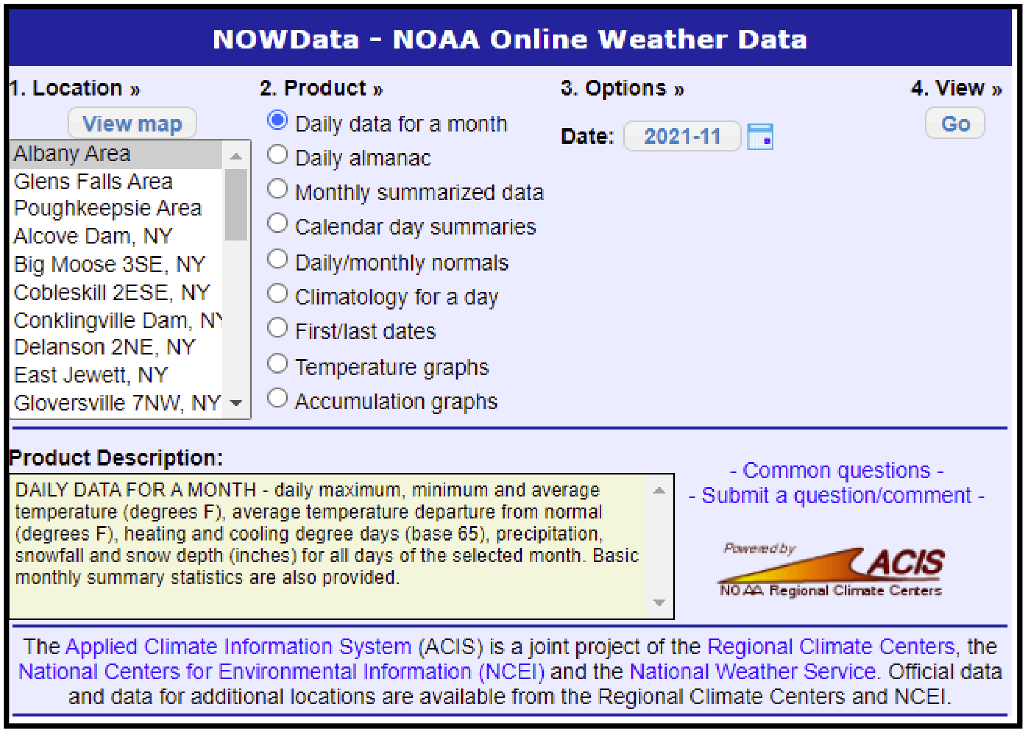
Step 2: Enter zip code



Step 3: Scroll down to "Additional Forecasts and Information" (right underneath the Detailed Forecast box)



Step 4: Click "Past Weather Information"



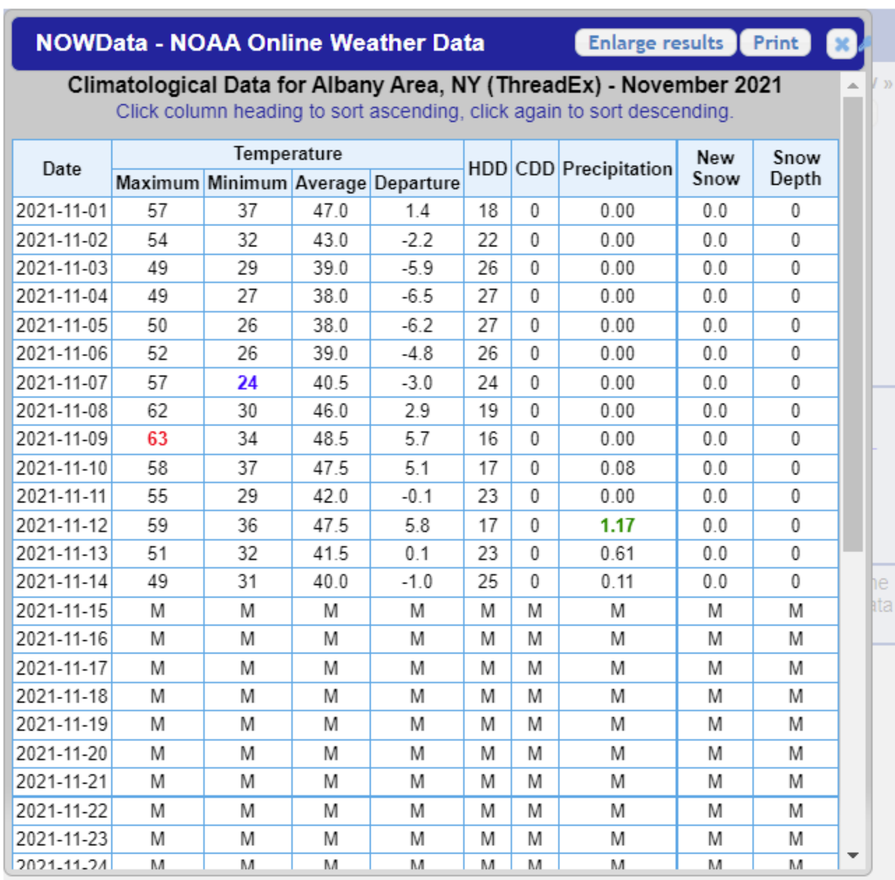
Step 5: Complete the following parameters-

1.) Location >>

2.) Product >> daily data for a month

3.) Options >> Date (the month that you wish to view)

4.) View >> (select go to generate report)



Climatological Data for Albany Area, NY (ThreadEx) - November 2021
Click column heading to sort ascending, click again to sort descending.

Date	Temperature				HDD	CDD	Precipitation	New Snow	Snow Depth
	Maximum	Minimum	Average	Departure					
2021-11-01	57	37	47.0	1.4	18	0	0.00	0.0	0
2021-11-02	54	32	43.0	-2.2	22	0	0.00	0.0	0
2021-11-03	49	29	39.0	-5.9	26	0	0.00	0.0	0
2021-11-04	49	27	38.0	-6.5	27	0	0.00	0.0	0
2021-11-05	50	26	38.0	-6.2	27	0	0.00	0.0	0
2021-11-06	52	26	39.0	-4.8	26	0	0.00	0.0	0
2021-11-07	57	24	40.5	-3.0	24	0	0.00	0.0	0
2021-11-08	62	30	46.0	2.9	19	0	0.00	0.0	0
2021-11-09	63	34	48.5	5.7	16	0	0.00	0.0	0
2021-11-10	58	37	47.5	5.1	17	0	0.08	0.0	0
2021-11-11	55	29	42.0	-0.1	23	0	0.00	0.0	0
2021-11-12	59	36	47.5	5.8	17	0	1.17	0.0	0
2021-11-13	51	32	41.5	0.1	23	0	0.61	0.0	0
2021-11-14	49	31	40.0	-1.0	25	0	0.11	0.0	0
2021-11-15	M	M	M	M	M	M	M	M	M
2021-11-16	M	M	M	M	M	M	M	M	M
2021-11-17	M	M	M	M	M	M	M	M	M
2021-11-18	M	M	M	M	M	M	M	M	M
2021-11-19	M	M	M	M	M	M	M	M	M
2021-11-20	M	M	M	M	M	M	M	M	M
2021-11-21	M	M	M	M	M	M	M	M	M
2021-11-22	M	M	M	M	M	M	M	M	M
2021-11-23	M	M	M	M	M	M	M	M	M
2021-11-24	M	M	M	M	M	M	M	M	M

Step 6: This will generate a NOWData report. Precipitation is between the CDD and New Snow columns and is in inches.

The precipitation for the two days prior to the day that you are viewing the report will constitute the 24 and 48 hour rainfall.

Example: If you want to conduct ORI inspections on Monday, 2021-11-15, 48 hours prior, on Saturday, 2021-11-13 there was .61 inches of precipitation. 24 hours prior, on Sunday 2021-11-14, there was .11 inches. Combined precipitation is .72 inches. If using .25 inches of rain as a runoff-producing rain event, runoff is likely, dry weather conditions NOT met for Monday, 2021-11-15 outfall inspections.

Box Inventory Item Check List	For All Kits ORI Kit Mtg 27Oct2020 Decision. NH 2021 ORI Kit Invtry	Kit item match to Coalition ORI Paper Form (July 10, 2009) & EPA/CWP IDDE Appendix D	KITS - Distribution & Restock Notes					
			1	2	3	4	5	6
			MS4:	MS4:	MS4:	MS4:	MS4:	MS4:
			To:	To:	To:	To:	To:	To:
			Date:	Date:	Date:	Date:	Date:	Date:
Field Work Laminated Instructions	YES	Sec 2 Outfall Descr, Sec 4 & 5 Physical Indicators						
Pen	YES	For notes & paper forms						
Sharpie	YES	For notes & paper forms						
Clip Board	YES	For notes & paper forms						
Small notebooks		For notes						
Thermometer (C)	YES	Air & Sec 3 Flowing:Quantitative Char (Temp - required)						
Tape Measure	YES	Sec 3 Flowing: Quantitative Char (Flow Method #1 & #2)						
Stop Watch	YES	Sec 3 Flowing: Quantitative Char (Flow Method #1 Vol & #2)						
1 Gallon Pail	YES	Sec 3 Flowing: Quantitative Char (Flow Method #1 Vol)						
2 Ping Pong Balls	YES	Sec 3 Flowing: Quantitative Char (Flow Method #2)						
Water Sampling tips & Chemistry parameters	YES							
1 Hach Ammonia Test Strip bottles (25ea)	YES	Sec 3 Flowing: Quantitative Char (Ammonia - required)	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:
HACH Item No 2755325 Test strip Ammonia, 0-6ppm pk/25 ($25.75 2020)			# of strips:	# of strips:	# of strips:	# of strips:	# of strips:	# of strips:
1 Hach pH Test Strip bottle (50ea)	YES	Sec 3 Flowing: Quantitative Char (pH - required any method)	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:
HACH Item No 2745650 Test strip pH mid-range, 4-9 pH ($13.55 2020)			# of strips:	# of strips:	# of strips:	# of strips:	# of strips:	# of strips:
1 Hach Phosphate test strip bottle (50ea)	YES	Sec 3a Coal 7/10/2009 Form Flowing: Quantitative Char (Phosphate-optional)	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:
HACH Item No 2757150. Test strip Phosphate 0-50ppm pk/50 ($26.55 2020)			# of strips:	# of strips:	# of strips:	# of strips:	# of strips:	# of strips:
1 Hach Nitrite/Nitrate Test Strip bottles (25ea)	YES	Sec 3a Coal 7/10/2009 Form Flowing: Quantitative Char (Nitrate/Nitrite-optional)	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:	Expiration date:
HACH Item No 2745425. Test strip Nitrate, Nitrite 0-50, 0-3ppm ($23.99 2020)			# of strips:	# of strips:	# of strips:	# of strips:	# of strips:	# of strips:
Checker Portable pH meter	YES	Sec 3 Flowing:Quantitative Char (pH - required)						
Small screw driver	YES	Sec 3 Flowing:Quantitative Char (pH - required any method)						
pH Buffer 4	YES	Sec 3 Flowing:Quantitative Char (pH - portable Checker)						
pH Buffer 7	YES	Sec 3 Flowing:Quantitative Char (pH - portable Checker)						
pH Buffer 10	YES	Sec 3 Flowing:Quantitative Char (pH - portable Checker)						
Squirt Bottle	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
1 Waste Bottle	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
10 Small Plastic Tubes	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
Disposable gloves	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
Kim Wipes	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
Lab Soap	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
Nalgene sample bottles (6)	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
Large Ziploc Bag for Garbage	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
Distilled Water	YES	Sec 3 Flowing:Quantitative (bottle/test strip clean up)						
10 Ziplock Bags	YES	Sec 3 Flowing:Quantitative Char (bottle/test strip cleanup)						
Optical Pads	YES	Sec 7 Intermittent flow trap set						
Fishing line (1 rolls)	YES	Sec 7 Intermittent flow trap set						
Hammer	YES	Sec 7 Intermittent flow trap set						
4 Light intensity cages	YES	Sec 7 Intermittent flow trap set						
4 Light intensity nets	YES	Sec 7 Intermittent flow trap set						
Rag	YES	Sec 7 Intermittent flow trap set						
Scissors	YES	Sec 7 Intermittent flow trap set						
7 Nails	YES	Sec 7 Intermittent flow trap set						
10 popsicle sticks	YES	Sec 7 Intermittent flow trap set						
10 Zip ties	YES	Sec 7 Intermittent flow trap set						

Box Inventory Item Check List	For All Kits ORI Kit Mtg 27Oct2020 Decision. NH 2021 ORI Kit Invtry	Kit item match to Coalition ORI Paper Form (July 10, 2009) & EPA/CWP IDDE Appendix D	KITS - Distribution & Restock Notes					
			1	2	3	4	5	6
			MS4:	MS4:	MS4:	MS4:	MS4:	MS4:
			To:	To:	To:	To:	To:	To:
			Date:	Date:	Date:	Date:	Date:	Date:
OTHER EQUIPMENT	Available SWC office							
4 Black Lights	**YES**	Sec 7 Intermittent flow trap set. Available - borrow (SWC office 175 Green)						
Waders	**YES**	Optional for kits. Available to borrow (SWC office 175 Green)						
Sample scooper	**YES**	Coalition should buy. Not purchased as of 10/5/2021. For hard to reach flow						
Carrying case or bag (field work friendly)	**YES**	Optional for kits. Available cinch bags (SWC office 175 Green)						
Safety vests	**YES**	Optional for kits. Available to borrow (SWC office 175 Green)						
PCS Testr 35 Multiparameter Tester (pH, conductivity, TDS, Saliniity, Temp)	**YES**	Optional for kits. 3 available to borrow (SWC office 175 Green)						
iPad tablet and **AGOL subscription** **(S123 Form)**	**NO**	Tablets purchase for Coalition members DEC Grant C00081GG ending 4/30/2020. Use for ORI S123/AGOL						
Batteries LR44 or **SR44** silver-oxide. (1 stopwatch; 4 Testtr	**YES**							
Batteries CR2032 3V (1 for pH Hanna Checker)	**YES**							

MCM 3: ORI Water Sampling Field Tips

1. SAFETY FIRST:
    a. Although the water sometimes seems clean and clear, there can be bacteria in/around flowing outfalls.
    b. Whenever doing water tests, gloves should be worn at all times to protect yourself from potential hazards and disease.

2. Using the plastic bottle to take water samples:
    a. Once a plastic bottle is used for sampling, it CANNOT be reused in the field again. It has to be cleaned out using phosphate free soap. It cannot simply be washed out using distilled water, so plan accordingly. If you are doing a lot of outfalls one day, you may need to pick up extra sampling bottles.
    b. The very small plastic vials that are in the kits can be rinsed out using distilled water. This waste water should also go in the waste disposal container.

3. What to do with unused water samples:
    a. Water samples are taken from locations with flowing/stagnant water. This water is then divided into smaller vials so testing can be done on it. The water that was taken from the outfall, even if it was not used for testing directly, CANNOT be returned to the stream/outfall location. All water that is taken for sampling has to be put in the waste disposal container.

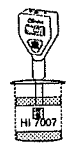
4. What to do with used test strip/samples that were tested using chemicals:
    a. After a test strip has been used, it should be placed in the disposal container along with all the water that was not used. HACH test strips are disposable.
    b. All waste water from chemical testing should also be poured into the waste disposal container.

5. What to do with used gloves/OB pads:
    a. Used gloves and OB pads can be placed into a plastic bag and returned to the Stormwater Coalition office for proper disposal.

HANNA pH Checker .. Directions
(screw type)

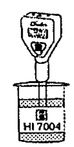
Checker® Checker® Checker® Checker®

CALIBRATION:

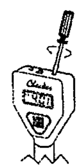


- Dip the tip of the electrode (bottom 4cm/1½") in a sample of pH 7.01 buffer at room temperature. Allow the reading to stabilize.

- Use a small screwdriver to adjust the pH 7 trimmer until the display reads "7.01".



- Rinse the electrode with water and dip it in a sample of pH 4.01 (or 10.01) buffer solution. Allow the reading to stabilize.

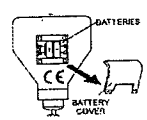


- With a small screwdriver adjust the pH 4/10 trimmer until the display reads the chosen buffer value.
- Calibration is now complete.

ALWAYS USE FRESH BUFFERS FOR CALIBRATION

BATTERY REPLACEMENT:

Replace the batteries when the display fades, or Checker® cannot be switched on.



Remove the battery cover on the back of the meter. Insert 2 new 1.5V batteries while paying attention to their polarity.
Batteries should only be replaced in a safe area using the battery type specified in this instruction manual.

ACCESSORIES:

HI 1207	Combination pH electrode 12 mm diameter with screw-type connector
HI 1208	Combination pH electrode 12 mm diameter with BNC connector
HI 1270	Combination pH electrode, 9 mm diameter with screw-type connector
HI 70300M	Storage solution (230 mL)

Choose from the following 20 mL sachet solutions:

HI 70000P	Electrode cleaning/ rinse solution (25 pcs.)
HI 70004P	pH 4 buffer solution (25 pcs.)
HI 70007P	pH 7 buffer solution (25 pcs.)
HI 70010P	pH 10 buffer solution (25 pcs)

SUGGESTIONS FOR USERS:

Before using this product, make sure that it is entirely suitable for the environment in which it is used. Operation of this instrument in residential areas could cause interference to radio and TV equipment. The glass bulb at the end of the pH electrode is sensitive to electrostatic discharges. Avoid touching this glass bulb at all times. During operation of instrument, ESD wrist straps should be worn to avoid possible damage to the pH electrode by electrostatic discharges. Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance. To avoid electrical shocks, do not use this instrument when voltage at the measurement surface exceeds 24 VAC or 60 VDC. To avoid damage or burns, do not perform any measurement in microwave ovens.

Visit our Internet Home Page:
www.hannainst.com

HANNA instruments

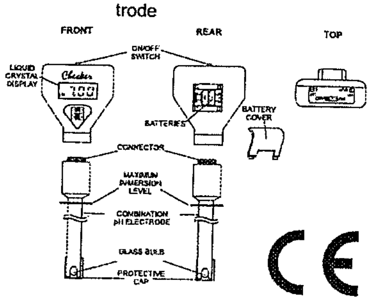
ISTRCHKR 02/97

Hanna
Screw
type

Checker® 1 : with **HI 1270** screw-type pH electrode

Checker® 2 : with **HI 1207** screw-type pH electrode

Checker® 3 : with **HI 1208** BNC-type electrode



SPECIFICATIONS:

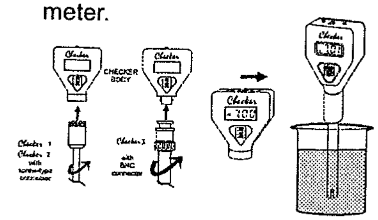
Range	0.00 to 14.00 pH
Resolution	0.01 pH
Accuracy (@20°C/68°F)	±0.2 pH
Typical EMC Deviation	±0.1 pH
Calibration	Manual two points
Electrode:	combination stick pH electrode
Checker® 1 :	**HI 1270 (included)**
Checker® 2 :	**HI 1207 (included)**
Checker® 3 :	**HI 1208 (included)**
Environment	0 to 50°C (32 to 122°F); 95% RH max.
Battery Type Life	2 x 1.5V alkaline approx. 3,000 hours of continuous use
Dimensions	66 x 50 x 25 mm (2.6 x 2 x 1")
Weight *(meter)*	70 g (2.5 oz.)

INITIAL PREPARATION:

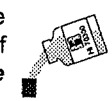
The pH electrode is shipped dry. Prior to using the *Checker*®, remove the protective cap and condition the electrode by soaking the tip (bottom 4 cm/1½") in pH 7.01 buffer solution for a couple of hours. Then follow the calibration procedure below.

OPERATION:

- Do not be alarmed if white crystals appear around the cap. This is normal with pH electrodes and they dissolve when rinsed with water.
- If the electrode is dry, soak it in tap water for a few minutes, prior to use.
- Connect the electrode to the meter.



- Switch the *Checker*® on.
- Remove the protective cap and immerse the tip of the electrode (bottom 4cm/1½") into your sample.
- Stir gently and wait until the display stabilizes.
- For best results, recalibrate periodically.
- NEVER IMMERSE THE ELECTRODE UP TO THE CONNECTOR. ALWAYS KEEP THE CONNECTOR CLEAN AND DRY.
- After use, rinse the electrode with water to minimize contamination.
- Store the electrode with a few drops of ***HI 70300 Storage Solution*** in the protective cap.



- DO NOT USE DISTILLED OR DEIONIZED WATER FOR STORAGE PURPOSES.
- Always replace the protective cap after use.

Hanna
screw
HM

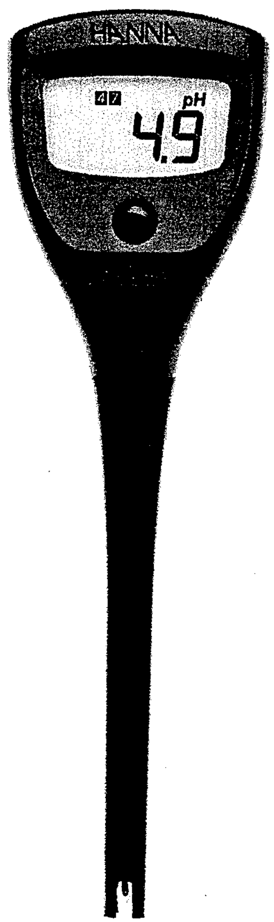
2

HANNA pH Checker - Automatic / or 2 point Instructions

INSTRUCTION MANUAL

Checker®

HI98103
pH Tester



HANNA® instruments

Thank You

Thank you for choosing a Hanna Instruments product. Please read this instruction manual carefully before using the instrument.

For more information about Hanna Instruments and our products, visit www.hannainst.com.

For technical support, contact your local Hanna Instruments Office or email us at tech@hannainst.com

Find your local Hanna Instruments Office on www.hannainst.com

Preliminary Examination

Remove the meter from the packing material and examine it carefully to make sure that no damage has occurred during shipment. If noticeable damage is evident, contact your local Hanna Instruments Office.
Each meter is supplied with:

- pH 4.01 Buffer Solution Liquid Sachet (2 pcs.)
- pH 7.01 Buffer Solution Liquid Sachet (2 pcs.)
- General purpose cleaning solution (2 pcs.)
- Instruction manual
- Quality Certificate

Note: Save all packing material until you are sure that the instrument functions correctly. All defective items must be returned in the original packaging with the supplied accessories.

Meter Overview

Preparation:

The pH electrode is shipped dry. Before using the Checker®, remove the protective cap and condition the electrode by soaking the tip (bottom 4 cm (1.5")) in pH 7.01 buffer solution for several hours. Then follow the calibration procedure.

- Do not be alarmed if white crystals appear around the cap. This is normal with pH electrodes and they dissolve when rinsed with water.
- Connect the electrode to the meter.
- Turn the Checker® on by pressing ON/OFF button.
- Remove the protective cap and immerse the tip of the electrode in the sample to be tested.
- Stir gently and wait for a stable reading.

NEVER IMMERSE THE ELECTRODE OVER THE MAXIMUM IMMERSION LEVEL. THE CONNECTOR MUST ALWAYS BE CLEAN AND DRY.

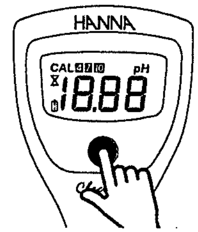
- After use, rinse the electrode with water and store it with a few drops of HI70300 storage solution in the protective cap.
- Replace protective cap after each use.

DO NOT USE DISTILLED OR DEIONIZED WATER FOR STORAGE PURPOSES.

Specifications

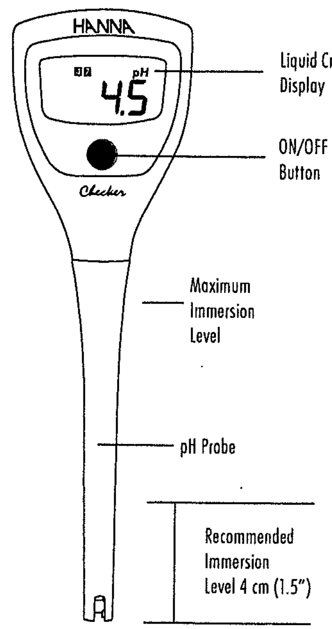
Range	0.0 to 14.0 pH
Resolution	0.1 pH
Accuracy (@25 °C/77 °F)	±0.2 pH
Calibration	automatic, one or two-point
Electrode	HI1271 (included)
Battery Type	CR2032 Li-ion
Battery Life	approximately 1000 hours of continuous use
Auto-off	8 minutes, 60 minutes or can be disabled
Environment	0 to 50 °C (32 to 122 °F); RH 95% max
Dimensions	50 x 174 x 21 mm (2 x 6.8 x 0.9")
Weight	50 g (1.8 oz.)

Operation

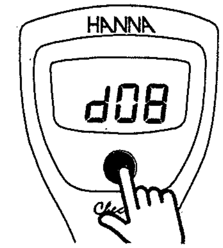


Press the ON/OFF button to turn the meter on. All tags will be displayed.

The meter will go into measurement mode: current reading and calibrated buffers are displayed.



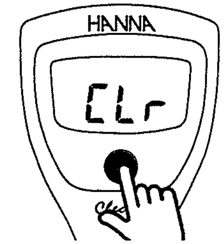
Auto-off



From measurement mode, press a hold the ON/OFF button. The met will cycle through "OFF," "CAL," then current auto-off setting.

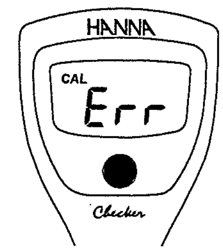
The default setting is 8 minutes ("d08"). Press ON/OFF button to change. "d60" is auto-off after 60 minutes, and "d--" disables the auto-off feature. Press and hold the button to exit the menu.

Clear Calibration



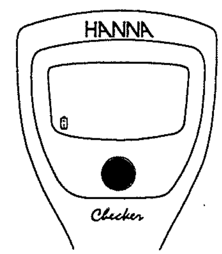
Place meter in calibration mode Press and hold ON/OFF until "CLr' is displayed. The meter will now b at default calibration. No tags wil be shown in measurement mod until calibration is performed.

"Err" Message



In calibration mode, if the meter displays an "Err" message when in the correct fresh buffer solution then the probe should be cleaned. Place the probe in the HI700601 cleaning solution for 15 minutes. Rinse with purified water and place in storage solution for 1 hour before calibrating. If the "Err" message persists then the HI1271 probe should be replaced.

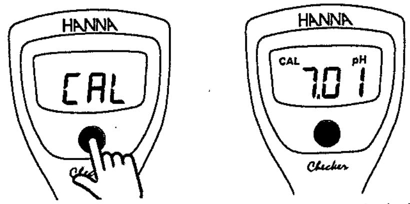
Battery Indicator



The Checker® features a low battery indicator. When the batter is running low, the tag will blink on screen. When the battery has been depleted, "Erb" will appear o screen and the meter will turn off.

Hanna ①

Meter Calibration



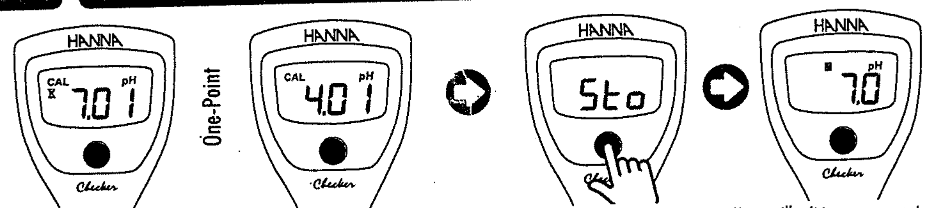
From measurement mode, press and hold the ON/OFF button until "CAL" is displayed.

When "7.01" blinks on the display, place the tip of the probe into a pH 4.01, 7.01, or 10.01 buffer solution.

A For one or two-point calibration using pH 7.01 buffer go to procedure A

B For one-point calibration using pH 4.01 or pH 10.01 buffer go to procedure B

A One or Two-Point Calibration with pH 7.01



If pH 7.01 buffer solution is used as the first point the buffer is recognized with the blinking stability indicator.

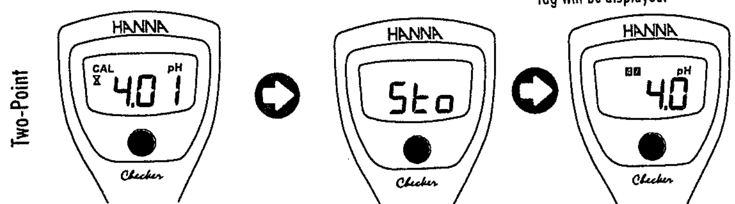
When the reading is stable, the stability indicator will disappear and pH 7.01 will be calibrated.

If pH 7.01 is the only calibration point, finish one-point procedure at right.

If using pH 4.01 or pH 10.01 as a second point, continue two-point procedure at right.

pH 4.01 will then blink on the display.

Meter will exit to measurement mode and the calibration tag will be displayed.

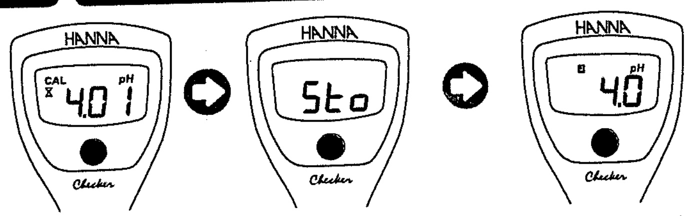


Use pH 4.01 or pH 10.01 to perform a two-point calibration. The value is automatically recognized and displayed with the blinking stability indicator.

When the reading is stable, the stability indicator will disappear. "Sto" will be displayed when the calibration is saved.

Meter will exit to measurement mode and the calibration tags will be displayed.

B One-Point Calibration with pH 4.01 or pH 10.01



If pH 4.01 or pH 10.01 buffer solution is used as the first point the value of the buffer is recognized and displayed with the blinking stability indicator.

When the reading is stable, the stability indicator will disappear. "Sto" will be displayed when the calibration is saved.

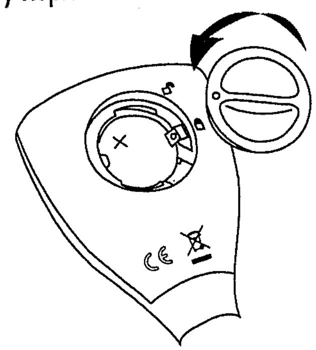
Meter will exit to measurement mode and the calibration tag will be displayed.

Care and Maintenance

To obtain the highest accuracy for measurements it is important to follow these tips:

- Calibration is only as good as the buffer being used. The pH buffer values change over time once the sachets are opened. Fresh buffer should be used for each calibration.
- The probe should be rinsed with purified water each time before placing in buffer or sample to be tested.
- When the meter is not in use it is important to add several drops of storage solution to the protective cap to keep the probe hydrated. If storage solution is not available, pH 4.01 or pH 7.01 buffer can be used.
- For improved accuracy it is recommended to calibrate to a minimum of two points. It is important to use buffers that bracket the expected value of the sample to be tested. For example, if the expected value is pH 8, the meter should be calibrated using pH 7.01 and pH 10.01 buffers.
- It is important to calibrate and measure samples at the same temperature. A dramatic change in temperature between buffer solutions and samples to be tested will give inaccurate readings.

Battery Replacement



To change the CR2032 Li-ion battery, turn the battery cover located on the back of the meter counterclockwise to unlock. Remove cover and replace with + side facing up.

Note: Batteries should only be replaced in a safe area using the battery type specified in this instruction manual. Old batteries should be disposed in accordance with local regulations.

Recommendations for Users

Before using Hanna Instruments products, make sure that they are entirely suitable for your specific application and for the environment in which they are used. Any variation introduced by the user to the supplied equipment may degrade the meter's performance. Avoid touching the electrode area. To avoid damages or burns, do not put the meter in microwave oven. For yours and the meter's safety do not use or store the meter in hazardous environments.

Accessories

Electrode

Code	Description
HI1271	pH electrode for Checker

pH Buffer Solution

Code	Description
HI70004P	pH 4.01 buffer solution, 20 mL sachets (25 pcs.)
HI70007P	pH 7.01 buffer solution, 20 mL sachets (25 pcs.)
HI70010P	pH 10.01 buffer solution, 20 mL sachets (25 pcs.)
HI77400P	pH 4.01 & 7.01 buffer solution, 20 mL sachets (10 pcs., 5 ea.)
HI770710P	pH 10.01 & 7.01 buffer solution, 20 mL sachets (10 pcs., 5 ea.)

Electrode Cleaning Solution

Code	Description
HI700601P	general purpose cleaning solution, 20 mL sachets (25 pcs.)

Electrode Storage Solution

Code	Description
HI70300L	electrode storage solution, 500 mL bottle
HI70300M	electrode storage solution, 230 mL bottle

Warranty

The meter is warranted for a period of one year against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. The electrode is warranted for a period of six months. This warranty is limited to repair or replacement free of charge. Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered. If service is required, contact your local Hanna Instruments Office. If under warranty, report the model number, date of purchase, serial number and the nature of the problem. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization (RGA) number from the Technical Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

IST98103N 06/18

Hanna Automatic

From P. [illegible], PE
Websearch No. Central Texas IDDE Program.
~ Dec. 2013

Table to help
analyze field test results

Tier I Parameters	Potential Sources	Level of Concern
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	1.0 mg/L
Chlorine	Used to indicate inflow from potable water sources; used as disinfectant in water and wastewater treatment processes	0.2 mg/L
Conductivity	Used to measure total dissolved solids (TDS); TDS can increase as a result of wastewater discharges, irrigation, and overuse of fertilizers	1500 µS/cm
Copper	Can indicate waste from manufacture of electrical components, coins, bronze, and brass products	0.2 mg/L
Detergent	Can indicate a discharge from wash water or laundry	0.2 mg/L
pH	Extreme pH values (low or high) may indicate commercial or industrial flows	Below 6.0 su or above 9.0 su
Tier II Parameters	**Potential Sources**	**Level of Concern**
Bacteria (Fecal coliform; *E. coli*)	Can be found in the feces of human and other warm blooded animals from direct discharge	*400 col/100 mL - fecal coliform 394 col/100 mL - *E. coli*
Dissolved Oxygen (DO)	Low DO can indicate sewage problem or excessive nutrient load; as water temperature increases, DO generally	**Exceptional - 4.0 mg/L High/Intermediate - 3.0 mg/L

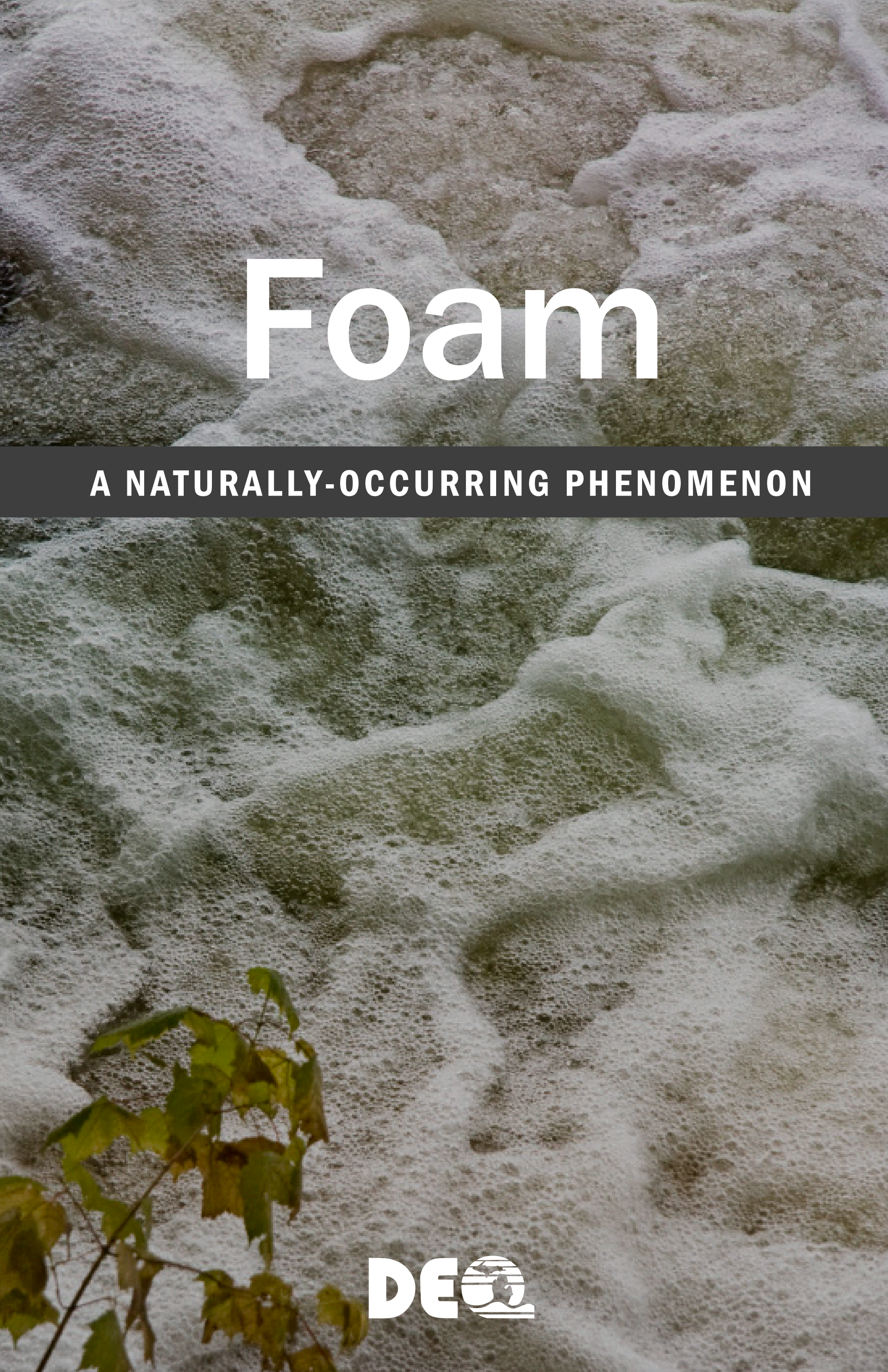
Texas IDDE

(1)

	decreases	Limited - 2.0 mg/L Minimal - 1.5 mg/L
Fluoride	Potable water	0.5 mg/L
Lead	Used in construction material for tank linings, piping, and other equipment for corrosive gasses and liquids	0.1 mg/L
Nickel	Used in making stainless steel and other alloys, coinage, armor plates	0.2 mg/L
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	1.0 mg/L
Phosphates	Found in fertilizer and industrial waste	0.5 mg/L

Txes J1712

2



Foam

A NATURALLY-OCCURRING PHENOMENON

DEQ

Foam

A NATURALLY-OCCURRING PHENOMENON

The Department of Environmental Quality often receives complaints claiming that “someone discharged laundry detergents into the lake” or that there are suds on the river or stream. This phenomenon is often the result of natural processes, not environmental pollution. Foam can be formed when the physical characteristics of the water are altered by the presence of organic materials in the water.

The foam that appears along lakeshores is most often the result of the natural die-off of aquatic plants. Plants are made up of organic material, including oils (e.g., corn oil and vegetable oil). When the plants die and decompose, the oils contained in the plant cells are released and float to the surface. Once the oils reach the lake surface, wind and wave action pushes them to the shore. The concentration of the oil changes the physical nature of the water, making foam formation easier. The turbulence and wave action at the beach introduces air into the organically enriched water, which forms the bubbles.

Foam commonly occurs in waters with high organic content such as productive lakes, bog lakes, and in streams that originate from bog lakes, wetlands, or woody areas. Oftentimes, streams that originate from woody areas will have a brown tint in the water. The brown tint is often caused by the presence of tannin, which is a substance that gives wood its brown color. The tannin is released during the decomposition of wood along with other materials that cause foaming when they are introduced in water. It is quite common to find foam in dark-colored streams, especially during late fall and winter, when plant materials are decomposing in the water.

Naturally-occurring foam: on Stoney Creek in Southeast Michigan and on the Grand River in the Jackson area.

Some foam in water can indicate pollution. When deciding if the foam is natural or caused by pollution, consider the following:

- **Wind direction or turbulence:** Natural foam occurrences on the beach coincide with onshore winds. Often, windrows of foam can be found along a shoreline and streaks of foam may form on open waters during windy days. Natural occurrences in rivers can be found downstream of a turbulent site.

- **Proximity to a potential pollution source:** Some entities such as the textile industry, paper production facilities, oil industries, and fire fighting activities work with materials that cause foaming in water. If these materials are released to a water body in large quantities, they can cause foaming. In addition, the presence of silt in water, such as from a construction site can cause foam.

- **Composition:** Presence of decomposing plants or organic material in the water.

- **Feeling:** Natural foam is usually persistent, light, not slimy to the touch.

If you find pollution and believe it is human-induced, please report it to the State of Michigan's Pollution Emergency Alerting System (PEAS) hotline at 1-800-292-4706.

For more information please contact any district office or call the State of Michigan's Environmental Assistance Center at 1-800-662-9278.

Michigan's Environmental Justice Policy promotes the fair, non-discriminatory treatment and meaningful involvement of Michigan's residents regarding the development, implementation, and enforcement of environmental laws, regulations, and policies by this state. Fair, non-discriminatory treatment intends that no group of people, including racial, ethnic, or low-income populations, will bear a disproportionately greater burden resulting from environmental laws, regulations, policies, and decision-making. Meaningful involvement of residents ensures an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health. 01/2016

How to use the Optical Brighteners (OB):
Information complied from the "Eight Towns and the Bay" Optical Brightener Handbook and should be referred to for more detailed explanations/information.

1. What do OBs test for?
    a. They test for fluorescent white dyes that are present most laundry detergents and soaps.
2. When should the Optical Brighteners be used?
    a. If there is foam or excessive bubbles in the water.
    b. If there is unusual growth of algae or other plants indicating nutrient loading.
    c. If you have completed other tests and decided that you still want to put in an optical brightener.
3. Keeping track of data using the Optical Brightener Sheet
    a. All pertinent information should be written on the OB sheet
    b. Placement, Retrieval, and Results are all included on the sheet
    c. Amount of rainfall, flow data, and the number of days the sample was in place is needed information.
4. Proper Handling
    a. Always wear gloves when placing optical brighteners because your hands or clothes might have soaps/detergents on them. So, if the OB comes into contact with either, there might be some cross contamination.
    b. Always wear gloves when retrieving optical brighteners because the water that the OB pad was exposed to might also contain other waste water.
    c. All sampling devices (cages and nets) should be rinsed thoroughly before being re-used to prevent cross contamination.
    d. OB pads should be checked under a long wave Ultra Violet (UV) fluorescent light before use to make sure they do not contain OBs.
5. Placement
    a. Wearing gloves, take the net or the cage and insert the OB pad. Add stones to the net to weigh it down.
        i. Use the black cages in an open pipe or stream.
        ii. Use the nets in catch basins.
    b. Close the open end by threading the fishing line or using a rubber band.
    c. Tie the other end of the fishing line to a nail/popsicle stick and put it in the ground/wedge it into the side of a grate cover.
6. Retrieval
    a. Wearing gloves, remove the pad from the cage/net.
    b. Rinse the pad off in the sampling waters as much as possible to remove excess sediment.
    c. Squeeze the pad to remove water. Do not tear/rip the pad.
    d. Label/tag the pads for cross referencing (included location, day of placement, and day of removal). Staple the label to the pad. Make sure that the labels you are using do not have optical brighteners by checking under a UV light.
    e. Put the sampling pads in separate plastic bags and place them in a dark area hanging over a fishing line (if possible; this line should be wiped down or replaced after each use).

    f. Let the pads dry out (at least overnight) in a place out of direct sunlight.
7. Analysis
    a. Place dried out pads on a table in a dark room and view under UV light.
        i. HINT: The darker the room the easier it is to see the results.
    b. Use an unused OB pad to compare the sampling pads to as they are exposed to UV light.
    c. There are 3 possible results:
        i. Positive – it will glow
            1. Sometimes only part of the OB pad will fluoresce, but that could be how it was sitting in the water. It is still positive.
        ii. Negative – it will look like the unused OB pad
        iii. Retest – undertermined
            1. When in doubt, retest.
    d. It is common to see some specks or spots on the unused and sample pads. These should be ignored and not used to indicate a positive result.
    e. Place the OB pads in respective result piles (positive, negative, retest) as they are read.
    f. After all the pads have been read, turn the lights back on and record the results.
8. The Next Step
    a. If necessary, a larger sampling of brighteners can now be done in areas with positive results.
    b. OBs can help detect faulty septic systems, sewage exfiltration, storm-drain cross connections, and human/animal waste differentiation.
    c. See the "Eight Towns and the Bay" packet Appendix C for more results and different courses of action.

Optical Brightener
Field Sheet
(From Eight Towns and The Bay Water Quality Sampling An Optical Brightener Handbook)

Sub Watershed (Drainage Area and/or Stream Name):		Collected By:
Sewershed Name (If available):		Page ___ of ___
Remarks:		

Location	Date Placed	Date Pulled	No days	Flow Volume (liters/sec)	O.B. +/-	Total Rain

Most industrial discharges can consistently be identified by extremely high potassium levels. However, these discharges would be misclassified as washwater when just the Flow Chart Method is used. Other benchmark parameters have value in identifying specific industrial types or operations. For example, metal plating bath waste discharges are often indicated by extremely high conductivity, hardness and potassium concentrations.

Adapting Industrial Flow Benchmark

By their very nature, industrial and other generating sites can produce a bewildering diversity of discharges that are hard to classify. Therefore, program managers will experience some difficulty in differentiating industrial sources. Over time, the composition of industrial discharges can be refined as chemical libraries for specific industrial flow types and sources are developed. This can entail a great deal of sampling, but can reduce the number of false positive or negative readings.

Table 45: 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	≥2,000µS/cm	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources.
Hardness	≤10 mg/L as $CaCO_3$ ≥2,000 mg/L as $CaCO_3$	• 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.

Table 46: Usefulness of Various Parameters to Identify Industrial Discharges

Industrial Benchmark Concentration	Detergents as Surfactants (mg/L)	Ammonia (mg/L)	Potassium (mg/L)	Initial "Flow Chart" Class	Color (Units)	Conductivity (µS/cm)[1]	Hardness (mg/L as $CaCO_3$)	pH	Turbidity (NTU)	Best Indicator Parameters to Identify This Flow Type	Additional Indicator Parameters to Identify This Flow Type
	--	≥50	≥20		≥500	≥2000	≤10 ≥2,000	≤5	≥1,000		
Concentrations in Industrial and Commercial Flow Types											
Automotive Manufacturer[1]	5	0.6	66	**Wash water**	15	220	30	6.7	118	Potassium	
Poultry Supplier[1]	5	4.2	41	**Wash water**	23	618	31	6.3	111	Potassium	
Roofing Product Manufacturing[1]	8	10.2	27	**Wash water**	>100[2]	242	32	7.1	229	None	Potassium Color
Uniform Manufacturing[1]	6	6.1	64	**Wash water**	>100[2]	798	35	10.4	2,631	Potassium	Color Turbidity
Radiator Flushing	15	(26.3)	(2,801)	**Wash water**	(3,000)	(3,278)	(5.6)	(7.0)	-	Potassium Conductivity Color	Hardness
Metal Plating Bath	7	(65.7)	(1,009)	**Wash water**	(104)	(10,352)	(1,429)	(4.9)	-	Ammonia Potassium Conductivity Hardness	pH
Commercial Car Wash	140	0.9; (0.2)	4; (43)	**Wash water**	>61; (222)	274; (485)	71; (157)	7.7; (6.7)	156		Potassium Turbidity
Commercial Laundry	(27)	(0.8)	3	**Wash water**	47	(563)	(36)	(9.1)	-		

Best Indicators, shaded in pink, distinguish this source from residential wash water in 80% of samples in both Tuscaloosa and Birmingham, AL.
Supplemental indicators, shaded in yellow, distinguish this source from residential wash water in 50% of samples, or in only one community.
(Data in parentheses are mean values from Birmingham); Data not in parentheses are from Tuscaloosa
[1] Fewer than 3 samples for these discharges.
[2] The color analytical technique used had a maximum value of 100, which was exceeded in all samples. Color may be a good indicator of these industrial discharges and the benchmark concentration may need adjustment downward for this specific community.

Findings and Follow Up Report

(Outfalls Characterized as Suspect or Obvious)

Stormwater Coalition ORI Inspection Form – AGOL Survey 123

Outfall ID:	**Date of Inspection:**	**Inspector:**

Municipality:	**Receiving Waters:**	**Watershed:**	**Rainfall (24-hr):**	**Rainfall (48-hr):**

Overall Outfall Characterization:

Description of physical location:

Outfall Type:	**Mode of Entry:**	**Submerged in water:**	**Submerged in sediment:**

Flow Present:	**Flow: ___vol (L) ___length___width ___depth (ft) ___time (sec) Rate:____(L/min)**

pH:	**Total Ammonia:**	**Total Nitrate:**	**Total Nitrite:**	**Total Phosphate:**

Physical Indicators (flowing): Odor____________; Color___________; Turbidity__________; Floatable__________.
How many physical indicators have a Relative Severity Index of 3? ____

Physical Indicators (flowing and non-flowing): Outfall Damage ________; Deposit/Stains________; Abnormal Vegetation ________; Poor Pool Quality ______; Pipe Benthic Growth ______. # of physical indicators ____

Land use in area:

Primary Concerns/Possible Pollutants of Concern:

Summary of findings:

Report Preparer/Title:	**Date of Report:**

Proposed Follow up to Findings (By Inspector, Coalition, and/or MS4):

Actions Taken:	**Date:**	**By Whom:**