Restoring Bacteria-Impaired Waters

A Toolkit to Help Local Stakeholders Identify and Eliminate Potential Pathogen Problems

developed by the
Water Quality Restoration Program
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

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1.0 Context

1.1 Purpose

This guidance is intended to help local stakeholders identify and eliminate pathogen sources in surface waters. It is based on the Florida Department of Environmental Protection's (DEP) use of fecal indicator bacteria (FIB) to indicate potential pathogens in surface waters, and it guides the subsequent development of strategies to identify and eliminate their sources. Protecting public health is paramount.

Keys to restoring bacteria-impaired waters include the following:

- Focus on identifying and reducing health risks.
- Gather, evaluate, and interpret relevant data.
- Build collaborative relationships among key stakeholders, especially local wastewater and stormwater utilities and local government leaders.
- Conduct mapping and field studies, such as Walk the Watershed (WTW) exercises, to uncover potential pathogen sources in the watershed.
- Prioritize hot spots based on water quality data and risk of human contact.
- Monitor and investigate problems.
- Ensure that entities with appropriate authority act in a timely way to locate and eliminate sources.
- Track and catalog identified sources.
- Select effective restoration strategies.
- Prioritize and increase source control measures and infrastructure operation, maintenance, and replacement practices to minimize future problems.
- Pursue local revenue generation opportunities and state and federal financial assistance to build or refurbish local infrastructure.
- Ask DEP for help.

Reference documents are listed as appendices. Electronic copies can be obtained by contacting Anita Nash at anita.nash@dep.state.fl.us. References in the guidance documents to fecal coliform also generally apply to *Enterococci* and *Escherichia coli (E. coli),* which are other indicator bacteria. Hyperlinks in the document provide fast access to supporting information and email addresses. **Appendix H** contains a list of the complete urls.

This Toolkit and its references are not an interpretation of DEP rules; rather, they offer guidance to help local stakeholders protect public health. The documents will be updated from time to time. Check the DEP website for the most recent versions.

1.2 Document Outline

Section 1 provides the context necessary to understand the Toolkit and use it effectively to restore bacteria-impaired waters.

Section 2 contains describes steps to identify the sources of pathogens and develop effective restoration strategies.

Section 3 describes management actions, including structural solutions, that stakeholders can use to remove likely pathogen sources and prevent reoccurrence.

The **Appendices** contain detailed references and resources to save stakeholders' time.

1.3 DEP's Watershed Management Approach

The following is a general overview of the watershed management approach, from the adoption of standards through the identification of water quality problems and establishment of restoration goals and implementation actions:

- DEP adopts surface water quality standards to protect the beneficial uses of Florida's rivers, lakes, springs, estuaries, and coastal waters (Chapter 62-302, Florida Administrative Code [F.A.C.]).

- The agency uses available monitoring data to assess whether those waters meet the standards or are impaired because of a particular pollutant or pollutants (Chapter 62-303, F.A.C.). Contact DEP for more information about impaired waters and water quality standards and assessments.

- For waters that do not meet water quality standards, DEP typically adopts a total maximum daily load (TMDL). A TMDL sets a restoration target by determining the maximum amount of a specific pollutant the waterbody can assimilate while maintaining water quality standards and designated uses (Chapter 62-304, F.A.C.). Ideally, DEP and local stakeholders can begin to reduce or eliminate the sources of the pollution problem so that a TMDL is not necessary.

- Restoration is a collaborative process between DEP and local stakeholders to identify the sources of the water quality problems and take actions necessary to reduce or eliminate them. In the case of bacteria, restoration can be accomplished by following the guidance in this Toolkit. In some cases—and typically with other water quality problems (nutrients, for example)—DEP adopts enforceable restoration plans, called basin management action plans or BMAPs, in response to TMDLs.

- Once effective strategies have been integrated into a restoration plan, local stakeholders proceed, with DEP's help, to make the investments and take the actions that will achieve the necessary water quality improvements.

- Stakeholders measure the effectiveness of the specific actions laid out in the restoration plan.

- Stakeholders adapt, changing the plan and the actions as necessary based on measured results and newly developed technologies or approaches.

    - Stakeholders continuously reassess the quality of local surface waters.

Reminder:

The ten percent threshold values (TPTVs) for Class III waters are:

- *E. coli* at 410 colony-forming units per 100 milliliters (cfu/100mL) in fresh waterbodies, or

- Enterococci at 130 cfu/100mL in marine waterbodies.

Please see the rule for the rest of the details (**Appendix A**).

1.4 Coordinating with DEP

The lead person for the restoration plan should contact the DEP municipal separate storm sewer system (MS4) Phase I regional coordinator up front to make DEP aware that a restoration plan is being developed. Entities can also contact Anita Nash, Environmental Consultant, in the DEP Water Quality Restoration Program (WQRP) (at anita.nash@dep.state.fl.us), to help develop restoration plans, WTW exercises, monitoring plans, and more. Staying in touch with DEP throughout the process of identifying and eliminating potential pathogen sources will improve your chances for success.

1.5 Recommended Approach

The guidance in this document is intended for MS4 Phase I coordinators and other local leaders working on developing and implementing restoration plans. The recommendations listed in this section are further detailed in later sections and appendices. **Figure 1** illustrates the iterative process used to locate and address specific FIB sources.

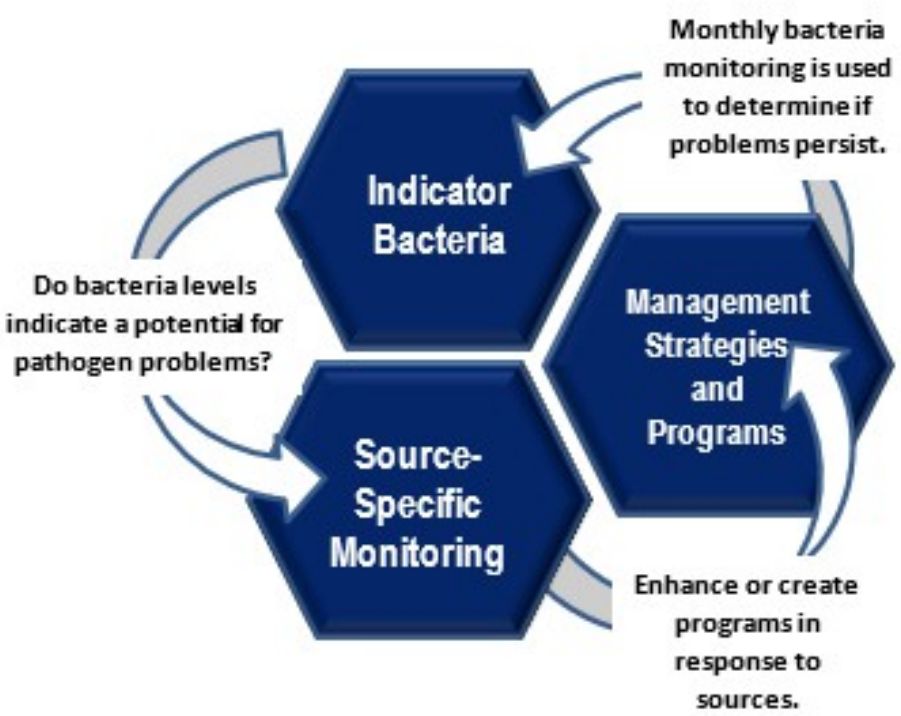

Figure 1. Iterative process for locating and addressing specific FIB sources

MS4 Phase I coordinators will perform some tasks directly and will coordinate with other responsible parties to ensure completion of other tasks. All activities and results should be documented for MS4 Phase I reporting to track progress.

1. Evaluate the existing water quality data. Is the waterbody currently impaired based on the indicator bacteria?

    - If the answer is no, notify the MS4 Phase I regional coordinator and move on to addressing another area.

    - If enough data are not available to determine impairment, gather the data. **Sections 2.5.2.1** through **2.5.2.3** describe monitoring plans and source-specific analytes. DEP does not recommend the collection of fecal coliform samples, even when implementing fecal coliform TMDLs. Instead, sample for the bacteria indicator associated with the waterbody type, either *E. coli* or Enterococci, per the current standard.

    - If the answer is yes, develop the geographic information system (GIS) database described briefly below and in more detail in **Section 2.3, Compiling and Evaluating Data**.

2. Develop and maintain a comprehensive GIS database. The database will be an ongoing record to be updated and maintained over the long term. If GIS layers are not available, develop them as you carry out field exercises. For example, private lift station inventories are not common, but these lift stations may be a source of bacteria (see **Section 3.1.2.1, Private Lift Stations**).

3. Evaluate existing water quality data and develop a monitoring plan if the dataset is insufficient. In addition to local data, check DEP's databases, the Florida Storage and Retrieval (STORET) Database and the DEP Watershed Information Network (WIN), for additional water quality information, such as source-specific data. As part of the data evaluation, consider the following:

    - **Indicator bacteria data:** Are stations adequately distributed throughout the watershed to determine which portions of the WBID are the hot spots (see **Section 2.5.2.1, Selecting Water Quality Sampling Station Locations**)?

    - **Source-specific data:** Even a few positive samples for untreated human waste will influence future steps and motivate participants. Although these analyses are more expensive, quantitative polymerase chain reaction (qPCR) microbial source tracking (MST) results provide a more direct linkage to the type of waste in the waterbody compared with bacteria indicator tests. Use a suite of source-specific analytes when looking for untreated human waste because it is the most dangerous waste source. DEP recommends the addition of the chemical tracers acetaminophen, naproxen, and ibuprofen because they indicate untreated waste when present in waterbodies and stormwater. It is recommended that Walk the Waterbody field investigations be completed before deciding which sources to monitor.

    - **Trend data:** Regular monitoring should be conducted monthly. Evaluate data to determine a range that is "high" for the waterbody. The response should include field investigations soon after analysis and additional sampling to determine the persistence and origin of sources. Ask the lab to notify you the next day if preliminary FIB results, measured in cfu/100mL, are in the tens of thousands or higher. In the case of a high exceedance, investigate as soon as possible to identify the cause and eliminate it. Monitor the site for any repeated exceedances. See **Section 2.3.1, Evaluating FIB Results,** to determine if it is a potential emergency.

4. Evaluate financial and staff resources to see if they meet monitoring and investigative needs. Reevaluate regularly and budget for projected needs.

5. Conduct the Maps on the Table (MOT) event and WTW field event **(**see the summary in **Section 2.5.1, WTW Process**, and the instructions and tools in **Appendix C. Source Identification**). Complete the resulting action items, including the following:

- Confirm the elimination of illicit pipes and discharges.
- Finish walking sections of the watershed.
- Further investigate unknown discharges.
- Sample for source-specific indicators near observations.
- Expand pet waste ordinances and focus public service announcements (PSAs) in areas noted for uncontained pet waste.
- Install pet waste disposal sites.
- Increase the frequency of inspections and necessary maintenance or replacement of sanitary sewer conveyances, focusing on impaired watersheds, especially if the pipes frequently overflow.

6. Determine if intensive source-specific monitoring is needed:
   - If source-specific tests indicate untreated human waste is present, were the origins of the waste sources identified and eliminated? If they were not located, plan intensive source-specific monitoring.
   - Is the waterbody exceeding the TPTV for indicator bacteria during repetitive (trend) monitoring?
     - *If yes, plan intensive source-specific monitoring of the waterbody and stormwater conveyances.*
     - *If no, continue trend monitoring and watch the trends over the next five years, or at least until a DEP impaired waters assessment determines the waterbody is no longer impaired. Act fast if the number of exceedances of the* TPTV *increases.*
7. Conduct intensive source-specific monitoring sub-basin by sub-basin until monitoring results indicate that each is free of untreated human waste or efforts are exhausted.
8. Revisit mystery hot spots as new technologies become available.

To save time, see the appendices for WTW forms, PowerPoint presentations, GIS symbology, examples, and contact lists.

2.0 Understanding the Basin

The first step in preparing a restoration plan is to gain an understanding of the basin. This section outlines the types of information and data that should be reviewed by the stakeholders to familiarize themselves with the basin and to begin identifying potential FIB sources. It also discusses the types of stakeholders typically involved in a plan to reduce FIB.

2.1 Causes of FIB Impairments

Surface waters across Florida, periodically or persistently, are contaminated by human and other animal wastes (feces). FIB commonly originate in the enteric (intestinal) systems of warm-blooded animals and are indicative of the possible presence of pathogens. Human waste can carry pathogens that cause disease.[1] Many researchers have concluded that pathogenic viruses in human feces are the principal cause of waterborne gastrointestinal illness.[2] Therefore, bacteria TMDL implementation must prioritize human waste sources to reduce risks to human health.

Human waste can enter surface waters from such activities as degraded sewer infrastructure, failing onsite sewage treatment and disposal systems (OSTDS) (septic tanks and drain fields), homeless camps, and direct illicit connections from homes or businesses.[3,4,5] Contamination commonly ends up in local stormwater systems, where it is conveyed and discharged to surface waters.

In agricultural areas, uncontained animal waste can migrate into surface waters via runoff. Cattle manure and other livestock waste also contains pathogens harmful to humans.[6] Plans for restoration must prioritize the elimination of contamination by cattle. Wastes from dogs and other domestic animals and livestock are not a natural part of the environment and, like most fecal sources, may cause an imbalance in nature, pose health risks to swimmers, and pollute seafood.

There also are natural sources of fecal wastes, such as birds and other wildlife, that end up in stormwater systems or directly in surface waters. Natural sources are less likely to threaten

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[1] U.S. Environmental Protection Agency (EPA). 2017. *National Water Quality Inventory: Report to Congress.* Available: https://www.epa.gov/sites/production/files/2017-12/documents/305brtc_finalowow_08302017.pdf.

[2] See, for example, *Human health risk implications of multiple sources of fecal indicator bacteria in a recreational waterbody* (Soller, J.A., M.E. Schoen, A. Varghese, A.M. Ichida, and A.B. Boehm et al., December 1, 2014, *Water Research* 66: 254–264, https://doi.org/10.1016/j.watres.2014.08.026), which cites various other reference sources.

[3] U.S. Geological Survey (USGS) Fact Sheet. 1998. *Fecal-indicator bacteria in surface waters of the Santee River Basin and coastal drainages, North and South Carolina, 1995–98.* FS 085-98. Available: https://pubs.usgs.gov/fs/1998/0085/report.pdf.

[4] Bicki, T.J., R.B. Brown, M.E. Collings, R.S. Mansell, and D.F. Rothwell. 1984. *Impact of on-site sewage disposal systems on surface and ground water quality*. Report LC170. Tallahassee, FL: Florida Department. of Health and Rehabilitative Services.

[5] Steele, J., J. Griffith, R. Noble, and K. Schiff. 2017. *Tracking human fecal sources in an urban watershed during wet weather.* Technical Report 1002. Southern California Coastal Water Research Project.

[6] LeJeune, J.T., T.E. Besser, and D.D. Hancock. 2001. Cattle water troughs as reservoirs of Escherichia coli O157. *Applied and Environmental Microbiology* 67(7): 3053–3057.

human health. Balanced populations of wildlife and natural densities of native wildlife, such as bird rookeries, should not be altered because of TMDL implementation. While these should be noted when explaining all potential contributors to the impairment of a waterbody, the TMDL focuses on remediating the anthropogenic causes of FIB in excess of the state criterion.

Trash and litter contribute to bacteria impairments by transporting waste and impeding flow. These changes in flow create shaded, stagnant pockets of water and increase surface areas. Each of these factors promotes bacteria proliferation. Litter and trash should be frequently removed until effective social marketing efforts and well-placed and properly designed trash receptacles help to eliminate trash buildup in streams and stormwater conveyances.

Poorly managed dumpsters can contribute to pollutants in stormwater runoff. Open dumpster lids and missing drain plugs allow rain to wash over the trash inside the dumpster. Rainwater then flows from the dumpster, carrying bacteria and food sources to the stormwater conveyance system. Closed lids and careful disposal practices prevent litter and food waste from lying around dumpsters and entering stormwater ponds and ditches.

Ultraviolet (UV) rays from the sun provide natural treatment by killing bacteria and pathogens suspended in the water column. Constructed stormwater infrastructure laden with litter or shaded by overgrown and excess plants creates conditions that reduce the effectiveness of the treatment and conveyance design. These areas should be identified and maintenance carried out more frequently.

Additionally, the buildup of silt and debris may impede flow and prevent the stormwater system from flushing, causing stagnant conditions in which bacteria can proliferate. Overgrown man-made conveyances and stormwater ponds should be managed to provide maximum UV treatment while maintaining structural integrity, flood attenuation, and nutrient treatment capabilities, as designed.

2.2 Prioritizing FIB-Impaired Watersheds

All Florida counties and many cities extend into multiple watersheds. If a number of waterbodies are not meeting the FIB criterion, then watersheds may need to be prioritized to focus the use of limited financial and staff resources. Of course, some bacteria-reducing actions bring about change across an entire municipality and therefore may benefit all of the watersheds in the municipality. In this case, the prioritization of watersheds is not necessary. However, site-specific restoration activities are often also needed to address all anthropogenic sources of bacteria. Many different factors may be considered to guide the prioritization of watersheds. **Figure 2** describes one optional method for prioritizing waterbodies.

Start with all of the waterbodies to which the city or county contributes stormwater that are not meeting the FIB criterion. Next, review the available data and score the waters by the magnitude of exceedances and by the frequency of exceedances. Ambient water quality data can be downloaded from two state water quality databases: the STORET Database and WIN. **Appendix B, Prioritization and Decision Matrix**, contains an Excel workbook that you can use to perform

the following scoring method. **Figure 3** provides a visual aid to accompany the description below.

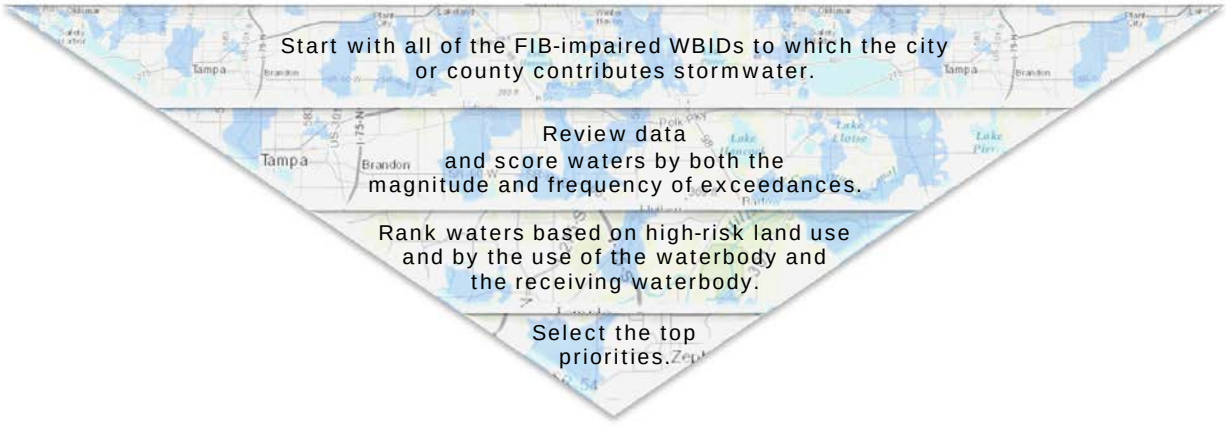

Figure 2: Example of method to prioritize FIB-impaired waterbodies

A simple way of scoring the magnitude of exceedances on a scale of 1 to 100 is by calculating the median of exceedances for the past seven and a half years (the length of DEP's verified period for assessment), subtracting the criterion, dividing by the median of exceedances, and multiplying by 100.

To calculate the exceedance frequency score, divide the number of exceedances by the total number of data points for the same period of record used above, and multiply by 100.

Average the two scores, and then multiply by the following confidence intervals (this applies more weight to the watersheds when more data are available):

- For 5 to 10 total samples, multiply by 0.65.
- For 11 to 19 total samples, multiply by 0.75.
- For 20 to 29 total samples, multiply by 0.8.
- For 30 or more samples, multiply by 1.0.

Now you have a score for the waterbody. DEP identifies waterbodies such as a tributary or segment of a waterbody with a waterbody identification (WBID) number. Score all of the WBIDs. The highest priority WBIDs in the second tier are those with the highest scores. You may see a natural break point from which to continue. If many or all of the waters score similarly, the next step may help differentiate them.

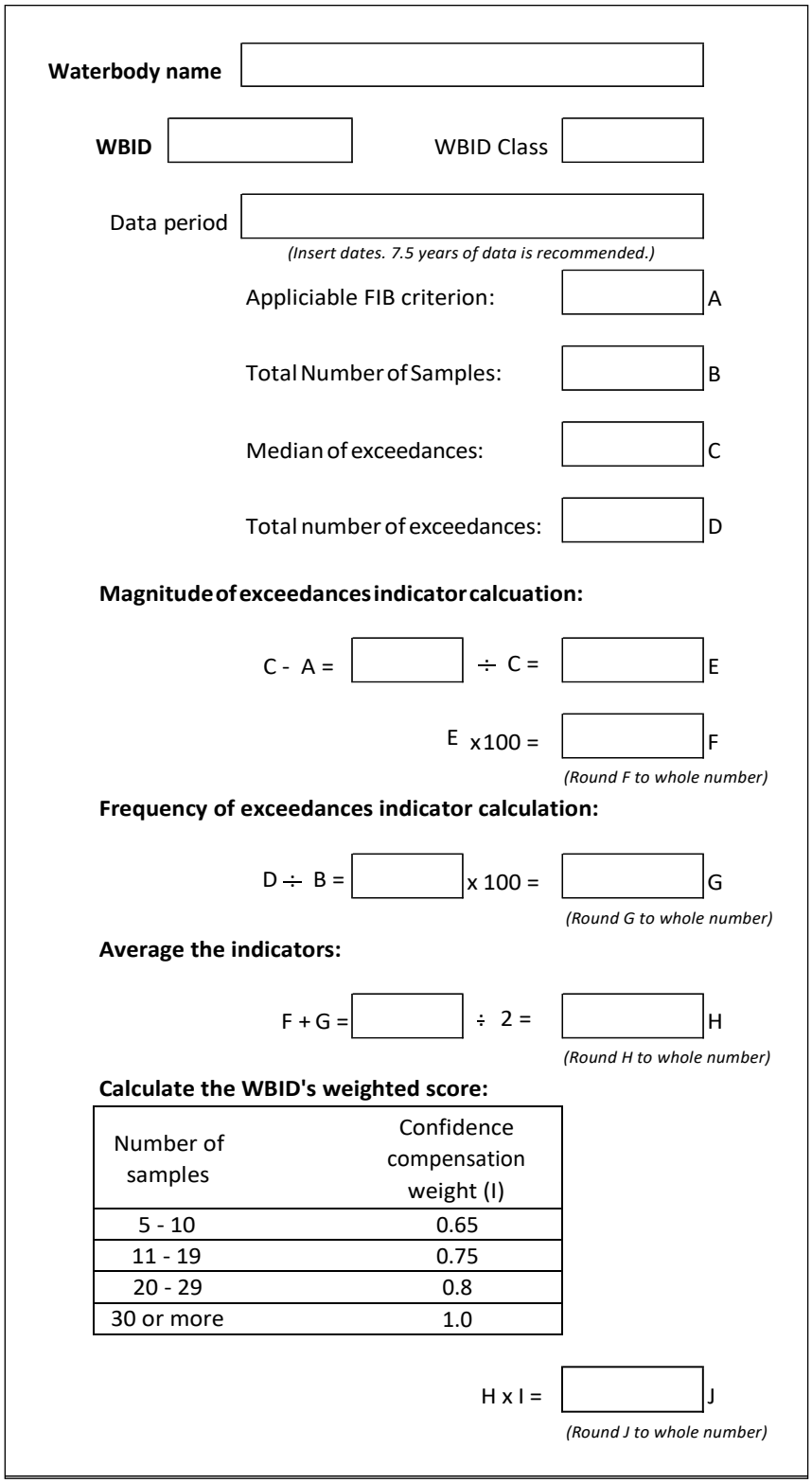

Figure 3: Visual representation of mathematical calculations described above

Consider the land uses and the age of the infrastructure in the watersheds. Those with the highest risk land uses should be scored or ranked as a high priority. This type of evaluation is not necessarily a numerical evaluation. A drive through the watersheds and a quick look at the aerial photos of each watershed may provide enough information to perform this part of the evaluation.

Additionally, waterbodies where humans are in contact with the water directly should score high because of the potential risk to human health. Similarly, waterbodies contributing to receiving waters that humans come in contact with should also score high. Sort the top-ranking WBIDs according to the potential sources (for example, land use, the age of sewer systems and OSTDS, and the behavior of residents) and the potential for human contact (such as swimming, beaches, kayaking, and fishing).

Remember, don't delay restoration by attempting to prioritize with 100 % confidence. Just begin restoration (on any impaired WBID) as soon as possible.

Waterbodies shared by multiple municipalities are best served when all parties collaborate. For example, if a watershed's neighbors are developing a restoration plan on your second-worst WBID, you may strongly consider bumping your second-place WBID to first place and working with them to develop a restoration plan at the same time. Or, if you are already working on reducing nutrients in a watershed, then it may make sense to continue with the same watershed and consider FIB reductions simultaneously.

2.3 Compiling and Evaluating Data

To gain a better understanding of the watershed, it is useful to compile existing data from all stakeholders in the basin. Stakeholders should become familiar with the adopted TMDL report before developing a restoration plan. The TMDL report provides a good starting point toward understanding the extent of the impairment, potential sources, and required reductions needed to meet the water quality criterion. Keep in mind that additional local investigations will be needed to understand the issues and sources of the impairment (see **Section 3.0, Management Actions**). Final DEP TMDL reports sorted by basin group and waterbody are available online.

2.3.1 Evaluating FIB Results

Evaluate FIB results by order of magnitude. Use historical FIB data to guide future sampling strategies, identify hot spots, and look for correlations to rainfall and seasonality, including seasonal differences in how the waterbody is used. Notate the range of results to expect. Evaluate new FIB data as soon as possible. Can your lab provide reliable preliminary results? Upon request, some labs call the samplers if results appear to range in the hundreds of thousands to trigger immediate follow-up actions (see **Section 2.5.2.4, Triggered Follow-Up Monitoring**, and **Section 2.5.2.5, Intensive Source Identification Monitoring**).

Possible emergency: Results in the range of hundreds of thousands of cfu/100mL

Wastewater influent *E. coli* and Enterococci counts are in the hundreds of thousands constitute a possible emergency. Any stormwater or ambient water samples in this range, barring any inflation at the time of sampling (biofilm disturbance), should be considered worthy of an immediate revisit. This is the first indication of a hot spot, a potential sanitary sewer overflow (SSO), illegal dumping, an illicit connection, or a failing OSTDS! If you collected human waste–specific tracers and markers with this sample, good. See if they are also present. Return to the site as soon as possible and investigate the contributing area for signs of the source. Resample the original site and take samples throughout the contributing area to narrow down the locational origin. It is best to add source-specific tracers and markers.

Very concerning level: Results in the range tens of thousands of cfu/100mL

FIB in the range of tens of thousands in stormwater and waterbody should grab the attention of restoration coordinators. First check the qualifiers to see if dilution in the lab wasn't enough. Is the actual count known to be higher than the reported value? If so, this site may have been in the hundreds of thousands and should be resampled, and visual field investigations should be conducted. If the actual count is what is reported and, barring any inflation at the time of sampling (biofilm disturbance), a result in the tens of thousands indicates a hot spot!

Difficult to discern: Results in the range of high hundreds to low thousands of cfu/100mL

FIB results in the high hundreds and low thousands don't warrant immediate action, but plan to address them when higher priority areas are remediated. Sample for source-specific indicators when trying to identify sources and their origins in waters where FIB results are common in this range.

Low-level exceedances: Mid-hundreds of cfu/100mL

FIB results in the mid-hundreds are not usually associated with persistent contributions of untreated human waste and don't warrant immediate action, but plan to address them when higher priority areas are remediated. Sample for source-specific indicators when trying to identify sources and their origins in waters where FIB results are common in this range.

2.3.2 Evaluating Source-Specific Lab Results

Evaluating source-specific lab results requires a lot of background information. **Appendix C, Source Identification,** summarizes current discussions on the topic and is based on DEP lab capabilities; thus further research will be needed for interpreting data from other labs. Persistence in the environment, resuspension ability, and dissolvability should be covered in a more detailed document specific to this topic.

Pay attention to qualifiers. For example, "U" qualified data means the result was not detected in the sample, even if a value was reported with the "U" qualifier. Source-specific indicators are

best used as guides to prioritize resources to address the highest risk sources identified as contributors to the waterbody.

Some chemical tracers are present in untreated human sewage (acetaminophen, naproxen, ibuprofen) and some in both treated and untreated human sewage (i.e., sucralose). "I" qualified data signal the presence of chemical tracers.

MST qPCR biological markers are specific to the enteric systems of certain species. Unqualified qPCR results in the hundreds of thousands and tens of thousands usually indicate the presence of waste. HF-183 in this range usually means the presence of untreated human waste, unless there is a reuse or effluent discharge nearby, and then the source of the HF-183 hit cannot be distinguished without the presence of other untreated sewage indicators. DEP does not consider "I" qualified HF-183 to be a hit. The greater the magnitude of an unqualified hit, the greater the proportion of sewage.

2.3.3 GIS Data Collection

Next, initiate discussions with stakeholders, informing them of the bacteria impairment and the need for their assistance during the restoration process. Ask them what they know about problematic areas, what they suggest, and what types of data they possess. Build a GIS database to create an informative map project. Computer-aided drafting (CAD) files, paper maps, prior studies, existing water quality data, and word of mouth can be informative, too.

View all available data together in one place to begin identifying potential sources such as areas with repetitive and persistent problems. It is a good idea to host a MOT meeting (see **Section 2.5.1, WTW Process**) to bring stakeholders together, make notations on the maps, and discuss the potential sources of the FIB impairment. Rarely have departments and municipalities viewed stormwater maintenance areas, sanitary sewer lines, and OSTDS failure areas on the same map as water quality monitoring hot spots. Interesting discoveries are made through this effort. For instance, a ditch may not be on the maintenance maps because each municipality mistakenly thinks it belongs to the neighboring municipality. Or, perhaps, the Florida Department of Health (FDOH) knows there is a neighborhood with frequent OSTDS repair permit requests, and the city knows a water quality hot spot is just downstream, but they have not previously discussed these related items with one another.

Continue to update the mapping database and use it to track information throughout the investigative and implementation process. The GIS database is a valuable tool that will help decision makers select appropriate projects to address sources. DEP recognizes that displaying all these layers on a single map may not create a clear visual, and it can be time consuming to create a symbology that works. Thus, DEP is including its GIS symbology package and recommended transparency levels as part of **Appendix C, Source Identification**.

The following types of data should be added to the GIS database, as available:

- Stormwater infrastructure and hydrology:

  - National Hydrography Dataset (NHD) or similar waterbody layers – NHD layers are available at this website.

  - Stormwater infrastructure – Canals, ditches, treatment ponds, outfalls, inlets, and control structures. Stormwater infrastructure information should be acquired through the managing entities—for example, cities, counties, water management districts (WMDs), and water control districts (WCDs).

- WBID boundaries – A polygon layer is available from DEP at this website.

- Stormwater basins – Polygons outlining the contributing areas to stormwater outfalls. One of these sub-basins may be a neighborhood or parcels along a street. Typically, a WBID comprises many smaller stormwater basins. These units are vital for hot spot monitoring and source tracking. Often, this layer is created by a county or city; if it does not exist, ask stormwater infrastructure maintenance crews to help. Funding can be acquired to study and develop the layer (see **Section 3.2.4, Revenue Generation and Financial Assistance Opportunities**).

- Water quality sampling stations – Location of stations and associated water quality data. Use symbols to notate any spots requiring further investigation. Stations uploaded to STORET are available here, and WIN stations are available here.

Potential contaminant sources:

- Human waste disposal:

  - Sanitary sewer infrastructure – Location of pipes, pipe material, manholes, lift stations, valves, and wastewater treatment facilities, as well as information on any recent past problems and upgrades. Include public (utility owned) and private sanitary sewer components. Notate where and when inspections and upgrades have or will occur.

  - SSO database – Location of SSO, impact to surface waters, the amount of sewage spilled, the cause of the overflow, and the correction of the root cause.

  - Private sanitary sewer lift stations and conveyances – Location of private sewer infrastructure such as private lift stations, private conveyances, and package plants. Check with local municipalities for available information.

  - OSTDS – FDOH maintains a layer showing the location of septic systems (septic tank plus drainfield), available here. If you find errors in this layer, submit your updates to health@flhealth.gov to improve the layer.

- OSTDS Repair Permits – Use this layer to look for patterns in failure areas. Patterns can indicate low-lying systems in floodplains or older systems that are aging out. FDOH created this layer at the request of DEP in early 2018. This will narrow down your field explorations in response to hot spots. For example, in neighborhoods with many repair permits, pay attention to parcels without repair permits to see if their system is failing or has been direct-piped. Ask FDOH for field work assistance. You can find a February 2018 shapefile or FDOH Repair Permits in **Appendix C,** or contact your local county FDOH environmental office for more recent information.

- Mobile home parks – The mobile home parks GIS layer is found here. Rate the parks based on their appearance regarding general maintenance. Those that appear to be neglected should be further checked for illicit connections and signs of SSOs.

- Age of developments, neighborhoods, and mobile home parks – A layer of parcels can be acquired from the county property appraiser or through the Florida Department of Revenue Map Data directory. You can symbolize parcels based on effective year built (referring to the main building onsite). This tells you the likely age of private sanitary sewer components, such as laterals from home to utility pipes or from buildings to private lift stations, as well as conveyances between buildings. It also indicates the age of OSTDS. Keep in mind that it does not tell you whether OSTDS have been replaced or which components have been upgraded.

- Agricultural and domestic animals:

  - Livestock operations and hobby farms – Production farms (usually large, for-profit operations) are under the jurisdiction of the Florida Department of Agriculture and Consumer Services (FDACS). Contact FDACS and ask for the Notice of Intent (NOI) to Implement Best Management Practices (BMPs) layer. This will let you know which operations have committed to implementing BMPs and which ones have not yet committed. Hobby farms may be addressed through a collaboration between FDACS and MS4 team members.

  - Dog walks (official and unofficial) – Include rights-of-way along ditches, empty lots, and green areas in apartment complexes and dog parks.

  - Businesses servicing animals – Include veterinarians, pet boarding and grooming facilities, and pet supply stores.

- Food sources for bacteria and bacterial runoff:

  - Food service businesses, fruit-processing facilities, seafood-processing facilities, bait shops, and restaurants – Bacteria levels can be increased near these sites if they have poor disposal practices. These areas also have a high potential for bacteria-laden runoff.

- Risk-of-contact land use:

  - Swimming beaches and recreational use areas – Include the FDOH-monitored Healthy Beaches Program, DEP's layer of public beach accesses; local and state managed parks with swimming in natural waterbodies; and fishing and kayaking sites.

- Logistics and orientation:

  - A base map with aerial photos and street names.

  - North arrow.

  - Legend and scale on 8.5" x 11" sheets of paper.

- Tracking progress:

  - As you identify potential sources and eliminate them, it is helpful to create a layer of these locations. In the attributes, notate dates and describe what was found and when, and what was done to remediate the source. This will help you track sources and remediation activities.

Free GIS Resources:

If GIS resources are not available in your municipality, you may be able to find useful free web-based GIS tools to help you. They are not as comprehensive as ArcMap, but you can use them to assist you with field navigation and to capture points and notes. Some stakeholders reported using the following resources during source identification efforts:

- DEP's **Numeric Nutrient Criteria (NNC) Tracker** is a web-based map. You can turn off the NNC layers and add and download WBIDs and other state GIS layers. You can place markers on the map and upload your own GIS layers. The map can be bookmarked and saved, including your changes, but DEP recommends backing up your GIS layers in case the system goes down.

- Create a **Google** account and generate maps. You can upload GIS KMZ and KML files with fewer than 1,000 features (sanitary sewer and stormwater conveyances cannot be uploaded here, but you can track many other things!). You can upload a WBID boundary, log in with a smart phone, and navigate

around the basin and determine whether you are inside or outside the watershed. You can capture notes and create a layer from points, lines, and polygons you create in the field or on your computer and then download the files for your records.

- **CommunityWalk** allows users to create points; upload notes, photos, and audio; and share the map with others.

2.4 Identifying Restoration Partners

The title of this section includes the word "partners" to indicate that source location and elimination activities are most successful when parties work together. If you are leading this effort, consider the value of facilitator training to enable you to organize productive meetings, listen effectively, motivate engagement, and generate the types of relationships required for a successful restoration plan. Your solicitations for support will go far beyond the section/department/municipality where you are employed. For example, MS4 Phase I permits require permittees to work with other cities, counties, state agencies, divisions of each of the preceding, and sanitary sewer utilities. Citizen groups have been known to provide support as well.

Use this section during all steps of the restoration process, to think about land uses, activities, infrastructure, and potential sources of untreated human waste in the contributing area. If any of the items listed below are present, then enlist the support of the corresponding stakeholders. Each category in **Appendix G, Complete List of Restoration Partners**, lists each of the items below along with at least one stakeholder, the benefit of involving them, the types of data they can contribute, activities and tools they can use to identify the origin of FIB loading, the source of their authority, and responsibilities related to FIB load reductions.

Are any of the following located in the watershed of the impaired waterbody?

- Phase I MS4 Conveyances (**Appendix G1**).
- OSTDS such as Septic Tanks or Cluster Systems (**Appendix G2**).
- Mobile Home Parks, Lodging and Recreational Vehicle Parks, Recreational Camps, Migrant Farmworker Housing (**Appendix G3**).
- Sanitary Sewer Utility–Owned Conveyances and Components (**Appendix G4**).
- Roadway Stormwater Conveyances (**Appendix G5**).
- Restaurants, Hotels, and Apartment Complexes (**Appendix G6**).
- Gas Stations that Sell Hot Food, Roadside Food Trucks, Donut Shops, and Coffee Shops (**Appendix G7**).

- Production Agriculture (agricultural operations operated as a business) (**Appendix G8**).
- Nonproduction Agriculture such as Hobby Farms (**Appendix G9**).
- Pathogen Transporters such as Sharps (hypodermic needles), Blood (vials of blood samples), Medical Waste, and Numerous Houseflies (**Appendix G10**).
- Any Anthropogenic Sources (**Appendix G11**).
- Watershed Protection Agencies (**Appendix G12**).
- Watershed Protection Activists and Others (**Appendix G13**).
- Potentially Dangerous Neighborhoods (**Appendix G14**).
- Military Bases (**Appendix G15**).
- Homelessness (**Appendix G16**).

2.5 Tools for Source Identification

The following subsections summarize source identification tools that DEP and stakeholders have found useful. This information is provided to help stakeholders select the tools that work best in their basin. There is no single measure that can be used to identify FIB sources, and an implementation plan should use multiple tools to determine the likely sources in the basin. The results of these assessment methods will provide the basis for selecting management actions (**Section 3.0**) and developing and documenting the restoration plan (**Section 4.0**). The data collected using the tools in this section should be compiled and analyzed along with the previously gathered GIS data to track progress and determine the next steps for restoration.

As you read this section, keep in mind that new tools are continually being developed to identify bacteria sources in waterbodies. A few options are described here, but there may be many other excellent alternatives. Please write to us and let us know about methods you have used so we can share them in the next version of this document. Feel free to contact DEP (at anita.nash@dep.state.fl.us, kevin.coyne@dep.state.fl.us, or puja.jasrotia@dep.state.fl.us) to discuss any of the tools you are considering.

2.5.1 WTW Process

The WTW is an informed field reconnaissance effort to gain a better understanding of a watershed, including the hydrology of the basin and its contributing branches, where infrastructure (sewer and stormwater) is located, and what potential sources are contributing bacteria to the waterbody. Examples of indications of untreated human waste are sewage odor;

illicit pipes discharging toilet paper, sewage, or kitchen waste; toilet paper, sanitary use plastics, and scum on the rim of a low-elevation sanitary sewer manhole lid or lift station; an unnatural, greasy film on the water's surface; white-grey bacteria coating sediment and plants under water; and pooling water or vibrant tall grass at an OSTDS drainfield.

Of similar concern to human waste is livestock waste. Pet waste is of a lesser concern for pathogen transmission but is most evident during the WTW field exercise.

The WTW process is an inexpensive initial step to identify observable sources while building collaboration among watershed stakeholders. **Appendix C, Source Identification,** contains a detailed document on the WTW process. Feel free to contact DEP (at anita.nash@dep.state.fl.us or kevin.coyne@dep.state.fl.us) for guidance about the process as needed. A summary of WTW steps are as follows:

- A representative from the entity leading the WTW, referred to here as the lead, identifies stakeholders with jurisdictional authority in the watershed. For additional information, see the TMDL report for a specific waterbody and **Appendix G, Complete List of Restoration Partners**.

- The lead gathers and reviews available data. See **Section 2.3, Compiling and Evaluating Data,** for a list of the types of data that may be helpful.

- The lead compiles a GIS database and then creates large-format maps in preparation for the MOT meeting. See **Appendix C, Source Identification**, for a GIS symbology package and guidance on which components of the stormwater and sanitary sewer to provide for this exercise.

- The lead reviews the available monitoring data and determines whether more data are needed to identify hot spots.

- The lead reviews recent SSO information.

- The lead hosts the MOT meeting, as follows:

    - To ensure interested parties attend, notice the public meeting. Call and send invitations directly to the staff of necessary divisions and departments requesting confirmation of their participation. **Appendix G, Complete List of Restoration Partners,** contains guidance on which participants to include in the meeting.

    - All jurisdictional entities should be represented. Other stakeholders and citizens should be given the opportunity to provide input at this meeting, or at a second MOT meeting geared toward citizen participation. The impairment and WTW process are introduced, and a review of existing data is presented. Participants are then strategically broken into groups of six or less per table.

- Next, the lead calls out potential sources, and all participants are asked to mark the maps to document the locations of these potential sources based on recent observations. For example, this may include areas where storm sewer and sanitary sewer lines may be close together, areas of homeless activity, routes used intensively for dog walking, large stormwater culverts and ponds discharging to surface water, areas where businesses may be releasing waste, etc.

- A note taker at each table is asked to capture the information on a notepad in such a way to tie the notes to the locations marked on the map by participants.

- Each table presents its notes and locations to the room to further discussion and to share knowledge. This process results in the identification of specific areas for field investigation.

- The meeting concludes with a discussion of logistics for the WTW field event.

- After the meeting is a good time for key representatives to choose monitoring locations for a one-time, watershedwide monitoring effort to precede the WTW field event.

- The lead will combine the notes from the MOT meeting into one list and will transfer locations to one map.

- MOT reconnaissance is carried out as follows:

    - *The lead takes the compiled MOT documentation into the field to conduct a preliminary reconnaissance of the watershed before the group field investigation. Unless the watershed is too large, the entire watershed and waterbody should be covered during the one-day group field event. Therefore, a lot of planning is essential.*
    - *Determine whether areas noted during the MOT warrant investigation during the group field event. Investigate locations from the MOT that are difficult to access or where more information is needed before taking the group to the site.*
    - *Choose a route for the field event.*
    - *Choose a lunch break location with shade and restrooms. Because of time constraints (30 minutes for lunch is ideal), restaurants may not be the best option for a lunch stop. Parks along the waterbody are ideal to continue participant focus on the FIB issue.*

- A one-time water quality monitoring event throughout the watershed, approximately 11 sites per WBID, is recommended approximately 2 weeks before the WTW field event. These results (preliminary results are acceptable)

should be used in conjunction with past results to help focus activities on the WTW field day. Monitor for *E. coli* bacteria in Class III fresh waters and Enterococci in Class III marine waters. Monitoring for more specific analytes can be helpful but is more expensive. It is okay to reserve the use of these analytes for a more targeted monitoring event later.

- The WTW field day! The field day is a single all-day event carried out as follows:

    - All key jurisdictional stakeholders need to be represented. Typically, field staff with local knowledge participate, and in the case of public works the supervisors also usually come along.

    - All representatives will ride in one vehicle (usually a 12-passenger van). Trolleys can be used, too. The vehicle stops frequently, and participants get out, walk, make observations, take notes and photos, and note locations on the maps.

    - Collaboration, stronger relationships, and a better understanding of each other's needs and abilities occur between individuals from participating agencies. This happens primarily in the van and to a certain extent in the field, making it vital for entities to be represented and riding in the van for the entire day. Staff on call often follow the van in a utility work truck, but their supervisors ride along in the van to participate in conversation.

    - Citizens are rarely encouraged or allowed to participate in the field event for safety and insurance reasons. However, citizen input is invaluable. Citizens will have the opportunity to attend a follow-up meeting.

    - The team drives and walks the watershed and waterbody making observations, taking photographs, documenting global positioning system (GPS) points, and making notes about problems that may be potential or confirmed FIB sources. The team should investigate any potential sources. This can include identifying sewer infrastructure (such as manholes and pump stations, and sewer lines crossing creeks) and inspecting for signs of recent overflows, MS4 conveyances that need cleaning, failing septic tanks, evidence of wildlife, heavy tree cover or vegetated ditches, evidence of homeless populations, and pet and livestock sources. Recommended locations to be added to the monitoring plan should also be noted. Care should be taken to ensure that only appropriate representatives access private property, unless the property owner has offered access to the entire team.

    - While in the field, participants call and report problems to appropriate agencies if immediate responses are needed to address problematic

observations such as an illicit connection, SSO, or dangerous substance spill. This provides immediate responses while allowing the team to continue investigating the watershed.

- Following the event, the lead drafts a report to summarize the WTW efforts and findings. Near the end of the report is a table of action items to address anthropogenic potential and confirmed sources. Responsible entities are noted for each action item. Sometimes the lead is unsure of the responsible entity, and in that case one should be delegated. If the issue is later determined to fall under the jurisdiction of another entity, the table should be updated, and comments should be used to explain the update.

- Follow-up activities often include the need for further field investigations, sometimes by boat, of areas that could not be explored during the big field event. Follow-up investigations can usually be carried out by one or two people. Sometimes follow-up actions include additional monitoring targeting an area of concern. Many follow-up activities consist of two parts. The first addresses an immediate need, such as removing trash that impedes flow or removing an illicit connection. The second part consists of long-term programmatic improvements, such as prescribing an increased frequency of trash removal at a specific location or increasing the frequency of illicit connection investigations in an area.

- Participating entities have the opportunity to review and edit or correct the report before it is finalized.

- The lead should track action items as problems are fixed and as programs are enhanced or developed, noting the date the action item was completed or initiated and the magnitude of the change, such as increasing street sweeping from monthly to weekly.

- A follow-up meeting is recommended to present the results of this effort. Citizens are encouraged to participate in the meeting and provide feedback.

Collaboration and the exchange of information will continue to occur long after the field event as a result of these efforts. Participants generally report stronger relationships and experience a shared understanding and ownership of the bacteria problem and the restoration efforts. Many recommend WTW for all their impaired creeks, and they often remark that this exercise should be repeated at least every five years or more often.

2.5.2 Pollution Assessment Monitoring and Investigative Field Work

The assessment and direct identification of FIB sources are complicated by many variables inherent in the use of indicator organisms and by the dynamic nature of microbial populations in various substrates and environmental conditions. The following discusses briefly discusses monitoring strategies, station selection considerations, and the collection of source-specific data,

both chemical and biological, which is key to assessing and developing corrective actions for FIB-impaired waterbodies. **Appendix C, Source Information,** provides more information on using chemical analytes such as acetaminophen, ibuprofen, naproxen, and sucralose. This section discusses investigative tools used along with monitoring.

2.5.2.1 Selecting Water Quality Sampling Station Locations

Depending on the monitoring strategy and goals, consider these suggestions when choosing station locations to bracket or divide the watershed into smaller contributing areas.

Four levels of specificity:

- The **first level of specificity** is a broad scan of the waterbody. The contributing area is most or all the watershed:
    - A sampling point at the mouth of the river, the center of an estuary or lake, or the discharge of a lake.
    - Bracket jurisdictions; place stations at city and county boundaries.
- The **second level of specificity** breaks the full watershed into a few smaller contributing areas:
    - Bracket tributaries and outfalls by sampling upstream and downstream of their convergence. Or, for a single tributary or single outfall, sample the main river just upstream of the convergence and sample the tributary just upstream of the convergence.
    - Bracket the areas where reverse tidal flow occurs.
- The **third level of specificity** answers a question within a small contributing area:
    - Bracket areas based on potential source types. For example, sample downstream and upstream of a livestock farm, or sample downstream and upstream of a neighborhood serviced by sanitary sewer if the surrounding area uses OSTDS.
    - Bracket neighborhoods by sampling upstream and downstream of outfalls or canals.
    - An alternative to bracketing is to sample water directly from an outfall or tributary when there is no chance of water from the river mixing with sample water. Think about the target contributing area that you want the sample results to represent when making this decision.

- The **fourth level of specificity** identifies the parcel where a source originates. Fourth-level stations are used during intensive source identification efforts:
    - Bracket parcels by sampling next to the corner of property boundaries.
    - Bracket a section of an MS4 conveyance between manholes.
- First- and second-level stations often make good repetitive or trend monitoring stations. In some cases, previously monitored stations are not ideal for monitoring for bacteria, and so it is important to assess the characteristics of these sites and decide whether to move the sampling location or keep the existing one. Ideal stations to represent the waterbody (i.e., repetitive or trend monitoring) should have the following conditions:
    - Steady flow.
    - Regular flushing.
    - Deeper than 10 centimeters (cm).
    - Open without floating, emergent, and submergent plants.
- Second- and third-level stations are used to identify hot spots.
- For all levels, the sampler should prepare to acquire the water sample without disturbing the sediment, seawall, culvert, plant life, and trash. Often, this is difficult closer to headwaters and in stormwater conveyances (fourth level). Disturbing them can disturb the biofilms growing on surfaces in the water and suspend bacteria in the sample water, thus inflating the results. The results are not representative of the water column in the waterbody, which is what the water quality criterion is written to address. A peristaltic pump with a quarter-inch diameter tube attached to the end of a grab pole works to extract samples from difficult-to-reach or shallow areas, such as inside a stormwater manhole during intensive source tracking.

2.5.2.2 Repetitive (Trend) Monitoring

FIB results from regular interval monitoring, commonly called "trend" monitoring, should be used to measure progress towards meeting the TMDL and water quality targets. Many sampling entities monitor ambient water quality monthly (recommended) or quarterly, year after year. Think of it as checking the pulse of the waterbody. This repetitive sampling can be plotted to determine the general range of bacteria levels. Statistically significant trends can be determined using a very large amount of data, but statistical trends are not necessary to gain a sense of recent conditions.

Water quality may spike occasionally, while remaining low around the criterion on a regular basis. If results remain high or continue to climb, there may be a persistent problem. The high results may be source related or caused by poor sampling conditions or techniques. For instance, if plants or sediment are disturbed, biofilms from these surfaces may come loose and become suspended in the sample water. Thus, it is important to review monitoring stations and techniques and determine if improvements can be made at the time of sampling. Once this concern is satisfied and if high results persist, further source identification efforts are necessary to restore the waterbody.

The first step in preparing a monitoring plan should be to gather information on existing sampling from the stakeholders conducting the monitoring in the watershed. Important monitoring information includes the station name, station location, parameters sampled, frequency of sampling, period of record, and organization.

When developing a trend monitoring plan, several key items should be considered, including the following:

- The parameter(s) addressed in the TMDL implementation plan. Florida no longer assesses waterbodies for fecal coliform. For fecal coliform TMDLs, it is almost always more useful to monitor instead for the applicable FIB described in the current state rule (see **Appendix A, FIB Criteria**).
- Goals and objectives for the monitoring, such as the following:
  - To identify sources.
  - To determine the success of the TMDL implementation plan core (such as *E. coli* or Enterococci) and supplemental parameters that should be assessed related to the impairment.
- Monitoring frequency (monthly is ideal for repetitive monitoring).
- Any important assumptions made in the development of the TMDL.
- The time of day you plan to monitor may need to correspond with activities in the watershed and tidal influence.

2.5.2.3 When to Sample

- Consider how to include all responsible entities.
- Explore how to share resources.
- The data collected as part of the monitoring plan are required to meet DEP standard operating procedure (SOP) requirements for quality assurance/quality control (QA/QC). The most current version of these procedures is available

online. DEP will determine the usability of the data received following the guidelines in *Process for Assessing Data Usability* (DEP-EA 001/07). A QA/QC plan and calibration logs should also accompany the records of the monitoring program. Ambient water quality data should be uploaded to the state's new water quality database, WIN. Data collected from monitoring performed to trace hits to a source's origin should be flagged as such, so it is not mistaken as ambient water quality data for assessment purposes.

Table 1: Example of sampling parameters for a FIB monitoring plan

Water Quality Indicators	Field Parameters
Enterococci, *E. coli*, or fecal coliform (see water quality criteria to determine what parameters will be assessed) Example of additional parameters: Human waste indicators – Sucralose, acetaminophen, qPCR HF-183 (MST marker)	Dissolved oxygen Dissolved oxygen saturation pH Conductance or salinity Temperature Turbidity Air temperature Cloud cover Rainfall Tide stage Canopy cover Water flow condition Wind

- A useful document to consult while preparing the monitoring plan is the EPA document, *Elements of a State Water Monitoring and Assessment Program*, which includes the following 10 essential elements for a monitoring plan:
  - Monitoring program strategy.
  - Monitoring objectives.
  - Monitoring design.
  - Core and supplemental indicators of water quality.
  - Quality assurance.
  - Data management.
  - Data analysis/assessment.
  - Reporting.
  - Programmatic evaluation.

- General support and infrastructure.

- An example of a water quality monitoring plan can be found in Section 4.2 of the Lower St. Johns River Tributaries BMAP.

2.5.2.4 Triggered Follow-Up Monitoring

One option for gathering additional data is to adopt responsive monitoring protocols. For example, conduct immediate follow-up sampling and field investigations triggered by high FIB monitoring results. This technique is used in the Lower St. Johns River Tributaries BMAP and follows the protocol outlined in the Lower St. Johns Tributaries Pollution Assessment Manual (see **Appendix C, Source Identification**). In this protocol, fecal coliform samples are collected monthly at set stations in the tributaries, and if the preliminary FIB results of the samples are greater than 5,000 counts per 100 milliliters (mL) (assumed to be mainly from human sources), crews return to the field immediately and collect additional samples upstream and downstream of the location of the recent high-count station in an effort to locate the source. This responsive targeted monitoring continues until the source is identified or the high results no longer persist. An enhanced variation of this approach is to immediately follow up by monitoring for source-specific analytes and FIB.

DEP is looking for documentation to support the development of response thresholds for *E. coli* and Enterococci and will update this document as they are identified. See **Section 2.3.1, Evaluating FIB Results,** for ranges and corresponding responses.

2.5.2.5 Intensive Source Identification Monitoring

An intensive source-specific water quality monitoring strategy is the most efficient way to determine the presence of high-risk sources and trace them to their origin so they can be eliminated. DEP recommends the use of a suite of source-specific indicators—MST biological markers, chemical markers, and *E. coli* or Enterococci—as appropriate for the waterbody.

Start with a hot spot. Map the contributing watershed area to decide where to place stations so that you can use the results to follow the source to its origin.

Use subsequent sampling events and select water quality sampling station locations that represent small sections of the watershed (**Section 2.5.2.1**). Gather samples from downstream to upstream during each sampling event (during the end of outgoing tides in tidally influenced areas), so that the samples represent the contributing area upstream. Each round of sampling should target the contributing area of the previous round's hot spot(s) to further narrow down the contributing area containing the suspected source. Evaluate the full suite of results, field staff observations, photos, institutional knowledge, and the GIS database you have been building (e.g., stormwater conveyances, sanitary sewer components, and OSTDS map layers) for each sample to determine where to sample and investigate next.

Field investigations range from broad to intensive: windshield surveys, walking surveys, smoke tests, dye traces, and closed-circuit television (CCTV) inspections (see **Section 2.5.2.12, CCTV,**

Dye Traces, and Smoke Tests). Communicate and coordinate investigations with all authorities in the contributing areas. Once a source is identified, the appropriate entity will use its authority to ensure the problem is remediated (by the property owner) and report back to the restoration coordinator for tracking. Call DEP as needed for guidance on intensive source identification monitoring.

2.5.2.6 When to Sample

Strategies for any monitoring plan should consider the following concepts:

- Seasonal human use of the watershed or waterbody such as colleges, vacation homes, retiree neighborhoods, and parks.
- High- and low-use time of day and week; for example, in bedroom communities, on weekday mornings, more families flush and shower than mid-day during the week.
- The end of an outgoing tide to represent upstream water quality.
- Seasonal bird populations, such as nesting rookeries, or animals that are fed by seasonal vacationers (for example, Muscovy ducks, seagulls, and geese).
- Part-time livestock populations on farms or at fairgrounds and other arenas.

2.5.2.7 Human Waste–Specific Chemical Analytes

Acetaminophen, ibuprofen, and naproxen are very effective in indicating the presence of untreated human waste in ambient water samples. Sucralose is also useful but should be used in contributing areas where no sources of untreated sewage are present because it is found in treated and untreated human sewage. Entities are adding these analyses to their TMDL implementation monitoring plans. **Appendix C, Source Identification,** contains more information.

2.5.2.8 MST

If you suspect that human or animal waste is contributing to the FIB impairment, MST, along with chemical tracers, can be very useful in confirming a source. MST tests for specific bacteria known to be common in the enteric system of specific animals or humans. It was used for source assessments in the Hillsborough River and Lower St. Johns River Tributaries Basins. Studies in these basins used human, ruminant, and horse indicators. **Appendix C, Source Identification,** contains examples of MST studies used in BMAP documents.

Users of MST analysis should be aware that a lack of hits for bacteria from a specific animal in a few samples does not rule out that species as a source. A lot of data is needed to draw conclusions to rule out sources. Rather, MST is best used to confirm a source. Because it is expensive, managers may consider using MST monitoring at identified hot spots and as a part of

the suite for intensive source identification monitoring. A quantitative MST test is called qPCR. An accompanying test for propidium monoazide (PMA) is available that helps identify the proportion of MST from live versus dead cells. Additional information on MST may be found at websites for laboratories that offer this analysis, the USGS website, and vendor laboratories.

2.5.2.9 EPA Sanitary Beach Surveys

EPA developed two types of beach sanitary surveys, the Routine On-Site Sanitary Survey and the Annual Sanitary Survey, to assist with short- and long-term beach assessments. The Routine On-Site Sanitary Survey is performed while water quality samples are taken. The Annual Sanitary Survey records information about factors in the surrounding watershed that might affect water quality at the beach, such as information on septic tanks and land use. Both surveys are available in paper and electronic (an app for tablets) formats. More information is available here.

2.5.2.10 Optical Brighteners

Optical brighteners such as those found in laundry detergents fluoresce under UV light. There are methods for deploying a material, such as cotton, over time and later testing it for brighteners that cling to cotton. Optical brighteners may not be the best option in Florida's dark-colored rivers because humic and tannic acids overshadow the fluorescing brightener, interfering with the results.

2.5.2.11 Sewage-Sniffing Dogs

Yes, you read that correctly. At least one company trains dogs to sniff out sewage sources. They walk the dogs along creeks and ditches to identify problem locations. Alternatively, water samples can be gathered from multiple locations, each in a separate container, and then brought to a parking lot. The samples are placed on the ground, lids off, and the dogs signal which samples contain sewage. The latter option may be safer for the dogs because Florida waterbodies can contain dangerous reptiles. Using the dogs for this purpose also makes for interesting press stories and brings awareness to the community about the impairment and restoration efforts.

2.5.2.12 CCTV, Dye Traces, and Smoke Tests

The sanitary sewer industry uses three test methods of identifying leaks into or out of their sanitary sewer conveyances: CCTV, dye traces, and smoke tests. The same techniques can be applied to underground stormwater conveyances.

CCTV is a remote control–operated vehicle with a video camera which that is driven through sanitary sewer or stormwater pipes to help technicians visually inspect the condition of the pipes. CCTV inspections can reveal breaks and failing infrastructure, blocked infrastructure, flowing and nonflowing segments, and illicit connections, all underground. CCTV is time consuming and somewhat costly, so DEP recommends narrowing down the origin of a source to a relatively small area, through an intensive source identification monitoring strategy, and inspecting short segments of stormwater pipes where no additional sampling can be performed to zero in on the origin of a source.

Dye traces are performed using food-grade dye manufactured for tracing leaking conveyance systems or confirming connectivity. The dye is usually green or red.

Smoke tests are performed by blowing smoke into sanitary sewer conveyances and watching the storm grates and inlets and neighboring yards for rising smoke. This indicates cross-connectivity. The test is usually used to determine where rainwater infiltration is overloading the sanitary sewer system during rain events.

So as not to alarm people, consider informing the public and municipality managers of planned dye traces and smoke tests.

2.5.2.13 Thermal Imaging

Additionally, in the Lower St. Johns River Tributaries Basin (see **Appendix C, Source Identification**), thermal imaging was used to identify inputs that could be FIB sources to several creeks. This process uses the differences in temperatures between the warmer inputs and the cooler creeks in winter. The warmer inputs to the creeks can come from a variety of sources, including natural sources such as groundwater, residential sources such as water from heat pumps, and illicit connections conveying pollutants. In association with the thermal imagery, it is helpful to conduct sampling before and after the flyover to help correlate FIB counts to the anomalies found through the imaging.

2.5.2.14 Decision Matrix and Ranking Tool

A decision matrix and ranking tool assists local stakeholders in determining the level of impairment in a waterbody and guides management actions to address FIB impairments. This decision-support tool incorporates fecal coliform levels, the presence and relative magnitude of human fecal contamination, and other potential sources of human pathogens. **Appendix B, Prioritization and Decision Matrix,** provides more detailed information on the tool and how to develop a site-specific matrix.

2.5.2.15 Wildlife Surveys

In some areas, wildlife can be a significant FIB source, especially in watersheds with significant acreages of wetlands, upland forest, or wooded corridors. While wildlife is a contributing source of FIB loading to a waterbody, this is considered a background concentration. Stakeholders are not asked to remove or discourage native wildlife in and near waterbodies. However, it is helpful to record instances or indicators of wildlife to help correlate potential sources with FIB concentrations.

Wildlife surveys can be used to help determine what portion of the FIB impairment might be attributable to natural conditions. Information on and methods for conducting these surveys are provided at the following websites:

- University of Florida Institute of Food and Agricultural Sciences (UF–IFAS) Extension Electronic Data Information Source (EDIS), Wildlife Conservation and Ecology website.

- Florida Monitoring Program: Point Count Method to Survey Birds (M.E. Hostetler and M.B. Main).

- *Breeding Season Survey Techniques for Seabirds and Colonial Waterbirds throughout North America* (M. Steinkamp, B. Peterjohn, V. Byrd, H. Carter, and R. Lowe), **Appendix C**.

3.0 Selecting Management Actions

Once the watershed has been evaluated using one or more of the tools described in **Section 2.0** to identify potential sources, the responsible stakeholders must implement management actions to address these sources. If an assessment of existing efforts by stakeholders in the basin demonstrates that current practices are sufficient to address the potential sources, then this should be documented (**Sections 3.2.1** and **2.5.1**), and repetitive water quality monitoring (**Section 2.5.2.2**) should continue at Level 1 or Level 2 stations (**Section 2.5.2.1**) to keep an eye on water quality.

However, if additional work is needed to address the impairment, the stakeholders should develop a restoration plan that describes the additional management actions that will be implemented and timelines for completion. The sections below include examples of the projects and programs that have been used in other basins to reduce FIB loading. The identified FIB source guides the most appropriate management actions to be taken.

3.1 Projects and Activities

Many different types of activities can be implemented to address potential FIB sources. Once the potential sources have been evaluated, the appropriate projects to address those sources can be identified. The following sections discuss examples of management actions to address FIB.

3.1.1 Structural Activities

Several types of stormwater and sanitary sewer structural projects can help to reduce FIB loading. Flood control projects are one option. Not only do these projects reduce the amount of nonpoint source pollution to a waterbody after a rain event, they also prevent flooding in septic tank areas, alleviating conditions that may cause septic tank failures. In addition, flooding can cause infiltration of the sanitary sewer system, leading to overflows. Therefore, controlling flooding also benefits the sewer system.

Several types of standard stormwater treatment BMPs, such as wet ponds and swales, can reduce FIB loading. These projects capture and treat stormwater before it is discharged to surface waters.

Upgrades to the sanitary sewer system can reduce FIB levels. Replacing and upgrading old sewer lines, rehabilitating or relining manholes, rebuilding pump stations, and replacing air release valves (ARVs) are types of projects that make the system more efficient and reduce the likelihood of an SSO from faulty infrastructure.

If large numbers of OSTDS are failing, a solution may be developed that is more effective than individual repairs. For example, drain field enhancements, such as adding treatment tanks or supplementing the drain field media, can be done to improve treatment. Mounding drain fields removes them from the surficial groundwater table and potentially flooded areas. The Florida Onsite Sewage Nitrogen Reduction Strategies Study describes a few affordable options for

enhancing OSTDS. Work closely with FDOH to ensure the proposed OSTDS modifications can be permitted before constructing. Experts at the Florida Onsite Wastewater Association, Inc. can assist with OSTDS-friendly solutions. If necessary, phasing out septic tanks may be an option if sanitary sewer is available.

3.1.2 Nonstructural Activities

The following sections outline several types of nonstructural activities that address FIB loading.

3.1.2.1 Inspection and Maintenance Programs

Implementing inspection and maintenance programs can proactively identify and prevent problems with infrastructure before the problems result in water quality issues. If these programs already exist, consider the benefits of shifting inspection schedules to target the impaired watershed as soon as possible and increase maintenance frequency where the need is apparent.

Private lift station inspections
Private lift stations are sanitary sewer pump stations that are not utility owned. They can be a significant source of pathogens. A private lift station inspection program is an effective way to ensure the stations are maintained and operating correctly. Inspect a statistically significant number of private lift stations in the basin and note their condition. Use these data to gauge how soon an inventory and inspection program should be developed, if it doesn't already exist, or to decide if an existing program needs to be revised. Entities can adopt local ordinances requiring certified operators to maintain private lift stations.

Sanitary sewer system inspections
For sanitary sewer systems, inspections should include the pipes, manholes, ARVs, and lift stations. These important components of the collection system all need to be inspected and maintained regularly to prevent breaks and overflows of sewage. Any part of the system identified as compromised (i.e., tuberculated pipe, leaking ARVs, broken lift station components, etc.) should be rehabilitated, repaired, or replaced to prevent failures.

Stormwater conveyance system inspections
Stormwater conveyance systems should also be inspected regularly to ensure they are free of trash and debris. All ditches, canals, ponds, pipes, inlets, catch basins, and outfall structures that make up the stormwater system should be maintained regularly. During the inspection and maintenance efforts, note all potential illicit discharges and investigate to ensure that the connection is not contributing FIB to the conveyance system. Entities can add natural creeks to their illicit discharge detection and elimination (IDDE) inspection schedules if necessary, based on the results of field investigations.

OSTDS inspection program
An inspection and maintenance program is also important for OSTDS to ensure they are functioning properly and to identify any repairs needed on the systems. FDOH–Duval County has been inspecting OSTDS in FIB-impaired WBIDs for many years via EPA 319 grants

distributed through DEP (see **Section 3.2.4, Revenue Generation and Financial Assistance Opportunities**).

Frequent communication across programs
Increase collaboration with inspection entities such as local code enforcement, FDOH, the Florida Department of Business and Professional Regulation (DBPR) (Division of Hotels and Restaurants), FDACS, UF–IFAS Extension Offices, and wastewater managers to strengthen the plan's effectiveness. This can be done through frequent discussions initiated by the lead restoration coordinator. Work to make other programs aware of the impairment and restoration efforts for the watershed and share ideas.

3.1.2.2 Social Marketing

Public education and outreach are useful tools to inform the public about FIB sources and how to prevent these sources from impacting waters in a particular area. Social marketing is more complicated and integrates public education into strategies proven to change behavior that will reduce FIB loading to a waterbody. Be sure to research effective and audience-sensitive social marketing before choosing a strategy. Consider hiring social marketing professionals to run successful campaigns. The following are examples of public education materials and a successful social marketing campaign:

- PSAs on local cable or commercial television and radio stations. PSAs can be developed locally—for example, the "Think About Personal Pollution" campaign by the City of Tallahassee. PSAs are available through the University of Central Florida (UCF) Stormwater Management Academy. One example of a PSA about dog waste was developed by the City of Dunedin after a WTW exercise on Cedar Creek.

- Informational pamphlets and/or presentations on pollution prevention, septic tank maintenance, and pet waste management. The Stormwater Education Tool Box is available online from the UCF Stormwater Management Academy.

- Websites that provide information on reducing FIB pollution for homeowners and businesses.

3.1.2.3 Ordinances

Adopting and implementing rules or ordinances can give local governments the additional authority needed to achieve FIB reductions.

A septic tank ordinance to address FIB loading involves several different measures. It could require inspections on a set schedule, and a requirement that the tanks must be pumped out every five years with a notice to local government that this maintenance occurred. The ordinance could require a greater distance between the septic system drain field and the groundwater table and/or surface waters to reduce bacterial loading that travels directly from the septic system to

groundwater or surface water. The ordinance might also require septic tanks in certain areas to be advanced treatment systems, which provide a higher level of wastewater treatment. Another option is to require septic tanks to be connected to the sanitary sewer system, where sewer lines are available. This can occur when a septic tank has failed, when a property with a septic tank has changed ownership, or in areas near impaired waterbodies where a sewer system would provide better treatment.

A pet waste management ordinance is another important step to address FIB pollution. It requires residents to pick up and properly dispose of pet waste. To help implement this ordinance, local governments could provide pet waste stations with bags and trash cans in areas where residents typically walk their dogs. Local governments could also implement a fine for not complying with the ordinance as an incentive for residents to pick up after their pets.

3.1.2.4 Fats, Oils, and Grease (FOG) Program

FOG generated during food preparation builds up in sanitary sewer lines. Without proper maintenance, these lines clog, eventually leading to the occurrence of SSOs. Creating a FOG Program can help to reduce the amount of commercial grease dumped into the sewer system, preventing clogs and reducing the number of SSOs and FIB discharges to the watershed. This program would be required for food service establishments, which would need to pump out their systems regularly. Failure to meet the pump-out requirement would result in enforcement actions, such as an initial notice of violation, followed by a cease and desist order, and finally the emergency suspension of service for establishments that fail to comply with the requirement.

3.1.2.5 Root Cause Program

When an SSO is reported, the assumption made about the cause of the overflow may be incorrect. To properly address the problem and prevent future issues, it is important to identify the root (actual) cause of the SSO. A Root Cause Program would allow the utility to determine the best short- and long-term corrective actions to prevent the problem from reoccurring. In areas where this program has been established, a committee should be formed to meet periodically to determine the root cause of the SSOs. The purpose of this committee is to identify key issues across the system to better prioritize resources for the maintenance, repair, and replacement of sewer infrastructure and to prevent future issues with the system.

3.2 Project Selection Process

While all of the management actions described above are useful to reduce FIB loading, the stakeholders will need to choose a combination of these activities based on the conditions in the watershed. Management actions must be selected to address the potential sources identified during the basin evaluation process. Projects are often most effective in areas that do not already have stormwater treatment and in areas with older sewer or septic tank infrastructure that could be upgraded or replaced. Adding stormwater treatment to flood-prone areas would help to reduce FIB loading from stormwater runoff and any septic tanks in the area, while also reducing the amount of infiltration in the sanitary sewer system. The stakeholders should analyze the costs

and benefits of the projects to select the most cost-effective options. Once the projects have been selected, a timeline for project implementation should be determined, in coordination with DEP, to provide a reasonable schedule to achieve water quality benefits.

Chapter 11 of the Lower St. Johns River Tributaries BMAP provides a good example of how all of the above considerations come together to form a plan for restoration activities.

3.2.1 Summary of Potential Sources and Management Actions

To determine if the identified management actions are sufficient to address the potential FIB sources in the watershed, the information on sources and actions should be summarized in a format that aids in evaluation. Each stakeholder should provide information on past and current projects and programs, as well as any planned projects and programs that could reduce FIB loading. These efforts should be matched to the potential FIB source(s) addressed. Summarizing the existing and planned management actions compared with the confirmed and potential sources in the watershed is helpful in identifying any sources that are not adequately addressed.

Tables 2 through **6**, which are based on tables in the Lower St. Johns River Tributaries BMAP, illustrate how the efforts in the basin can be summarized. These tables list the responsible entities, as well as the potential sources and types of management actions to address those sources. Under each entity, the following symbols can be placed in the tables to explain the level of effort:

- A check mark ("√") denotes an activity that the entity currently implements or plans to implement in the near future.
- A dash ("-") denotes an activity that the entity currently does not implement in the basin but could be an option for the entity to implement if additional actions are needed.
- An "X" denotes an activity that is not the responsibility of the entity (note those boxes can also be shaded to help illustrate what activities are and are not the entity's responsibility).

Table 2: OSTDS sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Ordinances	√	X	X	X
Enforcement	√	√	X	X
Program Implementation	√	√	X	X
Permit Review (new and repair permits)	X	√	X	X
Failure Area Evaluation	√	√	X	X
Failure Area Ranking	√	√	X	X
Septic Tank Inspection	√	√	X	X
Septic Tank Phase-Out	√	√	X	X
Septic System Upgrade	√	√	X	X
Public Education (PSAs)	√	X	X	X
Surface Water Sampling for Conditions and Trends	√	X	X	X

Table 3: Sewer system sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Sewer Line Upgrades	X	X	X	√
Manhole Inspection and Rehab	X	X	X	√
Pump Station Inspection and Maintenance	X	X	X	√
Pump Station Rebuild	X	X	X	√
ARV Inspection and Rehabilitation	X	X	X	√
Program Implementation	X	X	X	√
Private Lift Station Inspections and Enforcement	√	X	X	X
SSO Investigations	√	X	X	√
Surface Water Sampling for Conditions and Trends	X	X	X	√

Table 4: Stormwater sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Flood Control Capital Projects	√	X	√	X
Private Lift Station Inventory	√	X	√	X
Private Lift Station Inspection Program	X	X	X	X
Capital Projects/Stormwater Water Quality BMPs	√	X	-	X
Stormwater System Ditch and Canal Maintenance	√	X	√	X
Stormwater Pond Maintenance	√	X	-	X
Stormwater Pipe Cleaning and Maintenance	√	X	√	X
Potential Illicit Connection (PIC) Identification	√	X	√	X
Illicit Connection Detection and Removal	√	X	√	X
Public Education and Outreach	√	X	√	X
Surface Water Sampling for Conditions and Trends	√	X	√	X
Program Implementation	√	X	√	X

Table 5: Pet waste management sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Ordinances and Enforcement	√	X	X	X
Public Education and Outreach	√	X	X	X

Table 6: Special source assessment sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Intensive Water Quality Sampling to Track Sources	√	X	X	X
MST	√	X	X	√

3.2.2 State of Oregon Implementation Matrix Template

To organize source information and project information, the Oregon Implementation Matrix is a good example to follow. Oregon's guidance for developing TMDL implementation plans includes an implementation tracking matrix to assist in describing, tracking, and reporting on TMDL implementation efforts. The Oregon guidance document contains a fecal coliform example of the matrix that serves as another useful evaluation tool for stakeholders.

The matrix includes columns for information on the pollutant sources, strategies to control the source, specific projects to address the source, expected resources needed, how implementation will be measured, timeline and milestones, and status of the activity. The matrix is found in

Appendix D of the report *TMDL Implementation Guidance for State and Local Government-Designated Management Agencies*.

3.2.3 Evaluation of Management Actions

Summarizing the existing and planned actions will help stakeholders identify what more needs to be done to address the FIB impairment. All of the stakeholder activities should be organized by the type of source the projects address. Data gaps or uncertainties related to the FIB sources should be identified, and studies planned to address these needs should be included in the TMDL implementation plan.

3.2.4 Revenue Generation and Financial Assistance Opportunities

Investigating sources of potential pathogen problems and, especially, financing infrastructure upgrades to resolve them is expensive. DEP and other federal and state agencies have a variety of programs to assist in the effort.

DEP's Clean Water State Revolving Fund provides low-interest loans to plan, design, and build or upgrade infrastructure. Since the program's inception, more than $1.8 billion, or nearly 40 % of the program's total assistance, has been awarded to local communities for the construction or rehabilitation of sewer system infrastructure. As much as $200 million in loans is typically available each year. The Small Community Wastewater Program helps smaller, poorer communities with grants to plan, design, and build wastewater management facilities. More than $10 million typically is available each year. The highest priority in both programs is public health protection where need is **documented**. Conducting field investigations and source tracking monitoring strategies can help develop the necessary documentation.

DEP's Division of Water Restoration Assistance produces a guidance document, *Water Resource Funding in Florida*, available here, that summarizes these programs and a host of other state, regional, federal, and even potential private sources of wastewater and stormwater assistance, along with contact information.

Various technical assistance programs are also available to help communities better operate and maintain their wastewater and stormwater system and evaluate resource needs, including the Florida Rural Water Association, the Southeast Rural Community Assistance Project, the Florida Stormwater Association, and the Florida Water Environment Association Utility Council.

4.0 Developing and Documenting the Implementation Plan

Many people who will use this document are developing a bacteria pollution control plan (BPCP). The specific elements required in these plans should be discussed with your MS4 permit contact at DEP.

The purpose of this section is to outline the elements that should be included in a TMDL implementation plan. This information will help stakeholders prepare a comprehensive plan to address the FIB impairment to meet the TMDL.

4.1 TMDL Implementation Plan Elements

To ensure that the restoration plan includes all the necessary information to show how FIB sources will be removed or reduced, data gaps will be filled, and the waterbody will be monitored to show progress towards the TMDL, certain elements must be included. A helpful tool for preparing a restoration plan is the EPA *Handbook for Developing Watershed Plans To Restore and Protect Our Waters*, which outlines the elements essential for a watershed plan, as follows:

- Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan.
- Describe the nonpoint source management measures that will need to be implemented to reduce sources and identify the critical areas where those measures will be needed to implement the plan.
- Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied on to implement the plan.
- Develop an information/education component to enhance public understanding of the project and encourage early and continued public participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
- Develop a reasonably expeditious schedule for implementing the nonpoint source management measures identified in the plan.
- Describe interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
- Develop a set of criteria to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards and, if not, the criteria for determining whether the watershed-

based plan needs to be revised or, if a nonpoint source TMDL has been established, whether the TMDL needs to be revised.

- Develop a monitoring component to evaluate the effectiveness of efforts over time, measured against the state's FIB criteria.

Developing a TMDL implementation plan takes time and dedication. Unlike nutrients and other nonpoint source pollutants, bacteria are very dynamic. A thorough investigation of the watershed, a strong understanding of potential sources, and programs developed to address each potential source are the essential ingredients for an initial restoration plan. Progress toward restoration must be evaluated, and plans must be updated and adapted to meet current needs. It can be overwhelming when one thinks of how many components in a watershed are in need of upgrades and inspections, but don't fret. Having a plan and moving step by step through it will lead to success. Contact DEP (at anita.nash@dep.state.fl.us and kevin.coyne@dep.state.fl.us) for more information.

5.0 Appendices

The additional documents referenced in this report, listed below, may be useful to review when preparing a FIB watershed restoration plan. These documents can be obtained by contacting DEP.

- Appendix A – FIB Criteria
- Appendix B – Prioritization and Decision Matrix
  - Hillsborough Decision Matrix.
  - Prioritizing FIB-Impaired WBIDs.
- Appendix C – Source Identification
  - Walk the WBID.
  - FDOH Repair Permits GIS Layer.
  - DEP Interpretation of HF-183 Human MST Marker, Sucralose, and Acetaminophen Results.
  - DEP Study Design and Unofficial SOPs for Source Identification Monitoring.
  - Lower St. Johns Tributaries Pollution Assessment Manual 2006.
  - Mammalian Survey Techniques.
  - Bird Surveys.
  - Thermal Imaging Report.
  - EPA MST Guide.
  - GIS – MOT Layer List and Symbology Package.
- Appendix D – Management Strategies
  - Pet Waste Ordinances.
  - Scoop the Poop Alachua County PSA Information.
- Appendix E – Evaluating Progress
  - Annual BMAP Report Template Example.

- Detailed Description of Statistical Analysis of Bacteria.

- Appendix F – Funding
  - Creating a Sustainable Watershed Funding Plan 2008.
  - Sample Watershed Funding Plan.
  - Grant Sources: DEP Water Restoration Assistance Handout.
- Appendix G – Complete List of Restoration Partners
  - Appendix G1 – Phase I MS4 Conveyances:

    The entity to involve: Phase I MS4 permit coordinators for all counties and cities in the watershed.

    Jurisdictional authority: MS4 coordinators are responsible for managing the quality of stormwater conveyed to waters of the state that must meet water quality criteria. They are also responsible for reporting on the activities of multiple divisions in the municipality. They have the authority to address violations of local and state regulations pertaining to stormwater by initiating warnings and, if necessary, fines. They can also refer violations to appropriate departments.

    Source identification activities are, in part, field inspections. "Programs" and "inspections" are mentioned throughout because some problems can be improved by increasing the frequency of maintenance or reprioritizing areas for inspection and maintenance. MS4 Phase I coordinators should recommend increases or reprioritization of contributing areas by providing supporting evidence (i.e., notes about observations and photos) as needed. Additional information can be obtained by contacting the WQRP and MS4 Phase I regional coordinators at DEP (at anita.nash@dep.state.fl.us or NPDES-stormwater@dep.state.fl.us).

    Information and data they may possess: GIS shapefiles illustrating the location of stormwater conveyances, maintenance schedules and the frequencies of trash removal from conveyances, sediment removal, IDDE inspection schedules, knowledge of local ordinances and state regulations to protect water quality, and private lift station inspection inventories and inspection frequencies.

    When to engage in the implementation process: From beginning to end.

    How the entity can help: May lead the implementation process, develop monitoring plans, conduct source tracking efforts, enforce the permit and related ordinances, refer enforcement actions to other agencies as appropriate, and coordinate public education efforts where observations indicate need.

- Appendix G2 – OSTDS such as Septic Tanks or Cluster Systems

  The entity to involve: FDOH.

  Jurisdictional authority: Once a source is identified on a property serviced by an OSTDS, FDOH is responsible for ensuring that the property owner eliminates the illicit connection or repairs the failing drainfield. If the owner cannot afford to remediate the issue, a financial assistance plan should be developed and used (see Section 3.2.4, Revenue Generation and Financial Assistance Opportunities). If the owner refuses to remediate the issue, FDOH may take legal enforcement actions against the owner. In some cases, FDOH may remediate the issue and charge the owner or obtain funding after the work is completed.

  FDOH is also responsible for issuing installation or repair permits for OSTDS. In cases where an OSTDS is failing and sanitary sewer is available, FDOH may reject an application for a repair permit, forcing the homeowner to hook up to sanitary sewer.

  Information and data they may possess: Statewide GIS layers of septic tanks and repair permits. However, the county or city may maintain a more accurate or up-to-date layer.

  When to engage in the implementation process: MOT; WTW and other field events.

  How the entity can help: An FDOH OSTDS inspector should attend the WTW field event because that individual has the authority to investigate if sewage is smelled or directly observed. Additionally, when you get persistent human waste indicator hits and narrow the source location to a relatively small contributing area, serviced only by OSTDS, document that the source is persistent and cannot be attributed to pet waste or another non-OSTDS source. Report the source to the county FDOH environmental division and request field assistance to locate the contributing pipe or failing drainfield. FDOH may conduct an OSTDS inspection on a site where drainfield failure or direct pipe is observed or raw sewage is smelled, indicated by persistent human source–specific sampling results, or where drainfield failure or a direct pipe is suspected and the property owner grants permission to inspect the system.

  Note that if a human waste source is suspected, rather than confirmed, FDOH must first gain permission from property owners to access private property.

  Chapter 64E-6, F.A.C. (Standards for Onsite Sewage Treatment and Disposal Systems), states:

  > A sanitary nuisance is defined as: 386.01 Sanitary nuisance.—A sanitary nuisance is the commission of any act, by an individual, municipality, organization, or corporation, or the keeping, maintaining, propagation, existence, or permission of anything, by an individual, municipality,

organization, or corporation, by which the health or life of an individual, or the health or lives of individuals, may be threatened or impaired, or by which or through which, directly or indirectly, disease may be caused.

- Appendix G3 – Mobile Home Parks, Lodging and Recreational Vehicle Parks, Recreational Camps, Migrant Farmworker Housing

  The entity to involve: FDOH county office.

  Jurisdictional authority: In Florida, mobile home parks, lodging and recreational vehicle parks, and recreational camps are all potential FIB sources. FDOH's Mobile Home Parks Program inspects approximately 5,500 housing facilities enrolled in the program to reduce the risk of injury and illness, with a focus on the following: proper sewage disposal to minimize the risk of diseases such as hepatitis, Salmonella, and Shigella; safe drinking water to minimize the risks of diseases such as Giardia and Cryptosporidium; safe solid waste collection and disposal to minimize rat and roach infestations, reservoirs for mosquitoes, and associated diseases, as well as vectors that transmit rabies and diseases associated with ticks.[7] Also of concern is maintaining safe and disease-free swimming pools, where applicable.

  Migrant farmworker housing may require restoration work. According to FDOH, up to 200,000 migrant and seasonal farmworkers and their families travel to and provide labor in Florida each year.[8] FDOH's Migrant Farmworker Housing Program seeks to reduce the risk of communicable disease transmission and injury among migrant farmworkers by establishing procedures for permitting and inspecting migrant housing. Informational brochures on the program are available in English and Spanish.

  County Health Departments are responsible for complying with the Migrant Labor Camp Program rule and procedures. They provide plan review and permitting, preinspection and routine inspections, investigations, education, and the application of state laws and rules.[9]

  How the entity can help: County Health Departments receive and investigate environmental health and sanitation complaints about these facilities. They provide complainants with information on report findings and corrective actions taken.

- Appendix G4 – Sanitary Sewer Utility–Owned Conveyances and Components

[7] FDOH. *Mobile Home Parks.* Accessed on May 31, 2018. Available: http://www.floridahealth.gov/environmental-health/mobile-home-parks/index.html.
[8] FDOH. *Migrant Farmworker Housing.* Accessed on May 31, 2018. Available: http://www.floridahealth.gov/environmental-health/migrant-farmworker-housing/index.html.
[9] FDOH. *Migrant Farmworker Housing.* Accessed on May 31, 2018. Available: http://www.floridahealth.gov/environmental-health/migrant-farmworker-housing/index.html.

The entities to involve: Sanitary sewer utility (or utilities).

Jurisdictional authority: Per Florida statute, sanitary sewer utilities are responsible for maintaining sanitary sewer conveyances, lift stations, and other components owned by the utility. The sanitary sewer utility should work closely with county FDOH staff and stormwater permittees on a program to identify properties where OSTDS are failing and a timeline to convert from septic to sanitary sewer. In some municipalities, the utility may have authority, through a local ordinance, to convert a home from septic to sewer. The cost of hook-up services may be fronted by the utility and charged to the property owner, or a hardship funding source may cover it.

Information and data they may possess: Many utilities have a GIS layer of their infrastructure. These professionals can share their knowledge of the age of the infrastructure, conveyance and manhole construction materials in each neighborhood, conveyance inspection schedules, inspection methods, repair and replacement plans, causes of SSOs, and common locations of SSOs. Sanitary sewer representatives can provide information about utility-owned lift stations, such as inspection frequency, what happens if an overflow is impending, whether they are equipped with back-up generators to prevent SSOs during power outages, how staff are notified immediately when there is a problem, and how quickly they respond once notified.

When to engage in the implementation process: MOT; WTW and other field events, as well as inspections of sanitary sewers in response to human waste source–specific monitoring results.

How the entity can help: Whether the utility is owned by a municipality or a private company, or is a co-operative, sanitary sewer utility leaders and field staff are invaluable in source detection and elimination. They are most familiar with the industry and can expeditiously inspect and identify a sewage problem.

During a WTW field event, the utility is usually willing to pop manhole covers for staff to observe the inside. The construction materials of manholes and conveyances can indicate their age and potential for structural degradation. The depth of conveyances varies depending on many factors. Therefore, stormwater conveyances may be higher or lower or at similar elevations as the sanitary sewer conveyances. This knowledge helps everyone think through the possibility of cross-contamination.

After the WTW event, especially if monitoring results suggest a leak, the utility may also be willing and able to inspect a portion of its conveyance system using smoke testing and CCTV inspections.

- Appendix G5 – Roadway Stormwater Conveyances

The entities to involve: City and county public works departments, Florida Department of Transportation (FDOT).

Jurisdictional authority: Authorities include the maintenance and management of stormwater conveyances, illicit connection detection programs, and notification of the responsible entity when illicit sources of human waste are identified. Per MS4 Phase I permits, mowing and maintenance crews are trained to identify and report illicit connections to stormwater systems. Leaking sanitary sewer utility pipes are reported to the utility for immediate repair. Sewage conveyed from homes to stormwater systems should be directed to the county FDOH. Team members can also report illicit connections to the local MS4 permit contact, code enforcement, or DEP. The MS4 Phase I permit requires documentation of IDDE Program activities and requires permittees to take legal actions, if necessary.

Information and data they may possess: GIS layers of conveyances, stormwater manholes, inlets, and outfalls. Knowledge of the flow direction and connectedness of stormwater conveyances above ground and underground may be in GIS format but is more likely relayed by word of mouth. These entities retain maintenance schedules and information on the frequencies of trash removal from conveyances, sediment removal, plant removal along and inside stormwater infrastructure, and street sweeping. Other important knowledge includes IDDE inspection schedules and areas, as well as problem sites, such as recurring potholes indicative of broken underground pipes, areas with excessive litter, areas with flooding problems, areas with siltation buildup and erosion, and nuisance odor areas indicating the degradation of biological waste.

When to engage in the implementation process: Information gathering. Managers and staff who mow rights-of-way, maintain conveyances, or are contract managers for these practices are beneficial at the MOT event and during the WTW and other field investigations. When tracing sources by monitoring human waste–specific source tracking parameters, engage these teams to provide input on contribution areas, flow direction, connectivity, and field investigations.

How the entities can help: Per the MS4 Phase I permit, maintenance frequency may be increased in areas demonstrating the need for more frequent activities. Local roadway departments and FDOT may be well suited to aid in watershed-focused IDDE efforts before or after the WTW field event. These teams can provide traffic safety and open manholes so monitoring staff can safely collect samples from underground conveyances. In response to indications of human waste in underground stormwater conveyances, crews (with access to the necessary equipment) may be able to use CCTV to inspect stormwater conveyances.

- Appendix G6 – Restaurants, Hotels, and Apartment Complexes

The entity to involve: DBPR, Division of Hotels and Restaurants.

Jurisdictional authority: The Division of Hotels and Restaurants issues permits to hotels, most restaurants, and multi-unit housing such as apartment complexes. These permits, in part, address health and safety. DBPR works with permit holders to

remediate and prevent future issues for the following situations: trash and litter around dumpsters and anywhere onsite, food waste exposed to rain (rodent attractants), grease recycling containers with grease drips on the outside or spills on the ground, private lift stations, missing sewer clean-out caps, and privately owned sanitary conveyances. DBPR has the authority to legally enforce permit requirements.

Information and data they may possess: Knowledge of restaurants, hotels, and apartment complexes with a history of problems.

When to engage in the implementation process: MOT; WTW and other field events.

How the entity can help: When observations of concern are made at hotels, restaurants, and apartment complexes, assign follow-up activities to DBPR. If source tracking points to any of these properties, ask DBPR to assist during field investigations. Contact FDACS Division of Food Safety (DFS) to get in touch with your local FDACS Food Safety field representative.

- Appendix G7 – Gas Stations that Sell Hot Food, Roadside Food Trucks, Donut Shops, and Coffee Shops

The entity to involve: FDACS DFS.

Jurisdictional authority: DFS issues permits to some food service providers that do not have a DBPR permit. Examples are gas stations with a small hot bar (such as pizza or fried chicken), food trucks, and some coffee and donut shops. These permits are less environmentally comprehensive than DBPR permits for restaurants. For instance, they do not address sanitary sewer components. However, they do cover rodent attractants near dumpsters and in the general vicinity, such as grease spills and dumped food. DFS can legally enforce permits.

Information and data they may possess: Knowledge of areas of concern with a history of problems.

When to engage in the implementation process: MOT; WTW and other field events.

How the entity can help: When issues of concern are observed on DFS-permitted facilities, assign follow-up activities to DFS. If you are unsure if the facility has a permit from FDACS' DFS or the DBPR Division of Hotels and Restaurants, report the observation to either of the two agencies and they will forward it to the other if necessary.

- Appendix G8 – Production Agriculture (agricultural operations operated as a business)

  The entities to involve: FDACS Office of Agricultural Water Policy (OAWP) and UF–IFAS Extension Offices.

  Jurisdictional authority: Both OAWP and UF–IFAS may work directly with producers to identify appropriate BMPs and cost-share funding to implement BMPs. Outside of BMAPs or springs priority focus areas (PFAs), participation in the BMP Program is voluntary because there are no requirements for producers to implement BMPs.

  Information and data they may possess: FDACS maintains a GIS database of production agricultural operations enrolled in the BMP Program.

  When to engage in the implementation process: MOT; WTW field event.

  How the entities can help: If livestock or manure are observed near waterbodies or conveyances on production agricultural operations (businesses), OAWP may work with producers after the WTW field event to educate them on the benefits of enrolling in the BMP Program. The goal is for producers to sign an NOI to implement BMPs. OAWP will assist producers by prescribing appropriate BMPs, finding cost-share funds, and following up once BMPs are in place.

  In some regions, UF–IFAS Extension Offices are available to team up with OAWP for this task. These agencies may also work together to host public education events. Note that producers are not required to participate in the BMP Program outside of BMAP areas and springs protection zones but may sign up voluntarily.

- Appendix G9 – Nonproduction Agriculture such as Hobby Farms

  The entities to involve: UF–IFAS Extension Offices and MS4 Phase I permit coordinators for counties and cities.

  Jurisdictional authority: UF–IFAS and MS4 permit coordinators may work with the owners of hobby farms to reduce impacts to waterbodies through public education.

  Information and data they may possess: Knowledge of areas with hobby farms.

  When to engage in the implementation process: MOT; WTW field event.

  How the entities can help: May host public outreach events for small parcels with livestock, such as ranchettes, to discuss hobby farm BMPs, including manure management and waterbody impairments.

- Appendix G10 – Pathogen Transporters such as Sharps (hypodermic needles), Blood (vials of blood samples), Medical Waste, and Numerous Houseflies

  The entities to involve: FDOH and local code enforcement.

Jurisdictional authority: FDOH and code enforcement are concerned with any uncontained human medical waste and evidence of drug use. Medical waste containing animal blood, such as from a veterinarian's office, is a code enforcement issue, not an FDOH issue. FDOH should be called when animal manure or another biological waste is drawing numerous houseflies. If the fly nuisance originates from a farm business, FDACS OAWP should also be called to assist the owner with BMP planning.

Information and data they may possess: Knowledge of areas of concern with a history of problems.

When to engage in the implementation process: MOT; WTW field event.

How the entities can help: They will work with property owners to remediate the immediate problem and develop a plan to prevent it in the future. Many times, after initial remediation is completed, staff will add the site to their periodic inspection schedule until a clean history is noted.

- Appendix G11 – Any Anthropogenic Sources

The entity to involve: County and city code enforcement.

Jurisdictional authority: Enforcement of county or city ordinances.

Information and data they may possess: Code enforcement staff are trained to make observations beneficial to the WTW field event, and they know local and state regulations.

When to engage in the implementation process: WTW field event.

How the entity can help: Staff are rarely available to participate but should be notified in advance of the WTW field event date and its purpose. Carry code enforcement's phone number and call them from the field if something urgent is observed. Often, the MS4 coordinator is also familiar with county and city codes and can stand in for code enforcement during the field event.

- Appendix G12 – Watershed Protection Agencies

The entities to involve: WMDs, DEP, WCDs, National Estuary Program (NEP).

Jurisdictional authority: WMDs – Water consumption, water treatment projects and initiatives, irrigation schedules, flood control. DEP – Water quality assessments, permits regulating stormwater discharges to waters of the state. WCDs – Flood control, water quality in stormwater conveyances; maintenance of stormwater conveyances. NEP – Restoring and maintaining healthy estuaries and bays; water treatment projects and initiatives.

Information and data they may possess: Knowledge of some history of the watershed and modifications to the waterbody; laws and regulations on waters of the

state and federal waters; may suggest participants and partners who can assist in the restoration effort; knowledge of hydrology and water quality–related subjects.

When to engage in the implementation process: From the very beginning.

How the entity can help: During the MOT and WTW events, staff will ask valuable questions from a watershed management perspective. DEP may be able to assist with monitoring plan development, monitoring efforts, data analysis, minor GIS support, and WTW planning. All the entities in this category may be able to provide outreach assistance and assistance with public education materials.

- Appendix G13 – Watershed Protection Activists and Others

The entities to involve: Environmental concern groups and citizens such as The Nature Conservancy, Audubon Society, River Keeper, Friends of (waterbody name), Bream Fishermen's Association, local politicians, universities, citizens, homeowner associations, and neighborhood outreach coordinators employed by municipalities.

Jurisdictional authority: Not applicable.

Information and data they may possess: Environmental concern groups and citizens, both organized and unorganized, are often very observant and can provide information about site-specific issues and concerns.

When to engage in the implementation process: MOT; post-WTW field event.

How the entity can help: May provide support with public education, litter pick-up events, and dog waste campaigns. Universities may be able to assist with a portion of the water quality monitoring, laboratory analysis, and data interpretation. They may also assist in organizing and running think tanks for specific problems.

- Appendix G14 – Potentially Dangerous Neighborhoods

The entity to involve: Florida Fish and Wildlife Conservation Commission (FWCC) officers or another law enforcement entity.

Jurisdictional authority: Environmental and standard law enforcement.

Information and data they may possess: Some law enforcement officers may also be trained in environmental law, such as FWCC officers.

When to engage in the implementation process: In advance of the WTW field event.

How the entity can help: If an area of the watershed is known for illegal activity and is potentially dangerous, remember, the safety of the field team is the highest priority. With an advance request, law enforcement will sometimes escort and accompany the team.

- Appendix G15 – Military Bases

  The entity to involve: Military base.

  Jurisdictional authority: Military base stormwater and sanitary sewer management.

  Information and data they may possess: Knowledge of base operations and history of the area.

  When to engage in the implementation process: MOT; WTW field event.

  How the entity can help: Notify and invite participation from military base stormwater and sanitary sewer system managers. The event will inform them about the FIB impairment and associated concerns. If allowed, they may choose to invite a select group of participants to come on base to make observations.

- Appendix G16 – Homelessness

  The entity to involve: Florida Department of Children and Families (DCF) Office on Homelessness, local homeless coalitions, and continuum of care lead agencies.

  Jurisdictional authority: The Office on Homelessness is responsible for coordinating resources and programs across all levels of government, and with private providers that serve the homeless. It also manages targeted state grants to support the implementation of a local homeless service continuum of care plans.

  Information and data they may possess: Knowledge of homeless camps.

  When to engage in the implementation process: Before MOT and after WTW. Determine through discussion whether their participation in MOT or WTW will be the best use of their time or would benefit the team. After field events, provide them a list of locations where homeless camps and activities were observed and encourage their teams to reach out to people in need of services. Their services to the homeless population are of significant value in their involvement with the WTW and general restoration process.

  How the entity can help: The lead agency can coordinate with other service providers to assist the homeless in the basin with the goal of providing them with health care, food, and shelter.

- **Appendix H – Complete List of Website Addresses**

  - City of Dunedin YouTube PSA about dog waste: https://www.youtube.com/watch?v=U9FxFBRElSA.

  - City of Tallahassee Think about Personal Pollution Campaign website: http://www.tappwater.org/.

  - CommunityWalk website: http://www.communitywalk.com/.

- DBPR websites:
  - *Hotels and Restaurants: http://www.myfloridalicense.com/DBPR/about-us/department-divisions/.*
  - *DBPR field reps: http://publicfiles.dep.state.fl.us/DEAR/BMAP/Fecal%20Toolkit/APX_C_Source_ID_Tools/Walk_The_WBID/.*
- DCF websites:
  - *DCF Office on Homelessness: http://www.myflfamilies.com/service-programs/homelessness.*
  - *DCF contacts: http://www.myflfamilies.com/service-programs/homelessness/local-homelessness-contacts.*
  - *Contacts for regional lead agencies who coordinate services: http://www.dcf.state.fl.us/programs/homelessness/docs/leadagencies.pdf.*
- DEP websites:
  - *BMAPs: https://floridadep.gov/dear/water-quality-restoration/content/basin-management-action-plans-bmaps.*
  - *FIB Toolkit Appendices: http://publicfiles.dep.state.fl.us/DEAR/BMAP/Fecal%20Toolkit/.*
  - *Final DEP TMDL documents: https://floridadep.gov/dear/water-quality-evaluation-tmdl/content/final-tmdl-reports.*
  - *Florida STORET Database public access website: http://prodenv.dep.state.fl.us/DearSpa/public/welcome.*
  - *Lower St. Johns River Tributaries BMAP: https://floridadep.gov/sites/default/files/lsjr-tribs-fecal-bmap.pdf.*
  - *NNC Tracker: http://fdep.maps.arcgis.com/home/item.html?id=da661fe32e9d49b6a0c2706a42d4782c.*
  - *QA/QC SOPs and quality manuals: https://floridadep.gov/dear/quality-assurance/content/dep-sops.*
  - *Process for Assessing Data Usability (DEP-EA 001/07): http://mytest.sfwmd.gov/portal/page/portal/xrepository/pdf2/usability_doc.pdf.*
  - *Program for MS4s: https://floridadep.gov/water/stormwater/*

- *Surface Water Quality Standards, Chapter 62-302, F.A.C.:* *https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-302*.
- *Impaired Surface Waters Rule (IWR), Chapter 62-303, F.A.C.:* *https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-303*.
- *TMDLs, Chapter 62-304, F.A.C.:* *https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-304*.
- *TMDL Program: https://floridadep.gov/dear/water-quality-evaluation-tmdl/content/total-maximum-daily-loads-tmdl-program.*
- *WBID shapefiles: http://geodata.dep.state.fl.us/datasets/waterbody-ids-wbids.*
- *Water Resource Funding:* *https://floridadep.gov/wra/wra/documents/water-resource-funding-florida.*
- *Watershed Assessment Section: https://floridadep.gov/dear/watershed-assessment-section.*
- *WIN:* *http://prodenv.dep.state.fl.us/DearWin/public/welcomeGeneralPublic?calledBy=GENERALPUBLIC*.

- FDACS websites:
  - *OAWP: http://www.freshfromflorida.com/Divisions-Offices/Agricultural-Water-Policy*.
  - *Division of Food Safety: https://www.freshfromflorida.com/Divisions-Offices/Food-Safety*.
- FDOH websites:
  - *Environmental health directors statewide list of county contacts:* *http://publicfiles.dep.state.fl.us/DEAR/BMAP/Fecal%20Toolkit/APX_C_Source_ID_Tools/Walk_The_WBID/*.
  - *FDOH nitrogen reduction study:* *http://www.floridahealth.gov/%5C/environmental-health/onsite-sewage/research/nitrogen-reduction.html*.
  - *OSTDS: http://www.floridahealth.gov/%5C/environmental-health/onsite-sewage/ostds-statistics.html*.
  - *Migrant Farmworker Housing Program:* *http://www.floridahealth.gov/environmental-health/migrant-farmworker-housing/index.html*.

- *Migrant Farmworker Housing Program informational brochure (English): http://www.floridahealth.gov/environmental-health/migrant-farmworker-housing/_documents/migrantframworkerenglish.pdf.*
- *Migrant Farmworker Housing Program informational brochure (Spanish): http://www.floridahealth.gov/environmental-health/migrant-farmworker-housing/_documents/migrantframwokerspanish.pdf.*
- *Mobile Home Parks Program: http://www.floridahealth.gov/environmental-health/mobile-home-parks/index.html.*
- *FDOH Repair Permit February 2018 GIS layer.*

- Canine Services, LLC website: http://www.ecsk9s.com/home.html.
- Environmental emergency call lines – Statewide list: http://publicfiles.dep.state.fl.us/DEAR/BMAP/Fecal%20Toolkit/APX_C_Source_ID_Tools/Walk_The_WBID/.
- EPA websites:
  - *Elements of a State Water Monitoring and Assessment Program: https://archive.epa.gov/water/archive/web/html/statemonitoring.html.*
  - *Handbook for Developing Watershed Plans To Restore and Protect Our Waters: https://www.epa.gov/polluted-runoff-nonpoint-source-pollution/handbook-developing-watershed-plans-restore-and-protect.*
- *Florida Monitoring Program: Point Count Method to Survey Birds* (M.E. Hostetler and M.B. Main): http://edis.ifas.ufl.edu/uw140.
- Florida Onsite Wastewater Association, Inc. website: http://www.fowaonsite.com/services.
- Florida Rural Water Association website: http://www.frwa.net/.
- Florida Stormwater Association website: http://www.florida-stormwater.org/.
- Florida Water Environment Association Utility Council website: http://fweauc.org/.
- Google: https://accounts.google.com/SignUp?hl=en.
- Oregon Department of Environmental Quality website on TMDL implementation guidance for state and local government–designated

management agencies: https://digital.osl.state.or.us/islandora/object/osl:20723/datastream/OBJ/view.

- Southeast Rural Community Assistance Project website: http://sercap.org/.
- UCF Stormwater Management Academy website: http://stormwater.ucf.edu/.
- UF–IFAS Extension, EDIS, Wildlife Conservation and Ecology website: http://edis.ifas.ufl.edu/department_wildlife_ecology_and_conservation.
- USGS Microbial Source-Tracking and Detection Techniques website: http://water.usgs.gov/owq/microbial.html.

- **Appendix I – Glossary of Terms**

ARV: Air release valves are often attached to metal sanitary sewer pipes to release corrosive sewer gases. They are usually located at high points in a sanitary sewer conveyance (this gas rises), which frequently coincides with bridges. The sewer gas released often smells bad and can cause source identification inspectors to suspect a sewer leak. Many ARVs are checked for liquid leaks regularly by the utility that owns them; however, it is good practice to inspect them to see if liquid is dripping from them.

Back-up generator: A generator used by sanitary sewer utilities during power outages to keep sanitary sewer lift stations and pressure mains flowing.

Conveyances: Man-made structures above (ditch or canal) or below ground (pipes or troughs made of various materials [such as vitrified or red clay, polyvinyl chloride [PVC], concrete, etc.]), used to move liquid, often by gravity flow; sometimes they are pressurized. The term conveyance applies to both stormwater and sanitary sewer systems.

Curb Inlet: An opening where stormwater enters the underground stormwater conveyances in the curb of a street.

Force Main: Pressurized sanitary sewer pipe that receives sewage from smaller pipes in which sewage is moved upgradient by pressure created by pumps.

Grate: A metal covering of an entrance to the stormwater conveyances underground. Water passes through holes in the grate.

Gravity Main: Sanitary sewer pipe that receives sewage from smaller pipes in which sewage is moved downgradient by gravity.

Hot or **Hit:** A way to refer to a monitoring site with lab results indicating raw sewage—for example, "During Rounds 2 and 3, Site C4 was hot. Acetaminophen and *E. coli* results were at levels consistent with wastewater treatment plan influent."

Illicit Connection: A pipe discharging something (such as sewage) other than stormwater, air conditioner condensate, or dechlorinated pool water to a natural waterbody, canals, or the MS4 system. The term potential illicit connection (PIC) is used when an outfall is observed but the observer is uncertain whether the outfall is illicit (illegal) or allowed. Illicit connections may occur without a pipe—for example, a ditch or trench, surface flow, or leak.

Lateral: A small pipe, 2 to 4 inches in diameter, that conveys sewage from a home or business to the sanitary sewer main conveyance.

Lift Station: A lift station, also called a pump station, is an underground holding tank or well containing a pump that turns on when triggered by a float in the well. The purpose is to gather sewage or stormwater by gravity. When a certain volume is gathered, the pump pushes the liquid to a higher elevation, allowing the liquid to flow by gravity to the next low point. Eventually sewage will enter a wastewater treatment facility, or stormwater will discharge to a stormwater system or waterbody. Sanitary sewer lift stations often stink when the pump is active.

Outfall: A pipe that discharges stormwater into a waterbody.

Manhole: Often a circular metal lid flush with the ground that covers an access to sanitary sewer (raw sewage conveyance) or storm sewer (stormwater conveyance).

OSTDS: Onsite sewage treatment and disposal system. One example is a septic system (septic tank and drainfield).

Pressure pipe: A conveyance used to move liquid sewage uphill, usually under pressure. Facilities usually know immediately if one of these is leaking, and so it is expected that the sources being followed are probably not pressure pipes.

Private: Components of stormwater conveyances or sanitary sewer conveyances not managed by a utility or municipality.

Pump Station: Stormwater or sanitary sewer station in which a pump is used to move liquid.

Sewage: This term is confusing when it is not explained or preceded by an adjective, as follows:

> ***Sewage****: Animal or human waste.*
>
> ***Raw sewage****: Untreated sewage; human waste that is not disinfected.*
>
> ***Influent*** *to a wastewater treatment plant is untreated sewage, or raw sewage.*

***Treated sewage**: Effluent; human waste that is disinfected at a wastewater treatment plant. Effluent from a functioning drainfield could be considered treated sewage, although it is not exposed to a measured level of disinfectant.*

***Wastewater reuse water** is treated effluent and is sometimes mixed with stormwater before being used for lawn irrigation.*

Sewer: This term is confusing when it is not explained or preceded by an adjective, as follows:

***Sanitary sewer =** Raw sewage conveyance.*

***Storm sewer =** Stormwater conveyance.*

SSO: Sanitary sewer overflow, in other words, a sewer spill or sewage leak from a sanitary sewer conveyance.

- **Appendix J – List of Acronyms and Abbreviations**

ARV	Air Release Valve
BMAP	Basin Management Action Plan
BMP	Best Management Practice
BPCP	Bacterial Pollution Control Plan
CAD	Computer-Aided Drafting
CCTV	Closed-Circuit Television
CFU	Colony-Forming Unit
cm	Centimeter
DBPR	Florida Department of Business and Professional Regulation
DCF	Florida Department of Children and Families
DEP	Florida Department of Environmental Protection
DFS	Division of Food Safety
DMR	Discharge Monitoring Report
E. coli	Escherichia coli
EDIS	Electronic Data Information Source
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FIB	Fecal Indicator Bacteria
FOG	Fats, Oils, and Grease
FWCC	Florida Fish and Wildlife Conservation Commission
GIS	Geographic Information System
GPS	Global Positioning System
IDDE	Illicit Discharge Detection and Elimination
IWR	Impaired Surface Waters Rule
mL	Milliliter
MOT	Maps on the Table
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NEP	National Estuary Program
NHD	National Hydrography Dataset
NNC	Numeric Nutrient Criteria
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
OAWP	FDACS Office of Agricultural Water Policy
OSTDS	Onsite Sewage Treatment and Disposal System
PFA	Priority Focus Area
PIC	Potential Illicit Connection
PMA	Propidium Monoazide

PSA Public Service Announcement
PVC Polyvinyl Chloride
QA/QC Quality Assurance/Quality Control
qPCR Quantitative Polymerase Chain Reaction
SOP Standard Operating Procedure
SSO Sanitary Sewer Overflow
STORET STOrage and RETrieval (Database)
TMDL Total Maximum Daily Load
TPTV Ten Percent Threshold Value
UCF University of Central Florida
UF–IFAS University of Florida Institute of Food and Agricultural Sciences
USGS U.S. Geological Survey
UV Ultraviolet
WBID Waterbody Identification (Number)
WCD Water Control District
WIN Watershed Information Network
WMD Water Management District
WQRP Water Quality Restoration Program
WTW Walk the Waterbody/Watershed/WBID