



# SANIPATH™

Alpha Version

Rapid Assessment Tool Manual

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**EMORY**  
UNIVERSITY

**Center for  
Global Safe Water**

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## Acronyms

CBO	community-based organization
GPS	Global Positioning System
NGO	non-governmental organization
WASH	water, sanitation and hygiene

## Definition of key terms

**Biosolids:** The nutrient-rich organic materials resulting from the treatment of sewage sludge; sometimes used as manure.

**Flooding:** Standing water that lasts for at least an hour in an area where water is generally absent. Flood water comes from excessive rainfall as well as from high water levels and high tides. Flooding can also be caused or exacerbated by dysfunctional drainage systems or broken water mains.

**Household:** Consists of all the people who share a cooking pot.

**Municipal water system:** Piped water system managed by the city, water utility, or a private company.

**Open defecation:** Any feces left in the open (on the ground or in drains). This includes chamber pots or potties emptied into drains, and includes both adult and children's feces.

**Open drain:** Any drain without a cover that allows human contact with its contents (see **Figure 1**).

**Private toilet / latrine:** A toilet or latrine intended for use by one family or extended family, including those in family compounds. The proposed definition for post 2015 indicators is "shared between no more than five families or 30 persons, whichever is fewer" (UNICEF/WHO 2013).

**Public toilet / latrine:** Includes any toilet or latrine available for anyone to use (either for free or a fee), including those in schools, workplaces, houses of worship, or other locations in the community.

**Sanitation infrastructure:** All built items meant to contain, transport, and treat fecal matter; this can include toilets, latrines, pipes, drains, sewage treatment plants, settling ponds, and septic pits.

**Septage:** The partially treated waste in a latrine pit or septic pit

**Wastewater:** Water that has been used for washing, flushing toilets, or manufacturing, and thus contains wastes. Sewage is the subset of wastewater that is contaminated with feces or urine.

**Wastewater irrigated produce:** Produce grown above ground, possibly irrigated by wastewater, for which the edible part of the plant could touch wastewater directly, and for which the edible part can be eaten raw. Examples include but are not limited to: lettuce, tomatoes, spring onion, cabbage, cucumbers, and peppers. Examples of produce that are not relevant either because they are not eaten

raw, they grow below the ground, or because the edible part is not watered, include the following: bananas, oranges, potatoes, corn, and mangoes.

**Waypoint:** A set of coordinates (longitude and latitude) that identify a unique location.



**Figure 1:** Children can be seen playing in and around open drains in Accra, Ghana.

## Part 1: Overview of the SaniPath Rapid Assessment Process and Tool

*The SaniPath Rapid Assessment Tool aims to assess exposure to fecal contamination in urban, low-income settings. The tool is under development by the Center for Global Safe Water at Emory University with funding from the Bill & Melinda Gates Foundation. The tool guides users in collecting much needed data on exposure to fecal contamination in low income, urban neighborhoods, and synthesizes these data for community, government, and service providers' decision-making. The tool will be publicly available and is intended for non-governmental organizations, funders, and government institutions.*

### Background

Rapid urbanization has led to a growing sanitation crisis in urban and peri-urban areas of low-income countries. Currently, over half of the global population resides in urban areas, with cities in Asia and Africa projected to experience the greatest increase in population (K. Penrose 2010). Rapid population growth in developing countries has outpaced existing infrastructure, including water and sanitation systems, leading increasing numbers of urban dwellers, especially those in informal settlements, to live in very polluted environments (UN-HABITAT 2003, G.H.S. 2009, Keraita 2010). Despite the considerable sanitation needs of urban and peri-urban communities, there are little data to inform strategies to mitigate risks of fecal exposure in developing countries. Consequently there is a need for site-specific evidence to help make decisions about sanitation investments.

The SaniPath team conducted an in-depth risk characterization of exposure to contamination in Accra, Ghana along multiple pathways. The data that were collected have helped to inform an understanding of the broken sanitation chain in urban, low-resource settings. In many situations, the ability of decision makers to characterize sanitation issues is limited to deskwork or to relying on consultants to provide guidance. Therefore, the SaniPath Rapid Assessment Tool is designed to be accessible and understood by mid-level civil servants with a variety of scientific backgrounds (including environmental health officers, local government administrators, program managers, and lab technicians). The result is a “scaled-down” version of our in-depth assessment that can enable a wider audience to characterize sanitation in urban, low-resource settings.

The SaniPath Rapid Assessment Tool methodology distinguishes itself from other methodology in the following ways:

1. It focuses on sanitation conditions and exposure to fecal contamination.
2. It is designed specifically for use in high-density urban settlements.
3. It includes environmental microbiology methods to quantify magnitude of fecal contamination in specific environmental pathways.

The objectives of the SaniPath Rapid Assessment Tool are to:

- Generate reliable data on exposure to fecal contamination in low-income, urban neighborhoods
- Synthesize these data for community, government, and service providers' decision-making

The results of this assessment can be used to characterize a neighborhood or city according to a matrix of fecal exposure pathways. The outputs will serve as a simplified, but still informative, means of identifying priorities for sanitation investments or interventions. The tool will allow the following two primary ways of comparing risks:

- Comparing neighborhoods (either aggregate risk or identify the biggest pathway risk for each neighborhood)
- Comparing pathways within a neighborhood

The rapid assessment is designed to be completed within a month. The approximate cost to assess all pathways is 15,000 USD.

## System Requirement Specifications

The SaniPath Rapid Assessment Tool is able to run on the following operating systems:

- Microsoft Windows XP (with Service Pack 3), 32-bit
- Microsoft Windows Vista (with latest service pack), 32-bit
- Microsoft Windows 7 (with Service Pack 1), 32-bit and 64-bit

The computer is assumed to have a PDF reader already installed. If the computer does not already have a PDF reader installed, Adobe Reader can be downloaded for free [here](#). No Internet connection is needed to use the tool.

## The approach

The SaniPath Rapid Assessment Tool will be self-contained on a thumb drive to enable usage when access to the Internet is unreliable. It will also be available for download from the Internet. The major components included in the SaniPath Rapid Assessment Tool package are: (1) a manual with in-depth instructions on usage of the tool components, surveys, as well as guidance and recommendations for optimization, (2) software, within which assessment planning, data entry, and analysis will all take place, and (3) an optional Geographic Information Systems (GIS) component (**Appendix 7** in this manual), for those with greater resources at their disposal.

The rapid assessment methodology guides the user through various modules to plan, obtain data, analyze, and develop reports. The methodology characterizes the behavior of adults and children in the public domain along eight different pathways:

- Surface water (rivers/lakes/ponds)
- Open drains
- Flood water
- Municipal drinking water
- Public latrines
- Produce (fruits/vegetables)
- Bathing water
- Ocean water



In addition, the methodology involves collecting and processing environmental samples from these same pathways. Each pathway listed above has an environmental sampling component to complement the behavioral data, with the exception of flood water because flood water samples can often be difficult to obtain. Soil samples from a variety of public locations are also included in environmental sampling. The tool does not include pathways of exposure in the private domain or those strongly related to personal hygiene as they are less influenced by public intervention.



**Figure 2:** A wide variety of public latrines, such as these in Accra, Ghana, are among the sites tested during the rapid assessment process.

The behavioral and environmental microbiology results are then combined using a novel rapid risk characterization method. The software will automatically conduct all analysis and produce graphical representations of the data.

The main outputs of the rapid assessment that users can expect to create, include the following:

1. A **preliminary assessment report**, which describes the status of sanitation infrastructure and treatment in the neighborhoods the assessment will take place in, reviews the relevant local actors in the realm of sanitation management, and presents some key behaviors and potential areas for environmental sampling.
2. The **final rapid assessment report** combines the environmental microbiological data and the behavioral data (how many people are exposed and how often) to quantify risks of key exposure pathways for comparison. It also includes key summary statistics on the behavioral and environmental data as well as some contextual data about behavior and access to sanitation facilities in the city.
3. Optional **geospatial maps** of environmental contamination hotspots for users with access to Google Earth, and ArcGIS Explorer.

## Target audience and assessment team

The SaniPath Rapid Assessment Tool, while designed by a team of academics and WASH professionals, is designed to be accessible and understood by people with a variety of scientific backgrounds (including

environmental health officers, local government administrators, program managers, and lab technicians). The result is a tool that can enable a wider audience to characterize sanitation in urban, low-resource settings. Audiences for which the SaniPath Rapid Assessment Tool could be appropriate include:

1. Local governments/NGOs looking to prioritize their intervention strategies and/or the area in which they work
2. Implementers/funders looking for a before/after monitoring tool for sanitation investments.

Those teams considering implementing the rapid assessment, should, at minimum, have access to the following resources:

1. A funder such as a local government or international organization (the cost of the rapid assessment is estimated at 15,000 USD)
2. A research organization/university or local hospital with basic lab facilities, that has or can procure necessary supplies for detecting *E. coli* (including an incubator and a membrane filtration manifold), and has experience with sterile techniques and membrane filtration. For a detailed checklist of environmental sampling supplies and equipment see **Appendix 4**.
3. Teams preferably with the manpower for and prior experience with conducting surveys
4. Community-Based Organization(s) (CBO) to facilitate access to data collection and dissemination



**Figure 3:** The appropriate laboratory equipment is an integral part of the rapid assessment process (Accra, Ghana). See **Appendix 1** for the full requirements.

Before beginning the rapid assessment process, teams should ensure that they can adequately provide the necessary components for the duration of the rapid assessment. See **Appendix 1** for a more detailed list of requirements.

## The Rapid Assessment Process

The SaniPath Rapid Assessment Tool software will have different modules for completion that feed into each other. The modules are sequential and guide the user through the implementation of the rapid assessment along with this manual. The output of each module provides information for the completion of the next module. The first modules assist with the planning of the rapid assessment implementation, and the subsequent modules lead the user through the steps that would take them all the way through analysis of their data and graphical outputs. The modules are dynamic and help to customize the tool for the user's context. Users will be able to print out survey and sample collection forms to use in the

field, and they will input their data into this tool at the end of the day. Each module has the option of downloading and printing a printer-friendly version of its contents when necessary. Below is a list of modules and a brief summary of their contents. *Please note that the software is currently in its pilot version, and there may be some issues that you discover during use. We appreciate your feedback on the tool, and plan to incorporate the feedback as we improve the software.*

### **Planning Module**

The planning module will include guidance on estimating the amount of resources, time, and costs needed to conduct the SaniPath Rapid Assessment Tool.

### **Preliminary Assessment Module**

The preliminary assessment will include a series of questions to identify the priorities of the user, the relevant pathways for the user, and templates to be filled out for key informant interviews and transect walks. Key informant interviews and transect walks will be used to identify sampling locations and prioritize areas for data collection.

### **Surveys Module**

The behavioral survey module will include electronic versions of the behavioral data entry forms to be filled out for surveys (either school survey, community-based survey, or household survey). Printer-friendly versions of the surveys are available for printing and use in the field at this step.

### **Environmental Sampling Module**

The environmental sampling module will include electronic versions of the environmental data entry forms for environmental sample collection and laboratory processing. Printer-friendly versions of the survey are available for printing and for use in the field at this step.

### **Risk Characterization Module**

The risk characterization module will calculate the exposure risk and generate graphs of exposure risk for all pathways of exposure and neighborhoods.

### **Statistics Module**

The summary statistics module provides descriptive statistics in pie charts and histograms to further understand the behavioral and environmental components of risk. This module also provides descriptive statistics of contextual data gathered from the behavioral survey.

### **Raw Data Module**

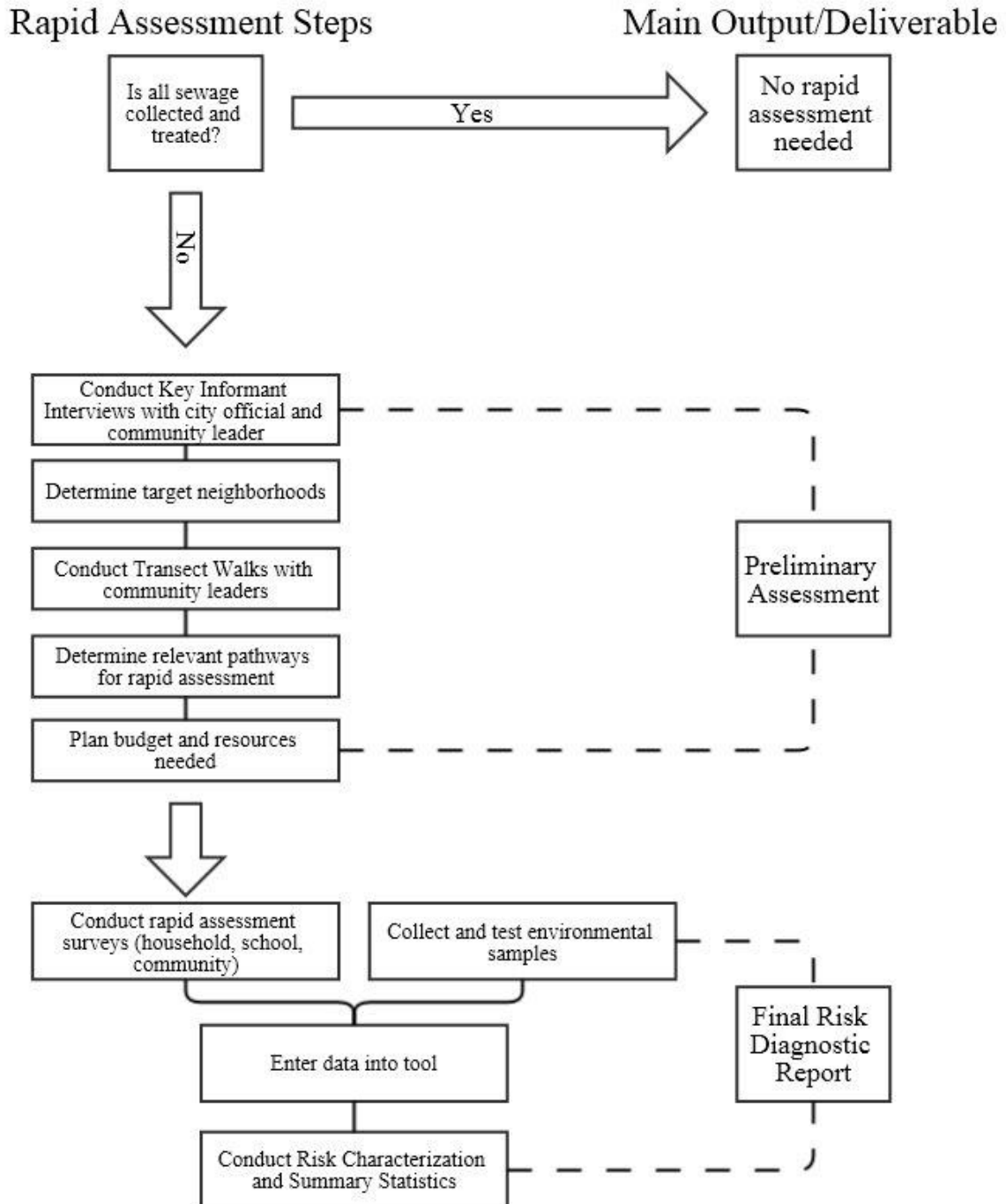
The raw data module allows the user to download .csv files of the raw data from the preliminary assessment, as well as behavioral surveys, and environmental sampling results.

### *Report Module*

The reports module will include concluding remarks as well as further instructions to compile a risk diagnostic report to be used by policy makers.

*The following page shows a flow chart of the rapid assessment process.*

## Flow Chart of Rapid Assessment Process



## General guidance for implementation

### Seasonality

The SaniPath Rapid Assessment Tool is designed to characterize risk due to gaps in the urban sanitation chain. Risk can vary greatly with climate and season, and so the SaniPath team recommends that all data collection for the rapid assessment happen during the region's rainy season.

Previous studies have shown distinct peaks in incidence of diarrheal disease or hospital admittance due to diarrhea that varies with seasonality. These peaks can vary by region as well as with different enteric pathogens (Kotloff 2013). Bacterial diarrhea transmitted as a result of fecal-oral route tends to peak during warmer, rainier months when the high levels of moisture and warmth are favorable for the replication and survival of bacteria. In contrast, viral pathogens that cause diarrhea tend to peak in the colder months. Results from the Mal-ED study in Thailand and a study in Orissa, India have shown associations of temperature and precipitation with the incidence of hospitalization due to diarrhea (Samal 2008, McCormick 2011). In addition, results from the GEMS study in The Gambia, have shown that the rainy season increases total microbial contamination in Gambian sources (Baker 2011).

The SaniPath Rapid Assessment Tool is focused on identifying fecal contamination in environmental samples. As a result, conducting the assessment during the rainy season when fecal bacteria are highest will help best identify and characterize transmission pathways associated with the movement of human feces. The rainy season will highlight both environmental and behavioral influences on risk.

It is important to recognize that choosing to implement the SaniPath Rapid Assessment Tool in the rainy season will produce results that may not be representative of overall risk throughout the year, but will most likely represent the "worst-case" scenario. Should the implementing team decide to implement the tool during a time other than the rainy season, the results may not be the best representation of greatest risk due to fecal contamination.

In addition, conducting the assessment during the rainy season is our best attempt at capturing risk, but there may still be variation in diarrheal seasonality between countries. Literature has shown that seasonal variations are less consistent in tropical climates where there are less pronounced climatic changes. In addition, in some areas, the indirect effects of rainfall may be beneficial as fecal disposal and hygiene practices improve when water is abundant.

### Ethical considerations

Prior to beginning any data collection, be sure to obtain all the necessary permissions to collect samples and survey local people. Often there is an institutional review board (IRB) that must approve survey protocols prior to their implementation. Permissions may need to be obtained at the country, city, neighborhood, or school level. This includes obtaining consent where appropriate. It is important that in carrying out sanitation research that the team is in compliance with local laws. Such actions help the team conduct research in a manner that respects the privacy and safety of participants.

## Planning the Rapid Assessment

The rapid assessment should be completed in a short period of time. We recommend allowing 1-2 weeks for training and planning. For behavioral surveys and environmental samplings we recommend



**Figure 4:** School surveys, such as this one in Vellore, India, are one of the three types of surveys used to gather behavioral data for the rapid assessment.

about 2 weeks per neighborhood. This assumes a team of 4 people working full-time on surveys, and a team of 2 working on environmental sampling and laboratory processing. We recommend allowing an additional 2 weeks to wrap up the data analyses and prepare summary reports. The “Planning” module of the SaniPath Rapid Assessment Tool will help the team determine how to schedule time and determine a more specific budget for

the main portion of the assessment. This can be an iterative process if the team has a limited budget—the team may determine that they can conduct more or fewer surveys, collect more or less data, and which of the optional activities they can add or remove.

In order to plan for the preliminary assessment, please refer to the sections on key informant interviews and transect walk, environmental sampling, and sanitation mapping in **Table 1** below in order to understand the resources needed to carry the activities out.



**Software Instructions:** The “Planning” module of the SaniPath Rapid Assessment Tool includes links to “Survey Activities,” “Resource Assessment,” “Resource Output,” and “Budget.”

**Table 1** shows the estimated resources needed for the assessment.

**Table 1 – Planning the Rapid Assessment**

Data Collection Method	Goal	Time Required	Number of People Required	Materials Required (in addition to data collection tools)
<b>Key informant interviews</b>	Identify target neighborhoods & sources of fecal contamination at the city and neighborhood level.	1.5 hr	1-2	-Data recording devices -Discussion venue

Data Collection Method	Goal	Time Required	Number of People Required	Materials Required (in addition to data collection tools)
<b>Transect walk &amp; sanitation mapping</b>	To obtain a general impression of sanitation related risks factors disease in a given neighborhood & to map key locations like drains & flooding areas.	4-8 hr	4 or more	-Optional GPS device (e.g., Garmin) or smartphone with GPS application
<b>Environmental sampling</b>	To measure & map the total amount of fecal <i>E. coli</i> contamination. Key data on conditions in the immediate environment are also recorded to give context to the microbial results.	20-40 minutes per collection; 20 minutes per laboratory processing	1-2 people	-Optional GPS device -Sampling materials (see <b>Appendix 4 &amp; 5</b> ) -Access to basic laboratory <sup>1</sup>
<b>School or community meeting</b>	To collect data on sanitation infrastructure and practices through discussion and voting on key questions as a more expeditious alternative to household surveys.	1-2 hr	2 facilitators per meeting <sup>2</sup>	-Meeting venue -Refreshments -Beans or tokens -Envelopes
<b>Household surveys</b>	To collect data on sanitation infrastructure and practices at the household level	30 minutes per household	1-2 people	- Optional GPS device -Recording device
<b>Drain or flood mapping (optional)</b>	To map and characterize open drains or flood areas in a neighborhood		6 days or less	1 -GPS device - Mapping form -Camera

<sup>1</sup> Basic lab has capacity for detecting *E. coli* including sterile technique, an incubator and membrane filtration facilities

<sup>2</sup>The number of meetings will depend on the desired sample size.



## Part II: The Preliminary Assessment

### Step 1: Choosing target neighborhoods

Target neighborhoods selected for the rapid assessment should be representative of key risk conditions associated with a broken sanitation chain. If neighborhoods have not yet been selected, the city official key informant interviews will help the team to identify low-income areas in the city.

Note: If the implementing team has pre-determined in which neighborhood(s) they will work, this step may be skipped. The name of the neighborhood(s) can be added to the “Neighborhoods” link in the “Preliminary Assessment” module of the SaniPath Rapid Assessment Tool.

The following conditions should be considered to identify and prioritize the target neighborhoods: coastal zones, area with large open drains, areas prone to flooding, squatter settlements, areas with large markets, areas with urban agriculture, areas with primary schools, and areas with highest population density. Depending on the city, the team might also wish to ensure a balance of religious or cultural groups and a mix of socio-economic levels because of the different sanitation and hygienic practices and cultural norms associated with these groups. **Table 2** is an example of how to describe potential target neighborhoods by key risk conditions.

**Table 2 – Example Neighborhood Categorization**

Neighborhood	Religious Group X	Flood Prone	Open Drains	Low-income <sup>3</sup>	Coastal	Consume raw produce
Zone A	No	Yes	Yes	Yes	Yes	Yes
Zone B	No	Yes	No	No	No	No
Zone C	No	No	No	Yes	No	No

Once the neighborhoods of concern are identified, the rapid assessment team should determine how many of those neighborhoods can be included in the rapid assessment based on available time and resources.

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<sup>3</sup> It is likely that all target neighborhoods will be low-income areas. However, the government acknowledges some while others are considered “illegal.”



**Software Instructions: The “Preliminary Assessment” module of the SaniPath Rapid Assessment Tool includes a link to “Neighborhoods” where neighborhoods can be added or deleted based on the number of neighborhoods indicated in the “Planning” module.**

## Step 2: Interviewing key informants

As a part of the preliminary assessment necessary to move forward with the SaniPath Rapid Assessment Tool, a series of key informant interviews are recommended. If the implementing organization does not already have target neighborhoods in mind, we recommend starting with an interview with a city official in order to identify potential target neighborhoods. After identifying potential target neighborhoods, we recommend key informant interviews with community leaders along with a transect walk in each target neighborhood in order to better characterize them.

The goal of key informant interviews is to identify target neighborhoods and potential sources of fecal contamination at the city and neighborhood level. If the target neighborhoods are not predetermined, it is ideal to interview a city official first in order to identify key areas of interest. To identify city officials or key informants to interview, the rapid assessment team should consider:

- Who is making sanitation policy and/or investments at the city level? It is possible that a donor organization could plan an urban area without government involvement?
- Who manages the budgets and is responsible for implementing such policies and/or investments?
- Who is advising sanitation policy?
- Who is focused on low-income urban neighborhoods? Insecure land tenure and lack of government approval for sanitation investments in unplanned settlements can be major roadblocks to sanitation improvements.

Key informants might include representatives of City Department of Engineering / Infrastructure or Department of Water Resources, Work & Housing, or Public Health. Supplemental information might be obtained from CBOs or NGOs that focus on hygiene or that work on slum-dwellers’ rights or housing. There is no suggested number of key informants to interview; the team will have to determine whether they have obtained enough information to move forward with the rapid assessment process.

The interview with the community leader(s) is intended to identify the characteristics, amenities, and main problems of the neighborhood. It allows more detailed comparison to other neighborhoods to plan survey activities and environmental sampling. There are two components of the meeting with the community leader: (1) an interview and (2) a transect walk through the neighborhood. The key informant interview/transect walk should take place in every neighborhood targeted for the rapid assessment. Collected data will be used to inform the pathways to be included in the rapid assessment.

The interview at the neighborhood level should be conducted with a person who is a recognized community leader in the neighborhood. This may be the leader of a neighborhood association, the CBO

leader, the chief, or the chief's assistant. The participant must be a resident of the neighborhood and be knowledgeable about the local community.

It is likely that enumerators will be meeting with key informants in their offices. Each interview should take approximately 2 hours. An overview, a script, and a data recording form for the key informant interviews can be found under the "Download Forms" link. Please ask these questions exactly as written in the script that will be generated by the SaniPath Rapid Assessment Tool (with clarification if necessary). What the team learns in the key informant interviews will be combined with observations from the transect walk to select pathways of exposure for the rapid assessment.



**Software Instructions: The "Preliminary Assessment" module of the SaniPath Rapid Assessment Tool includes links to "Download Forms" where overviews, scripts, and forms for Key Informant Interviews can be printed. There are links to "City Key Informant Interviews" and "Community Leader Key Informant Interviews" where results from the interviews can be recorded. The "Local Terminology" link should be completed prior to key informant interviews to ensure the forms and questions are specific and applicable to the given neighborhood.**

### Step 3: Performing transect walks

The purpose of the transect walk is to identify key locations within each target neighborhood where people could potentially come into contact with fecal matter. The transect walk can also be used to construct a neighborhood map if a map is unavailable. This is done by taking the GPS coordinates of the community boundary and other key points during the transect walk.

An interview with a key informant - such as a community leader or local government official - is required before a transect walk is undertaken. The rapid assessment team member should invite the key informant to join him or her on the walk through the target neighborhood. This can take about an hour or more, depending on the size of the neighborhood.

The transect walk should include visits to the following sites:

- Public toilet(s)
- Open defecation area(s)
- Open drain(s)
- Waste disposal site(s)
- Flood area(s)
- Market(s)
- School(s)
- Community center(s)
- Houses of Worship (i.e. Churches, Mosques, Temples)
- Food vending area(s)



**Figure 5:** Visits to public latrines should be included in the transect walk (Accra, Ghana).

- Public tap(s)
- Ocean/surface water area(s)
- Any additional sites identified by the key informant as locations where people could come into contact with fecal matter

Basic guidance for collecting GPS points can be found in **Appendix 7**.



**Software Instructions:** Before beginning the transect walks, input basic information into the “Transect Walks” link in the “Preliminary Assessment” module and print the Transect Walk Script and Data Entry Forms document from the “Download Forms” link. There are links to “Transect Walk Observation Checklists” and “Transect Walk Community Boundary Forms” where results from the transect walks can be recorded.

## Step 4: Selecting relevant pathways

The rapid assessment will result in risk characterization outputs for the following exposure pathways (as relevant for any given neighborhood). Each possible path of exposure shown in **Table 3** is called a pathway in the SaniPath Rapid Assessment Tool, and each will have a separate risk characterization output.

**Table 3 – Risk Characterization Pathways**

Pathway	Type of Exposure
Marine water	Contact
Surface water (Rivers, lakes or ponds)	Contact
Open drains	Contact
Flood water	Contact
Municipal drinking water <sup>4</sup>	Ingestion
Bathing water	Ingestion
Wastewater irrigated produce	Ingestion
Public latrines <sup>5</sup>	Contact
General Public Domain	Contact

You will select risk characterization pathways based on output from the key informant interviews and transect walks through target neighborhoods.

<sup>4</sup> Emphasizing consequences of the broken sanitation chain, rather than poor hygiene.

<sup>5</sup> Risk to the user, not to the surrounding community.



**Software Instructions:** The “Preliminary Assessment” module of the SaniPath Rapid Assessment Tool includes a link to “Module Selection” which will allow the team to determine which pathways of exposure will be considered in the assessment, based on the team’s answers to a series of questions. The pathways can be activated through the survey questions or they can be forced active manually.

## Step 5: Preparing the Preliminary Assessment Report

Data for the report will come from several sources including the key informant interviews, the transect walks, and any maps of target communities.



**Software Instructions:** Under the “Preliminary Assessment” module, is a link to the “Preliminary Assessment Report.” The tool is programmed to produce the tables that will go into the report; however, the rapid assessment team will need to complete the written part of the report.

The report should cover the following topics:

1. An overview of sanitation infrastructure in the city (including both private and public – schools, community facilities, large work places if relevant)
  - a. Summary of key informant interviews: who was interviewed, key findings
  - b. List of neighborhoods where fecal contamination is of concern
  - c. Nature of waste treatment
2. Overview of target communities
  - a. Specify relevant neighborhoods to do the rapid assessment (this will guide sampling, household surveys, community meetings)
  - b. Explanation of how and why target communities were selected
  - c. Description of demographics of each target community
  - d. Describe community based organizations or community leaders who could help with the assessment
3. Observations from transect walk
  - a. Detailed description of the sanitation infrastructure in the target communities
    - i. Public – schools, community facilities, large work places if relevant
    - ii. Private
  - b. Are there any sewage treatment facilities in the city or specific neighborhoods (e.g., settling ponds)?
  - c. Descriptions of behavioral observations for pathways without an environmental microbiology component
    - i. Practices for disposing of sewage (as relevant: description of municipal treatment plant(s), settling ponds, dumping sites, how private latrines are emptied, disposal of children’s feces, etc.)
    - ii. Practices for solid waste management as this relates to human waste (use of polythene bags as toilets, children’s feces in rubbish)
    - iii. Qualitative information on possible human exposures to solid waste

- iv. Flooding (unless by coincidence it is possible to collect flood water samples during the rapid assessment, in which case this would be moved to risk characterization)
4. Define pathways to be considered in assessment and why they were selected
5. Maps of each target community (Optional, see **Appendix 7**)
  - a. Location of key points in community - public and private schools, community facilities, large work places if relevant
  - b. Identify potential places to take environmental samples
  - c. Optional: more detailed mapping of drain networks and flood areas

## Part III: The Rapid Assessment

### Step 6: Conducting surveys

The goal of the survey is to collect data on sanitation infrastructure and practices. The percentages of respondents to each question will be extrapolated to the whole neighborhood.

While we recommend using household surveys for the most comprehensive results, the rapid assessment team can determine based on its goals and available resources whether to conduct surveys in schools, community groups, or at the household level, and how many visits can be accomplished. Pros and cons of each type of survey are summarized in **Table 4**. The team might opt to validate the results of household surveys with a school survey or vice versa.

**Table 4 – Comparison of Survey Methods**

Survey Method	Time to conduct (hours)	Pros	Cons
School group survey	1 – 1.5	<ul style="list-style-type: none"> <li>Likely to obtain information representative of more households more quickly than other methods</li> <li>Inexpensive</li> <li>Classes are already assembled</li> </ul>	<ul style="list-style-type: none"> <li>Children’s answers might not be as reliable as adults</li> <li>Oversampling of children vs. adults</li> </ul>
Community meeting	2 – 3	<ul style="list-style-type: none"> <li>Adults might give more reliable answers than school children</li> </ul>	<ul style="list-style-type: none"> <li>Adults might be more inhibited about personal hygiene questions; however the voting method should offset this bias</li> <li>It might be difficult to get people to come</li> <li>Results will be highly context specific</li> <li>The questions could be confusing</li> <li>More time-consuming than school method and requires two assistants plus facilitator</li> <li>Requires more materials than other methods (beans, envelopes)</li> </ul>
Household survey	.5 per house x number of houses	<ul style="list-style-type: none"> <li>Likely to be most representative</li> </ul>	<ul style="list-style-type: none"> <li>More expensive than other methods</li> <li>Time-consuming</li> <li>Adults might be more inhibited about personal hygiene questions</li> </ul>



**Software Instructions:** Based on the results of the “Planning” module as well as the pathway selections from the “Preliminary Assessment” module, the appropriate survey forms will automatically be generated by the software. The questions are the same for school groups, community meetings, and household surveys; however, the methods will be different. The “Surveys” module of the software contains a “Download Survey Forms” link where survey forms can be printed. Additionally the “Surveys” module contains links to enter data collected during the surveys.

## Guidance for surveys

The guidance in this section is based on the Methodology for Participatory Assessments with Communities developed by the Water and Sanitation Program and IRC (Dayal). If possible, the team should consider the use of visual aids – that is, pictures to represent the questions and the various options for answers – with any of the survey methods. Pictures to be used in the exercises should be drawn by a local illustrator to ensure that they depict local people, culture, and environment. Simple, realistic line drawings work best to help participants focus and to avoid mistakes in interpretation.

The rapid assessment team should be aware of and prepared to deal with factors that might inhibit people’s participation in the behavioral surveys (Dayal). For example, women and girls might hesitate to speak up in front of men in male-dominated cultures. The tool methodology has incorporated ways to maintain anonymity in the community meeting through the envelope voting method; however, if the team believes this will still be a concern, they could have gender-separated sessions.

The presence of authority figures could hinder free expression of other community members; one obvious strategy for dealing with this challenge is to have a team member tactfully remove the authority figure(s) from the scene (Dayal).

## Household surveys

The household survey is the gold standard for rapid assessment, however it is overall more resource and time intensive than conducting school-based or community group-based surveys. Households should be randomly selected if possible. An example of successful random household sampling is given below:

*Households can be randomly sampled by dividing neighborhoods into segments based on a map of the neighborhood (obtained either from a key informant or through optional geospatial data collection). Enumerators may work in pairs to randomly select a compound at the edge of their segment, administer the questionnaire, and then move at an interval of eight households counting both sides of the street/alley to obtain the next house for interview. If the household approached does not want to participate in the survey, then the next house is approached (and so on, etc.) until a survey interview is successfully conducted.*

Implementing teams should feel free to adapt the above sampling methodology for their context. There are a variety of other random sampling methods that the implementing teams may want to consider researching as well.



When conducting the household survey, ask to speak to an adult who manages water in the household. If the person is not available, then move to the next household. If resources are available, collect GPS data at each household and record them on a separate form.



**Software Instructions: Data entry forms for household surveys can be found in the “Surveys” module under the “Download Survey Forms” link of the SaniPath Rapid Assessment Tool.**

## School survey method

We recommend that the team select fourth grade classes to interview for the school group survey method. Students in fourth grade are typically 10-12 years old, which is old enough to understand the questions but not old enough to be inhibited about sensitive questions about sanitation and hygiene practices. If resources allow, we recommend that the rapid assessment team visit all of the fourth grade classes in the target neighborhood. If resources are limited, the team should interview at least one class per target neighborhood. When planning visits, the team should consider school schedules and public holidays. Informed consent should be obtained from school authorities prior to the survey (a community leader or CBO should assist with this).

The school survey method is a rapid way to obtain behavioral information for a large number of households in the target neighborhood. The actual survey questions the team asks will depend on pathways identified as relevant in the Preliminary Assessment. It is important to note the number of respondents to each question (using the scoring sheet provided by the SaniPath Rapid Assessment Tool) because these will be used to extrapolate the exposed population in the neighborhood.



**Figure 6:** Preparing the students for the school survey (Accra, Ghana).

To avoid the children answering solely according to their peers and to help them feel less inhibited about answering some sensitive questions, the facilitator might want to ask the students to put their heads down on their desks during the survey. This way, the students are discouraged from seeing how their fellow students are answering. The facilitator will ask each question and give the possible options for answers. Then the facilitator will ask the students to raise their hands for the relevant answer. The facilitator should have an assistant to count and record the number of hands raised for each answer on

the score sheet generated by the SaniPath Rapid Assessment Tool. If it is appropriate, the team should plan to bring light refreshments to the class.

If students are getting easily confused or voting for more than one answer per question, the rapid assessment team can pass out marbles to each student before each question. By having to hand over their marble when they vote “yes,” students will only be able to vote for one answer choice per question. See **Appendix 3** for more details about this voting method.



**Figure 7:** During school surveys in Vellore, India, students can be seen with their heads down handing over marbles when casting their vote to prevent answering more than once.



**Software Instructions:** Data entry forms for school surveys can be printed from the “Surveys” module under the “Download Survey Forms” link in the SaniPath Rapid Assessment Tool.

## Community survey method

The rapid assessment team should work with a CBO to identify potential community groups within each target neighborhood to survey. Ideally the team would ask to be allowed to survey a group that already meets regularly, such as a parent-teacher association, or at a church or mosque. At least one community group per target neighborhood should be selected.

If the rapid assessment team is planning to do the survey as part of a regularly scheduled meeting it should be made clear to the organizer and participants when the survey will be done – before or after – and how long it will take. This method is ideal because the team will not have to find a meeting location. Otherwise, the team should work with a CBO or local leader who can help get people to come to the meeting. If it is appropriate, the team should plan to bring light refreshments to the meeting.

The number of community meetings the rapid assessment team is able to conduct will depend on the time and resources available. The team should assemble at least 15 community members per meeting. A smaller group will not be representative so the team should postpone or cancel the meeting until more participants can be located. Because of the time involved in distributing and passing envelopes for the button voting method, 20 participants should be the maximum. The meetings should be conducted in the relevant local language. Therefore if translation is needed, that should be planned for prior to data collection.

Since the questions in the survey cover personal hygiene, participants might consider them sensitive. The community survey method allows participants to vote anonymously with buttons or other tokens in an envelope (method detailed in **Appendix 3**). The privacy offered by this method can ensure more honest answers (Dayal). This method should work well with various types of participants even if they are not literate or well educated. However, using visual aids will enhance the process. If visual aids are required, it is the responsibility of the implementing organization to work with local artists to produce culturally relevant illustrations to accompany questions. If available, monetary incentives could be offered as an option to subsidize hours spent in the community survey. This may encourage more participants to attend and stay for the length of the survey since the time spent at the survey is time that could have been used to earn money elsewhere.



**Software Instructions: Data entry forms for community surveys can be printed from the “Surveys” module under the “Download Survey Forms” link of the SaniPath Rapid Assessment Tool.**

## Step 7: Collecting and analyzing environmental samples

The rapid assessment team will collect environmental samples. The purpose of the environmental sampling is to identify which areas in the urban environment have fecal contamination and determine the magnitude of that contamination. The focus of the sampling is the public domain that would be affected by sanitation infrastructure changes. If the team has enough staff, this can be done at the same time as the surveys. Another option is to have a laboratory collect and analyze the samples. When planning logistics for sampling, the rapid assessment team needs to consider traffic patterns, typical working days, safety, when the laboratories are open, etc. Sampling can also be used as an opportunity to collect optional GPS data at the site of each sampling to use in conjunction with the environmental samples to develop a contamination map.



**Figure 8:** The rapid assessment team in Vellore, India collects samples from an open drain.

Sites for environmental sampling should be identified based primarily on prior transect walk visits in a neighborhood and information culled from key informant interviews.

**Table 5** shows the types of samples to be collected from the selected target neighborhoods based on the pathways selected for this assessment.

**Table 5 - Types of samples to be collected**

Pathways	Type of Sample(s) to be Collected
Marine water	Marine water and sand along the beach, particulate
Surface Water (River, lake, or pond water)	Surface water and soil along the surface water
Produce	Produce that might be irrigated by wastewater and eaten raw
General public domain	Soil
Public latrine	Swabs of the latrine walls, seat, floor, and door
Public taps	Piped drinking water
Other water source	Bathing water (if other than from public taps or surface water)
Public drains	Drain water and soil sediments

After identification of these sites, a daily sampling plan should be designed to enable the field team to efficiently collect samples for laboratory processing. The sampling plan should be based on the capacity of the laboratory to process samples within the workweek. Typically a laboratory may be able to process samples for only 4 out of a 5 day work week due to laboratory assay processing time. A recommended 80 samples per neighborhood (40 samples per week/10 samples per day) is advised for the SaniPath Rapid Assessment Tool. If two technicians are processing laboratory samples the process can be expedited (80-100 samples per week/20-25 samples per day). **Table 6** shows an example daily sampling plan.



**Figure 9:** The rapid assessment team collects swab samples from latrine walls in Accra, Ghana.

**Table 6 - Example Daily Sampling Plan for Neighborhood X for Week 1 (with one lab technician)**

Monday	Tuesday	Wednesday	Thursday
Produce rinse = 4	Ocean Water = 3	Drain water = 4	Piped drinking water= 5
Piped drinking water = 3	Sand = 2	Soil sediments = 2	Produce rinse =5
Public latrine swabs = 3	Surface water = 3	Public latrine swabs = 4	
	Soil = 2		

Appendix 5 has the protocols for data collection for each type of sample.



**Software Information:** The “Environmental Sampling” module includes a “Downloading Sampling Forms” link where the data collection forms for each type of sample can be printed. This module also contains a “Samples” link where the results of the environmental sampling can be recorded.

## Step 8: Generating risk characterization outputs from the SaniPath Rapid Assessment Tool

The behavioral and environmental microbiology results are then combined using a novel rapid risk assessment method. In the “Risk Characterization” module, the software will automatically conduct all analysis and produce graphical representations of the data. We have developed an analysis method for this risk assessment that uses the raw data collected to create a new variable, dose.

Dose is calculated by using the average contamination level (colony forming units (CFU) of *E. coli* per unit volume) weighted by intake (average unit volume ingested per event). The value for the intake variable is based off of the literature, and is dependent on the exposure pathway (drinking water ingestion, ocean water contact, etc.). Simplified, dose is the number of CFU of *E. coli* ingested per event.

$$Dose = Average Contamination Level \times Intake$$

$$= \left( \frac{CFU \text{ of } E. coli}{unit \text{ volume}} \right) \times \left( \frac{unit \text{ volume}}{event} \right)$$

$$= \frac{CFU \text{ of } E. coli}{event}$$

Average dose serves as one of the two major components of risk, where average frequency of exposure (number of events per unit time) is the other major component. Average frequency of exposure will be calculated from the raw survey data.

$$Risk = \left( \frac{CFU \text{ of } E. coli}{Event} \right) \times \left( \frac{\# \text{ of Events}}{Time} \right)$$

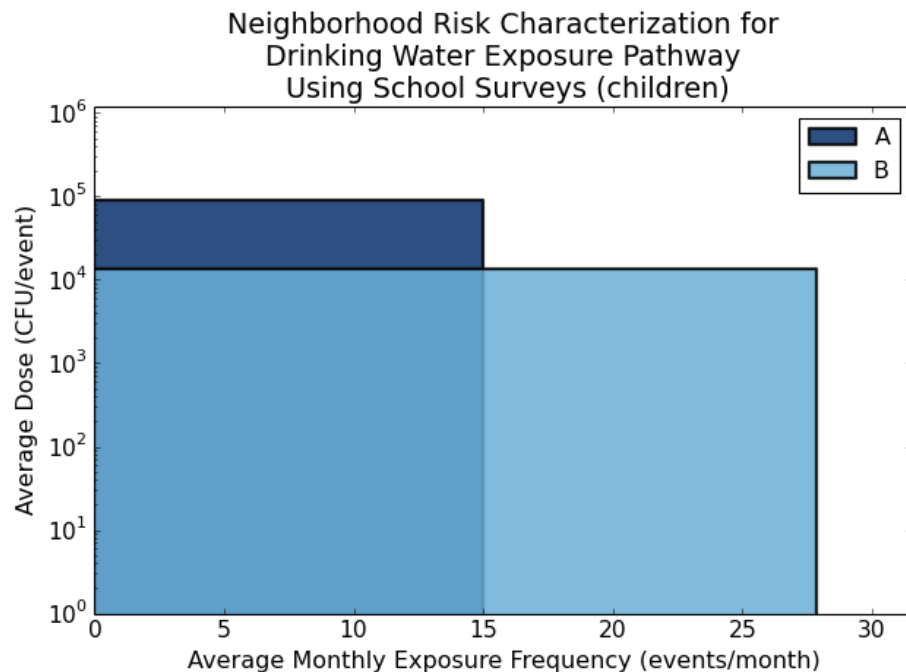
$$= Dose \times Frequency$$

Users can choose to use all survey types or only one selected type. This analysis will identify relative risk scores for each pathway and allow users to understand what components and pathways are contributing the greatest to risk of exposure to fecal contamination. Users will be able to compare pathways of risk, as well as to compare risk across various neighborhoods in a city.

**Figures 10, 11, 12, and 13** show how the results of the risk characterization will be graphically represented. Average Monthly Exposure (events/month) for a specific exposure pathway is plotted against the Average Dose (CFU/event). The resultant area of the boxes is the average number of *E. coli* colonies (CFU of *E. coli*) ingested per month by an average person in each neighborhood. **Figures 10 and**

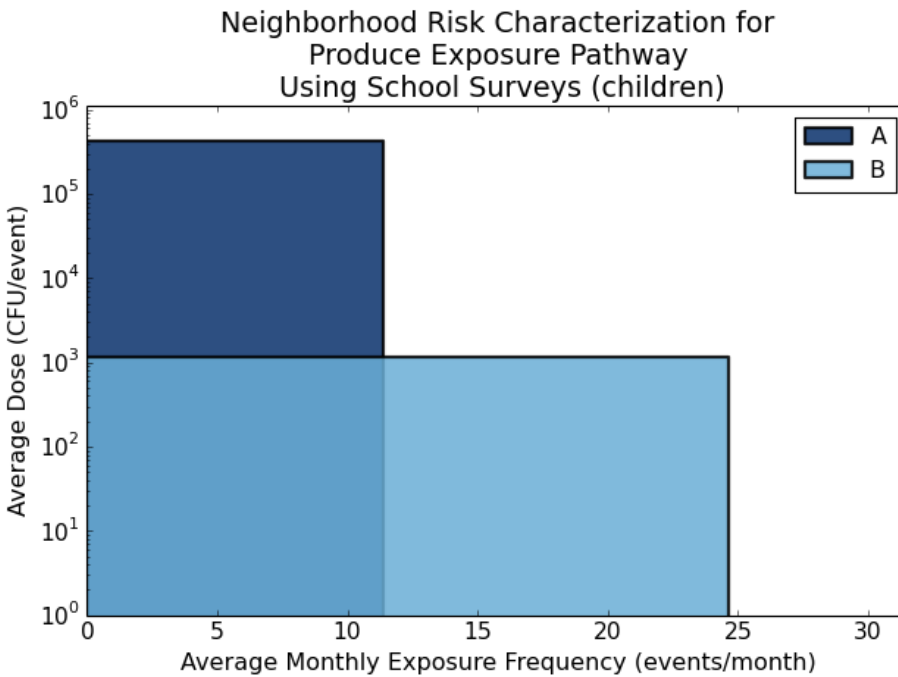
11 have the results grouped by pathway. Therefore, the colors distinguish between the two different neighborhoods being compared. **Figures 12 and 13** have the results grouped by neighborhood. Therefore, the colors distinguish between the different pathways being compared. Results for children and adults are separated into different graphs. **Figures 10-16** below are all results for children.

\*Note: Because the Y-axis of the graph (Average Dose) is represented logarithmically, it important to avoid comparing the absolute sizes of the boxes on the graphs. Instead, the actual numbers can be used for calculations.



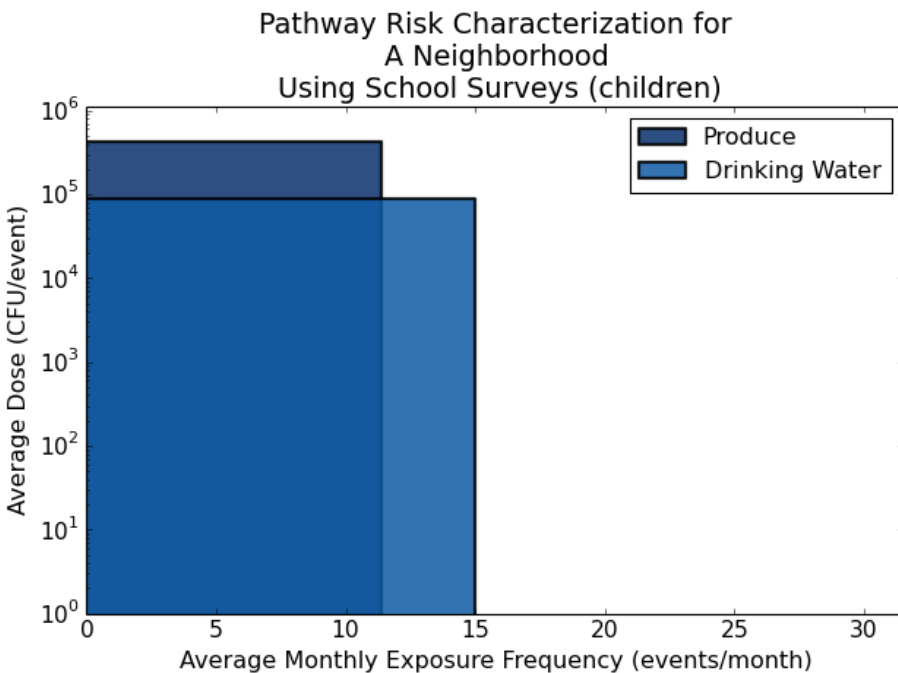
**Figure 10:** The area of each box represents the average number of *E. coli* colonies (CFU *E. coli*) ingested per month by an average child in each neighborhood (A and B) through the consumption of drinking water. This risk characterization uses school surveys for behavioral data and samples of piped water for environmental data.

Drinking Water (Figure 10): After calculating the area of each box, the data indicate that overall, children in Neighborhood A, on average, consume more CFU of *E. coli* per month from drinking water than children in Neighborhood B ( $10^5 \times 15 > 10^4 \times 28$ ). Although children in Neighborhood B are exposed at a higher frequency of events per month, children in Neighborhood A are exposed at a much higher average dose of CFU per event.



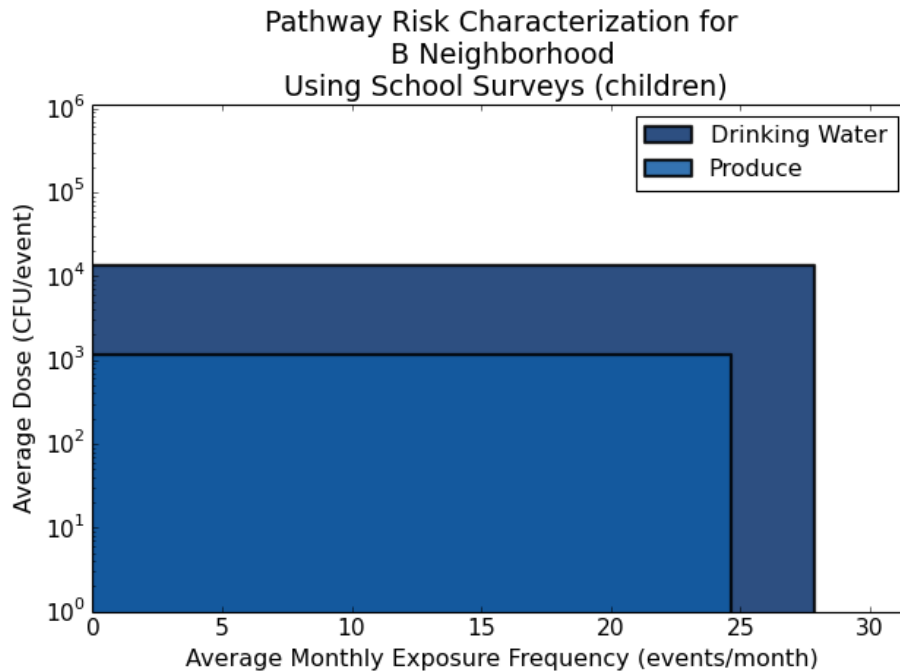
**Figure 11:** The area of each box represents the average number of *E. coli* colonies (CFU *E. coli*) ingested per month by an average child in each neighborhood (A and B) through the consumption of raw produce. This risk characterization uses school surveys for behavioral data and samples of raw produce for environmental data.

**Produce (Figure 11):** After calculating the area of each box, the data indicate that overall, children in neighborhood A, on average, consume more CFU of *E. coli* per month from raw produce than children in Neighborhood B. Although children in Neighborhood B are exposed at a higher frequency of events per month, children in Neighborhood A are exposed at a much higher average dose of CFU per event.



**Figure 12:** The SaniPath Rapid Assessment tool can also calculate risk characterization based on Neighborhood. This graph compares the risk from produce consumption versus drinking water for children in Neighborhood A.

Neighborhood A: While children were, on average, more frequently exposed to drinking water compared to raw produce in Neighborhood A, there is still greater risk from raw produce consumption because of the higher average dose of CFU per event (**Figure 12**).



**Figure 13:** This graph compares the risk from produce consumption versus drinking water for children in Neighborhood B.

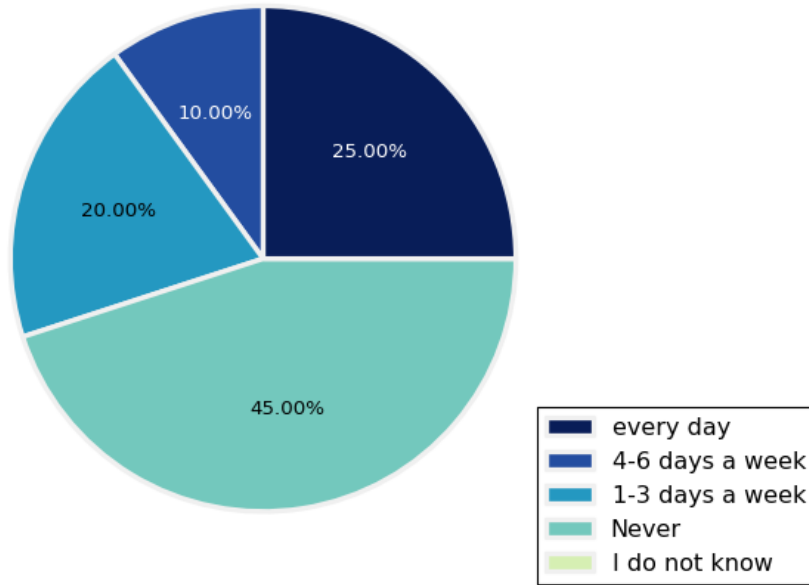
Neighborhood B: Exposure to *E. coli* through consumption of drinking water is a greater concern for children on average in Neighborhood B, both for average dose and average frequency of exposure events per month (**Figure 13**).

### Step 9: Generating summary statistics

The “Statistics” module will present pie charts for all the frequency of exposure questions from the behavioral surveys aggregated across survey types (**Figure 14**). In addition, it will present descriptive statistics in the form of pie charts to all contextual questions from the behavioral surveys which can be separated by survey type (**Figure 15**). Last, it will depict histograms of environmental contamination (**Figure 16**). Each type of statistic and resulting graph is split by neighborhood and into different graphs for children and adults. These statistics are meant to aid the user in better understanding of the individual components of risk of exposure to fecal contamination. The SaniPath Rapid Assessment Tool will automatically conduct all analyses.



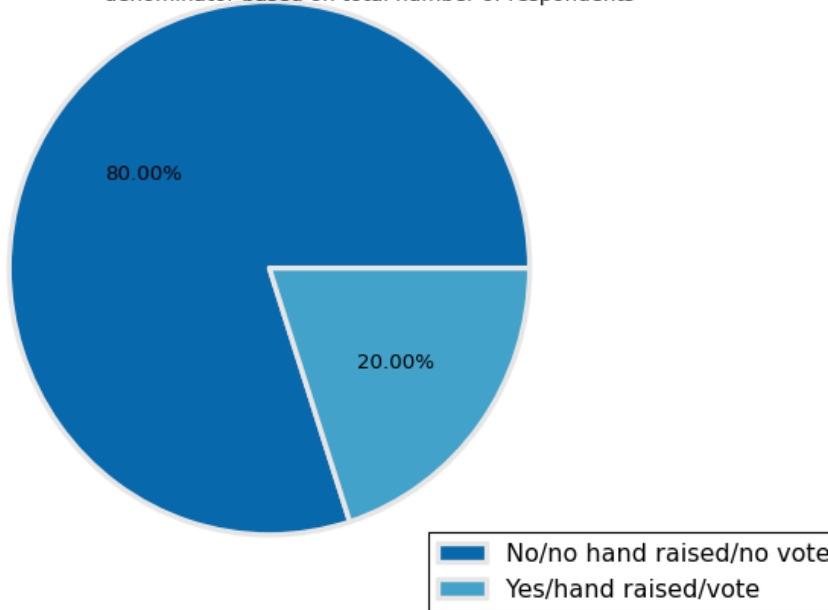
**Frequency of Fruits/Vegetables Contact in A (children)**



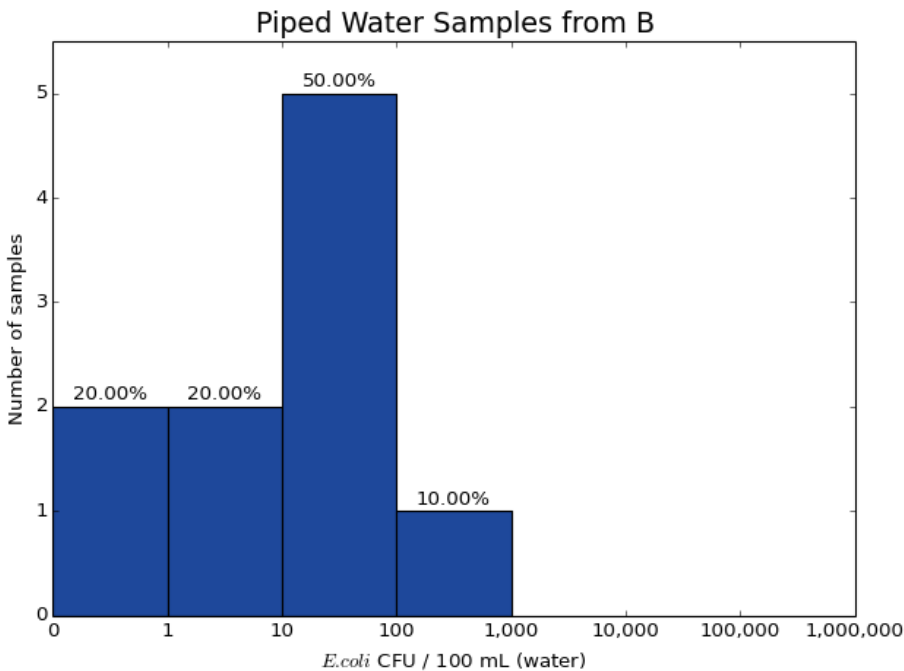
**Figure 14:** The SaniPath Rapid Assessment tool generates pie charts depicting the frequency of exposure for each pathway. This information is based off of behavioral surveys and is used in the overall risk characterization.

11. Does your family regularly treat your water by [boiling, adding chlorine, or using a filter] to make it less cloudy or safer to drink?  
(School survey)

\*denominator based on total number of respondents



**Figure 15:** The SaniPath Rapid Assessment Tool also generates pie charts to represent the contextual questions throughout the behavioral surveys.



**Figure 16:** Lastly, the SaniPath Rapid Assessment tool generates histograms to represent the environmental conditions based off of the environmental sampling completed during the rapid assessment.

### Raw data

The “Raw Data” module will allow the user to download all the data collected as part of the rapid assessment as .csv files. The .csv files can be imported into the program of your choice in order to conduct additional analyses that may not have been done as part of the tool. The various links in this module will allow the user to download an assortment of tables and reports based on your research interests. Although the Raw Data module is designed primarily for users with a programming background, any user can use the raw data to conduct further analysis on a specific data set, or the entire database.

The “Download Database Tables” link allows the user to download individual tables or the entire database. The database downloaded from this link will be a Structured Query Language (SQL) structured database and it contains all of the raw data collected using the software.

The “Download Data Reports” link allows the user to download reports specific to the rapid assessment survey and environmental sampling questions and results. This output is best for analyzing specific aspects of the rapid assessment.

The “Download Key Informant Interviews” link allows the user to download the Key Informant Interviews with City Officials and Community Leaders. The information is downloaded as a PDF document.

## Step 10: Preparing the final risk diagnostic report

Data for the report will come from several sources including the expert interviews, the transect walk and surveys, and the environmental microbiological tests. The SaniPath Rapid Assessment Tool will generate the risk characterizations for each relevant pathway as well as summary statistics to go along with the risk diagnostic report, which you can choose to save and insert into the final report.



**Software Instructions: The “Report” module on the SaniPath Rapid Assessment Tool includes a report outline and instructions. However, the rapid assessment team will need to complete the written part of the report.**

The outline for the report is as follows:

1. Summary of behavioral survey and environmental sampling
  - a. Which survey method(s) was/were used and how many people participated total (600 students, 60 households, 60 community members, etc.)
  - b. If community meetings were conducted, describe the attendees at community meetings (number of male/female attendees, etc.) and where they came from. What was the nature of the meeting? For example: Did the team find young men with no families who happened to be available? Were they at a clinic where there might be only sick people? Were they at a house of worship where the team would only have a segment of the populations? Etc.
  - c. Describe the number of environmental samples collected, where they were collected from (pathways), and how they were processed
  - d. Description of any changes or difficulties in sampling and survey methodology
2. Results of Rapid Tool Analysis
  - a. Contextual information regarding access to clean water and sanitation (as relevant from contextual descriptive statistics: water treatment practices, access to public and private latrines, open defecation practices)
  - b. Risk characterization outputs for each pathway
    - i. Comparison of risks by neighborhood and by pathway (informed by risk assessment outputs)
  - c. If relevant, describe exposure to floods (from flooding behavioral statistics) and soil contamination (from soil environmental statistics contamination levels, relevance of fecal dust to broken sanitation chain)
3. Discussion of risk

- a. Key summary statistics regarding exposure to fecal contamination (from behavioral summary statistics)
    - i. Report behavioral summary statistics for specific components, as they are relevant to how they contribute to risk, or where exposure between adults and children may be different. Note: not all summary statistics generated by the tool need to be used here. The study team should decide which summary statistics are most relevant for their target audience.
  - b. Key summary statistics regarding contamination in the environment (from environmental summary statistics)
    - i. Report environmental summary statistics for specific components, as they are relevant to how they contribute to risk, or where contamination is particularly high or low. Note: not all summary statistics generated by the tool need to be used here. The study team should decide which summary statistics are most relevant for their target audience.
  - c. Summary of risk
    - i. What risks are localized vs. city-wide (e.g., produce)?
    - ii. Which neighborhoods or pathways are priorities?
4. Maps of each target community (Optional)
- a. A map of each target neighborhood with a satellite image (from Google Earth/ArcGIS Explorer) as the backdrop, overlaid with markers for key places such as public toilets, garbage dumps, wastewater dumping sites / settling ponds / treatment facilities, schools, markets, etc., and microbiological data, color coded for risk.
5. Recommendations
- a. For further data collection, if necessary: For example, if surveys or transect walks indicate there is a great deal of flooding in households that could result in exposures to fecal contamination, then the team should recommend further data collection at the household level.
  - b. For next steps: Next steps will be dependent upon the findings of the rapid assessment, the objectives of the study team, and the local context.
6. Risk communication: Consider, who is your audience for dissemination (policy makers, community members, etc.)? What is the best way to deliver the information (through pamphlets, presentations, etc.)? How do you translate your findings into further action? Steps for risk communication will be dependent on the findings of the rapid assessment, the objectives of the study team, and the local context.

## Limitations

The SaniPath team has worked to create a tool that will provide a wide audience with the ability to obtain an evidence base with which to make programmatic and policy decisions regarding sanitation. However, in an effort to strike a balance between tool customizability and quality of information, all the while being cognizant to implementer resources, there are limitations.

1. Context: The tool is designed to be applied in any high-density urban setting; as a result the tool is limited in that it is not tailored to a specific setting. However, the SaniPath Rapid Assessment Tool has been designed to include a large amount of flexibility toward a variety of contexts.
2. Seasonality: Recommendations for the SaniPath Rapid Assessment Tool include conducting the surveys and environmental sampling during the rainy season (usually peak diarrheal disease season) in order to provide a “worst-case” scenario. Therefore, the results from the assessment will not be representative of the average risk over a year. Also it is likely that there may be other factors that contribute to peak diarrheal disease in addition to climate. Despite this, the rainy season will likely provide the best approximation of the “worst-case” scenario, which will be most relevant to decision makers trying to improve sanitation.
3. Focus on Public Sanitation: Due to the heavy resource demands of conducting such research, the tool focuses on sanitation (and the broken sanitation chain) in the public domain. Therefore, the tool does not capture household or individual level information about sanitation and underlying issues such as poor hygiene and water access that may affect a population’s risk. However, this is also appropriate as decision makers have the greatest power in the public domain.
4. Laboratory Technique: Results from the environmental sampling are limited by the ability of the local laboratory technicians to conduct testing in sterile environments with adequate equipment. Efforts have been made to create protocols for simple straightforward laboratory techniques that require minimal troubleshooting.
5. Ability to Provide Recommendations: While the SaniPath Rapid Assessment Tool is able to provide insight into areas of need with respect to sanitation and general ideas for action; it is limited in its ability to provide recommendations. Recommendations for improvement are incredibly context specific and involve greater consideration of cost-tradeoffs and resources that are not captured in the preliminary assessment.

## Appendix 1: SaniPath Rapid Assessment Tool Requirements

1. **Fully define research question**
  - a. What (if any) research has been done in the area?
  - b. What and where are the most pressing concerns?
  - c. Who are the in-country collaborators?
2. **Seek Partners**
  - a. A **funder** that can support the cost of the rapid assessment. The estimated cost for assessing all pathways is 15,000 USD.
    - a. Will the local government or an international organization support the rapid assessment costs?
  - b. Nationally recognized **laboratory** with the capacity to undertake environmental sampling and processing—assess experience and/or ability to undertake membrane filtration
    - a. **Supplies and equipment**
      - i. Does the laboratory have all the equipment needed for sample processing and membrane filtration? If not, what equipment is needed? (See **Appendix 4** for environmental sampling supplies and equipment checklist)
      - ii. What supplies needed for sample processing and membrane filtration can be found locally? What will need to be ordered?
      - iii. Is there a reliable power supply and back-up generators?



**Figure 17:** The SaniPath Rapid Assessment Tool requires laboratories with appropriate materials and capabilities, such as this laboratory in Accra, Ghana.



**b. Staff and budget**

- i. What is the daily salary for lab technicians?
- ii. How many lab technicians are available to work on samples from the rapid assessment?
- iii. What indirect costs does the institution require?
- iv. Determine additional staff training needs if necessary.

**c. Shipping**

- i. Do any samples or laboratory supplies need to be brought in from outside the country?
- ii. How is the customs process? What kind of regulations and taxes might be imposed?

- c. **NGOs or development partners** willing to conduct the rapid assessment in conjunction with the laboratory
    - a. Do they have experienced survey enumerators?
    - b. Do they have enumerators who are experienced in leading group surveys or community meetings?
    - c. Do they have experience working in water and sanitation?
    - d. Do they have connections and experience working in target communities?
    - e. Are they currently available to take on a new project?
      - i. How many would be available?
      - ii. What is their salary?
  - d. Select the **best fit partners** from a. and b. above.
  - e. Schedule a **meeting** with all partners to introduce the SaniPath Rapid Assessment Tool and discuss their roles.
  - f. **Investigate IRB process** now and begin submission procedures.
    - a. Does the IRB only meet certain times of the year? Can our study be added on as an amendment to a current study?
  - g. Collect and document all the **contacts' addresses and key points** that would guide decision making
3. **Study Sites and Data Access**
- a. Determine if a city wide rapid assessment or a preferred target community rapid assessment would be more appropriate.
  - b. Determine the best time for the rapid assessment team to collect environmental samples and conduct surveys.
4. **Contracts with in-country collaborators**
- a. Begin contract talks with partners selected based on availability and appropriate experience
    - a. What is daily salary for staff? What is indirect rate?
    - b. Collect W8-BEN tax forms (if your organization is not US based, there may be other tax forms needed for paying in-country collaborators), physical addresses, and contact information for contracts
    - c. Information for wire-transferring to their account

- b. Check with laboratory and/or partner on the availability for a vehicle for sole study use and note the daily rates/charges.
- c. Finalize contract as soon as practicable.

## Appendix 2: Key Informant Interviews and Transect Walks

### Introduction to Preliminary Assessments

We recommend conducting a series of key informant interviews as a part of the preliminary assessment. Start with an interview with a city official to help identify potential target neighborhoods (if the tool implementer has not already determined target neighborhoods). After interviewing the city official, we recommend key informant interviews with community leaders coupled with a transect walk in each target neighborhood. The transect walk will help to add context, and to characterize the neighborhoods.

### Purpose of the Preliminary Qualitative Assessments

The purpose of these preliminary qualitative assessments is to understand local context regarding sanitation infrastructure and sanitation-related exposures, and to use this knowledge to plan the rapid assessment.

#### The purpose for the city official interview:

- Prioritize neighborhoods for assessment
  - Learn enough about resource-poor areas of the city to select neighborhoods for inclusion in the assessment
- Provide background information regarding sanitation infrastructure and context

#### The purpose for the community leader interview:

- Learn more about specific neighborhoods
- Learn more neighborhood specific information about sanitation related behaviors, exposures, and cultural norms related to water and sanitation.

Both interviews will help select pathways for inclusion in the rapid assessment and inform the background portion of the preliminary assessment report.

#### The purpose for the transect walk:

- Inform the development of an environmental sampling plan
  - Where to sample?
- Inform the sampling scheme of the behavioral exposure surveys
  - How to select households?
- Informing logistical preparation for undertaking the SaniPath Rapid Assessment Tool



**Software Instructions: All materials for the key informant interviews and transect walks can be found in the “Preliminary Assessment” module of the SaniPath Rapid Assessment Tool.**



## Appendix 3: Survey Methods

### Introduction

Before you begin collecting behavioral data, be sure that you have thoroughly read the rest of the SaniPath Rapid Assessment Tool manual and completed the first two modules of the software (Planning and Preliminary Assessment). The “Planning” module of the software should have automatically generated the survey forms based on the method chosen by your team (school, community, and/or household). The forms will automatically only include questions and definitions relevant to your city based on your answers in the software. Please also refer to the manual for guidance on selecting households/schools/community groups to survey. Be sure to print the suggested number of copies of your surveys (and some extra) prior to going into the field.

Make sure that your enumerators have received adequate training on the survey instructions, and that everyone understands their role in the data collection process. Transportation, refreshments, and other materials that may be needed should be arranged in advance. In addition, make sure that you have consulted the appropriate authorities and ethical bureaus to administer surveys.

### General Guidance and Tips

The guidance in this section is based on the Methodology for Participatory Assessments with Communities developed by the Water and Sanitation Program and IRC (Dayal).

1. It is recommended that the implementation of surveys take place in the rainy season to best be able to characterize “worst-case scenario” risk. Please refer to the section on the seasonality in the SaniPath Rapid Assessment Tool manual.
2. Where appropriate, the team should consider the use of visual aids – that is, pictures to represent the various options for answers. Simple pictures to be used in the exercises should be drawn by a local illustrator to ensure that they depict local people, culture, and environment. Visual aids are not provided in the tool and are the responsibility of the implementing organization.
3. The rapid assessment team should be aware of and prepare to deal with factors that might inhibit people’s participation in the behavioral surveys (Dayal). For example, women and girls might hesitate to speak up in front of men in male-dominated cultures. The anonymity built into the community button voting method might mitigate some of the women’s concerns; however, if this is a concern, the team can consider having gender-separated sessions.
4. The presence of authority figures could hinder free expression of other community members; one strategy for dealing with this challenge is to have a team member tactfully remove the authority figure(s) from the scene (Dayal).

## Household Survey Method

If the time and resources are available, a household survey should be completed because it is the most representative type of survey. Once more, the tool would generate survey forms for the implementing team. In the target neighborhood, choose households randomly. Ask to speak to an adult who manages water in the household. If the person is not available, then move to the next household. Introduce the rapid assessment team and explain the purpose of the rapid assessment. Let them know the process will take about 30 minutes. A suggested introduction is below:

*My name is \_\_\_\_\_ and my teammates here are \_\_\_\_\_ and \_\_\_\_\_. Thank you for agreeing to help us with our rapid assessment of fecal contamination in your neighborhood. We are doing this assessment in \_\_\_\_\_ other neighborhoods around the city. The results will be shared with [the organization you are doing the assessment for]. The results of this assessment will be used to make improvements around the city [or other use; explain] so it's in your best interest to answer the questions candidly. Please answer the questions as best as you can. We will not record your name with the results. We may take down the location of your house, but it will not be used outside of this project. The process will take about 30 minutes. We know that some of these questions are sensitive, but we encourage you to be honest.*

If it is possible to collect GPS points at each house, these should be recorded on each household survey.



**Software Instructions: All materials for the school, community, and household surveys can be found in the “Surveys” module of the SaniPath Rapid Assessment Tool.**

## School Survey Method

The school survey method is a rapid way to obtain behavioral information for a large number of households in the target neighborhood.

Fourth grade classes (or students between the ages of 10-12) are recommended for the school-based surveys.

Students in in this age group are typically old enough to understand the questions, but perhaps not old enough to be inhibited about sensitive questions regarding sanitation and hygiene practices. We recommend that the rapid assessment team visit all of the fourth grade classes in the target neighborhood, if resources are available. However, if not, the team should interview at least one class per target neighborhood. Class sizes may vary depending on the school, so in some case

implementers may consider sampling a subset of 20-30 students so that the data collection is not overwhelming. Consider school schedules and public holidays when planning visits. Informed consent should be obtained from school authorities prior to the survey (a community leader or CBO should assist with this).

### Materials needed for school group surveys

- Refreshments (if appropriate)
- Survey question / scoring sheet (enough for the day's planned class visits)
- Marbles (enough for each student plus some extras)
- Clipboards
- Pens
- Camera (if appropriate)

To avoid the children answering solely according to their peers, and to decrease inhibition in answering sensitive questions, the facilitator should consider asking the students to put their heads down on their desks during the survey. This way, the students will not be able to see how their fellow students are answering. The facilitator will ask each question, give the possible options for answers, and ask the students to raise their hands for the relevant answer. The facilitator should have an assistant to count and record the number of hands raised for each answer on the score sheet generated by the SaniPath Rapid Assessment Tool.

Occasionally, students may vote for multiple options on a single question if they misunderstand the question or are confused by the answer choices. In order to prevent this, we recommend using a token, such as a marble, for children to hand over while voting. When a child raises their hand to vote they should be holding their marble. The enumerators can go around the room and collect the marbles as students vote. If a student raises their hand twice, enumerators would know because they would not have a marble in their hand when voting the second time. In some cases, the team may have to adapt the methodology slightly to fit their context or classroom.



**Figure 18:** A school survey being conducted in Vellore, India. The students have their heads down and marbles in their hands to turn over when casting their one vote.

A suggested introduction is provided below:

*My name is X and my teammates here are \_\_\_\_\_ and \_\_\_\_\_. Thank you for letting us come into your classroom and helping us with our project in your neighborhood. We are trying to understand how clean your neighborhood is and how people get sick. We are doing this assessment in \_\_\_\_\_ other neighborhoods around the city. The results will be shared with [the organization you are doing the assessment for]. We will use your answers to our questions to make improvements around where you live, so the more truthfully you answer the questions, the more we can help your neighborhood! Please answer the questions as best as you*

*can. The process will take about 1 hour today. Please let us know if you have any questions or concerns throughout this process- we will try to make the process fun!*

*We know that it can be tempting to look around and see what your classmates are answering to the questions, but we encourage you to be honest. We ask that you to put your head on the table and close your eyes so that you will be less likely to see how each other vote. If for any reason you do not feel comfortable participating, you may leave the room.*

As mentioned previously, the survey questions asked will depend on pathways identified as relevant in the Preliminary Assessment. Please use the data recording forms from the SaniPath Rapid Assessment Tool to record the survey answers. It is important to note the number of respondents to each question (using the scoring sheet from the SaniPath Rapid Assessment Tool) because these will be used to extrapolate the exposed population in the neighborhood. In addition, in the number missing column, record if a person has left the room for that question.

### Community Survey Method

In addition to school surveys, community surveys can be used. The rapid assessment team should work with a CBO to identify potential community groups within each target neighborhood to survey. Ideally you would ask to be allowed to survey a group that already meets regularly, such as a parent-teacher association or at a church or mosque. Please refer to the main portion of the manual for further guidance on selecting community groups to survey.

If the rapid assessment team is planning to do the survey as part of a regularly scheduled meeting it should be made clear to the organizer and participants when the survey will be done – before or after – and how long it will take. Otherwise the team should work with a CBO or local leader who can help get people to come to a separate meeting. The former method is ideal because the team will not have to find a meeting location.

To encourage participation, the CBO should tell participants about the topic of the meeting (assessing health risks due to fecal contamination in your neighborhood) and let them know that their contribution of time can help improve their family’s health. If available, monetary incentives can be offered for the hours spent in the community survey. This may encourage participants to attend and stay for the length of the survey.

#### **Materials needed for community meetings**

- Refreshments (tea, coffee, soft drinks and snacks)
- Survey question / scoring sheet (enough for the day’s group visits)
- Large envelopes for each answer option
- Smaller envelopes for each participant’s votes
- Paper (with optional pictures) representing each answer taped to envelopes
- Buttons or tokens
- Clipboards
- Pens
- Microphone or megaphone
- Monetary incentives if available

The number of community meetings the rapid assessment team is able to conduct will depend on the time and resources available. At least three community meetings per target neighborhood should be conducted. The team should assemble at least 15 community members. A smaller group will not be representative so in the event of a low turnout, the team should postpone or cancel the meeting until more participants can be located. Because of the time involved in passing envelopes for the button voting method, 20 participants should be the maximum.

The meetings should be conducted in the relevant local language. The facilitator of the meeting should be supported by at least one other team member who can record the answers on the score sheets and help with refreshments. Efforts should be made to ensure the poorer or female community members participate equally. In some contexts, the implementers should consider holding separate meetings for men and women if they feel that participation is hampered by presence of the opposite sex. The facilitators should note on the bottom of the form their feelings on the credibility of the data. Did all participants take the survey seriously and seem to answer truthfully? Did any individuals seem to be inhibited and why? (Dayal)

The button voting method has been developed based on community participatory assessment. It should work well with various types of participants even if they are not literate or well educated. Using visual aids will enhance the process. Since the questions in the survey cover personal hygiene, participants might consider them sensitive. The greater privacy offered by this method can ensure more honest answers (Dayal).



Figure 19: Example envelope for voting. Visual aids, such as pictures, can help prevent confusion.



Figure 20: The rapid assessment team in Vellore, India prepares for a community survey by pre-organizing buttons into small envelopes.

To prepare for the meeting the facilitators should prepare a large envelope for each possible survey answer – either by writing the question and answer on the envelope or – ideally – with a picture (see **Figure 19**). The number of envelopes needed (based on the pathways selected) can be calculated and included in the budget. If all pathways are active for the rapid assessment and each question is asked using the envelope method, the community survey will require a total of 96 large envelopes to account for each answer choice for each question. The survey will require 101 small envelopes **per person**: 30 envelopes with a button and 71 empty envelopes. These envelopes can be grouped before the community survey, as discussed below. The team should plan to bring extra in case any of the envelopes are damaged or if there are more participants than expected.

Before the meeting sets of envelopes should be prepared for each survey question. Each question should have a large envelope for each answer option. Furthermore, for each question there should be corresponding groups of small envelopes for each survey participant; one envelope should have a button in it and the rest should be empty. The buttons should be small enough that they do not show through the envelope, but can be easily felt through the cover. For each question, a set of envelopes will be passed out to each participant after all of the answer choices are read. Each participant should receive one envelope with a button in it and empty envelopes to correspond with the remaining number of answer choices. For example, for a question where participants are asked to choose one answer choice out of four options, each participant will be given four envelopes after all of the answer choices are read: one envelope will have a button in it and the remaining three envelopes will be empty. To reduce bulk or costs, small pieces of paper or disks of cardboard could be used in place of buttons. All tokens should be the same color and size.

Once the participants arrive, the first step for the community meeting is to formally introduce the rapid assessment team and explain the purpose of the rapid assessment. Let them know the process will take about 1.5 hours. Ask the community members to introduce themselves as well, ideally in the format of a quick, culturally appropriate introductory exercise. A suggested introduction is below:

*My name is X and my teammates here are \_\_\_\_\_ and \_\_\_\_\_. Thank you for agreeing to help us with our rapid assessment of fecal contamination in your neighborhood. We are doing this assessment in \_\_\_\_\_ other neighborhoods around the city. The results will be shared with [the organization you are doing the assessment for]. The results of this assessment will be used to make improvements around the city [or other use; explain] so it's in your best interest to answer the questions candidly. Please answer the questions to the best of your ability. The process will take about 1.5 hours today. Please let us know if you have any questions or concerns throughout this process.*

*We know that some of these questions are sensitive, but we encourage you to be honest. The enumerators will not know how you vote because all of the buttons look the same. Your votes will be anonymous with the method we are using.*

Before the survey begins the team should explain how the anonymous voting will occur. The votes will be used to help characterize the risk from potential exposures to fecal contamination. Before each question, each participant will receive a set of envelopes equivalent to the number of possible answer choices. For most questions, the participants are requested to choose one best answer. Thus, the participants will have one envelope with a button already inside of it and empty envelopes for the remaining answer choices. For example, for a question where participants are asked to choose one answer choice out of four options, each participant will be given four envelopes after all of the answer choices are read: one envelope will have a button in it and the remaining three envelopes will be empty.

Once all answer choices have been read and smaller envelope sets have been passed out to each participant, a member of the rapid assessment team should walk around the room with the larger envelope corresponding to each answer choice (labeled with the answer or a picture). This should be done one answer option at a time to decrease confusion.. To vote “yes” for an answer, the participant will place their small envelope containing the button into the larger envelope with the answer or picture that corresponds to them. For the remaining answer choices, the participant would place an empty envelope into the larger envelope to vote “no.” At the end of each question, participants should not have any envelopes left. To ensure that all votes have been cast, the rapid assessment team can count the number of smaller envelopes inside each larger envelope. The facilitator should not move on to the next question until it is confirmed that everyone has answered.

This system of pre-inserting buttons into the envelope will remove the possibility that participants will see and be influenced by how others are voting. Because a new set of envelopes will be given out for each question, this system also ensures that people will only vote “yes” for one answer choice for a given question. If the participant uses their one envelope with a button, they will only have blank envelopes for the remaining answer choices.

When the rapid assessment team comes to a question where the respondents are allowed to choose more than one answer (“select all that apply”) the envelope distribution will vary slightly. Participants should receive enough envelopes with buttons to vote “yes” for each answer option as well as enough empty envelopes to vote “no” for each answer option. For example, if there are five answer options where the participant is told to “select all that apply,” each participant should receive a total of ten envelopes: five envelopes with buttons and five empty envelopes.

The facilitator should ask warm-up questions (provided) to help the participants become familiar with the button voting process. Before moving on to the main survey questions, the facilitator might want to compare the votes for the number of men and women to the actual number of men and women in the room to verify that the participants understand the process. This should be confirmed again at the end of the survey to account for any participants who may have left.

At the end of the process, before leaving the meeting room, it is important to carefully count the buttons from each envelope and record these on the score sheet – along with the total number of participants, male and female – because these will be used to extrapolate the exposed population in the

neighborhood. If there is time, the results could be tallied and shared with the whole group to promote transparency and as a way of verifying that the participants understood the voting process and that they answered honestly. For example, the participants might say that they do know that open defecation happens in their neighborhood even though no one voted for the open defecation answer.

Please use the data recording forms that can be downloaded from the software to record the survey answers. It is important to note the number of respondents to each question (using the scoring sheet provided) because these will be used to extrapolate the exposed population in the neighborhood. In addition, in the number missing column, record if a person has left the room for that question.



## Appendix 4: Environmental Sampling Supplies and Equipment Checklist

Please check if the following supplies are available, and if not, if it can be obtained in-country. Manufacturer names and product numbers are provided in certain instances.

Item	Manufacturer	Product #	Availability (Yes/Can be ordered/No)
<b><i>For Sample Collection</i></b>			
Whirl-Pak Bags with Sodium Thiosulfate (100mL)	Nasco	B01040WA	
Whirl-Pak Bags (100 mL, 2L)	Nasco	B01062WA (100mL) B01323WA (2L)	
EnviroMax Swabs	Puritan Medical Products	25-88050-PF-RND	
Metal Spatula/Spoon			
Colorimeter			
Ice Chest (Thermacool boxes) with handles			
Ice Packs			
<b><i>For Membrane Filtration Method</i></b>			
Membrane Filter Absorbent Pads	Millipore	AP10045S0	
Membrane Filters	Millipore	HAW6047S6	
Membrane Filtration Apparatus			
Petri Dishes			
M-Coli Blue	Hach	2608442	

<b>For IDEXX Method</b>			
IDEXX Sealer	IDEXX	99-10896-010	
IDEXX Trays	IDEXX	WQTSRBR-2K	
IDEXX Collilert	IDEXX	WP200I	
<b>General Lab Consumables/Equipment</b>			
Pipette Tips			
Gloves			
70% Ethanol			
90% Ethanol			
Conical (Falcon) Tubes (15mL, 50mL)			
500mL Nalgene Bottles			
Racks for Whirl-Pack Bags			
Pipette holders			
10mL Pasteur Pipette or other disposable pipette			
NaOH			
pH strips			
1mL pipette			
Calibrated Pipetmen (0.1mL capacity)			
PBS (Phosphate Buffered Saline)			
PBST (Phosphate Buffered Saline with Tween-80)			

Incubator (37° C)			
Weight scale (balance)			
Refrigerator			
Vortex			

## Appendix 5: Standard Operating Procedures for Environmental Sampling

### Summary

These protocols provide instruction for sterile collection of piped drinking water, ocean or surface water, drains or flooded areas, soil, sand, sediments, swabs of public latrine environments and produce (fruits and vegetables) from markets that are eaten raw. Methods are designed to collect samples for microbial analysis to detect possible fecal contamination in these environments.

### Sample collection of piped drinking water or bathing water

The following materials and equipment are needed:

1. Gloves
2. Ice chest with frozen ice packs
3. Sterile 100ml Whirl-Pak bags with sodium thiosulfate for chlorinated water samples
4. Sterile 100ml Whirl-Pak bags for non-chlorinated water samples
5. Cotton swabs
6. 70% ethanol
7. Piped or Bathing Water Sample Collection and Processing Form
8. GPS device(optional)
9. Extra batteries for the GPS device
10. Pen
11. Chlorine test kit with test supplies
12. Permanent Marker
13. Clipboard
14. Blank adhesive labels

### Preparation for collecting piped drinking water or bathing water sample

The day before fieldwork, make sure all sampling materials are clean, sterile and of adequate quantity and quality. Generate unique sample identification codes (ID) made up of numbers and letters (ID) that would be used for labeling Sample Collection and Processing Forms, and Whirl Pak bags of samples collected. For example, PPWXXX represents public piped water sample and PBWXXX represents public bathing water. (i.e. the 5<sup>th</sup> public piped water sample collected will be PPW005). Prepare four labels for each unique sample ID using a permanent marker.

- Affix one label to the top leftmost corner of the piped water Data Collection Form.
- Staple the remaining three pre-coded adhesive labels to the piped drinking water Data Collection Form.

If collecting optional GPS data, be sure to read the instructions for operating your device carefully. Be sure to record *all* the numbers in the GPS coordinates.

### Sampling protocol for piped drinking water

1. Retrieve Piped water Sample Collection and Processing Form that has been pre-labeled with a sample ID and confirm that the Sample ID matches the Sample ID on the strip of extra printed labels stapled to the form.
2. Remove a printed label from the strip and affix it to each of the sterile 100ml Whirl-Pak bag.
3. Record the date and time of the sampling location on the space provided on top of the Sample Collection and Processing form.
4. If using the GPS device, record the GPS coordinates and waypoint on **Question 1** of the Sample Collection and Processing form.
5. Check the box for the appropriate neighborhood on **Question 2**.
6. Record any interesting observations or additional information such as the cost per liter for the water (if applicable) in the notes section provided on **Question 3**.
7. Record on **Question 4** the type of source that the piped water or bathing water was collected from. If the type of source is not listed, mark the “other” box and provide a description in the box provided.
8. Put on gloves and spray your hands with 70% ethanol.
9. Spray the cotton wool with 70% ethanol. First sanitize the interior of the mouth to the water source, rubbing the cotton wool in a circular motion around the interior about half a finger deep. Fold the cotton wool so that a new surface is available and spray the cotton wool with more alcohol. Wipe the exterior of the tap water source with the sprayed cotton wool making sure to clean both the tip and outside the tap.
10. If the sample to be collected is municipal provided piped water proceed to step 11. Otherwise proceed to step 15.
11. Turn the tap on and let the water run for about 30 seconds.
12. After 30 seconds, collect a small sample of water into the provided cup for chlorine testing using the chlorine test kit.
13. Close the tap.



Figure 21: A public water source in Vellore, India.

14. Follow the instructions from the chlorine kit to measure the chlorine concentration. Record the total and free chlorine concentration on **Questions 5** on the Sample Collection and Processing Form.
15. Turn the tap on and let the water run for about 30 seconds.
16. Make sure there are tablets of sodium thiosulfate in the 100ml Whirl-Pak bags for all municipal piped drinking water collection samples. Sodium thiosulfate tablets are not needed in the Whirl-Pak bags for non-chlorinated water piped water or bathing water samples.
17. After the 30 seconds, open the labeled Whirl-Pak bag by pulling gently on the tabs on the side of the bag without touching the mouth or inside of the bag. Do not touch the mouth of tap with the bag or your hands. Fill the Whirl-Pak bag carefully through the central opening to slightly above the 100mL mark.
18. Close the Whirl-Pak bag by carefully and quickly rotating the bag, without spilling the sampled water, and then twisting the wire tabs together. Make sure that the bag is completely closed and not leaking (Turn it upside down to check).
19. Confirm that the printed label is still firmly in place and carefully place the Whirl-Pak bag into the ice chest with frozen ice packs.
20. Sign the Sample Collection and Processing Form
21. Transport samples to the lab within 6 hours of collection and deliver samples to one of the designated laboratory personnel.
22. Immediately transfer the sample(s) into a 4°C refrigerator until they are ready to be analyzed. Samples should be stored no longer than 6 hours before analysis.

## Sample collection of sea or surface water

The materials and equipment needed for collecting samples of marine, river, pond, water are below.

1. Gloves
2. Ice chest with frozen ice packs
3. Sterile 100mL Whirl-Pak bags
4. 70% ethanol
5. Sea, or Surface Water Data Collection Form
6. GPS device (optional)
7. Extra batteries for the GPS device (optional)
8. Pen
9. Permanent Marker
10. Clipboard
11. Blank adhesive labels
12. Wader Boots (optional but recommended)
13. Sterile Bucket/Pail (8-10 liter capacity)

## Preparation for collecting surface water samples

The day before fieldwork, make sure all sampling materials are clean, sterile and of adequate quantity and. Generate unique sample identification codes (IDs) for labeling Data Collection Forms, and Whirl-Pak bags of samples collected. For example, MW11 represents marine water (MW) sample 1 from neighborhood 1. Prepare four labels for each unique sample ID using a permanent marker.

- Affix one label to the top leftmost corner of the Surface Water Data Collection Form.
- Staple the remaining three pre-coded adhesive labels to the Surface Water Data Collection Form.

If collecting optional GPS data, be sure to read the instructions for operating your device carefully.

## Sampling protocol for surface water

1. Retrieve a Piped, Sea, or Surface Water Sample Collection and Processing Form that has been pre-labeled with a Sample ID and confirm that the Sample ID matches the Sample ID on the strip of extra printed labels stapled to the form.
2. Remove a printed label from the strip and affix it to a clean, sterile 100mL Whirl-Pak bag.
3. Record the date and time of the sampling location on the space provided on top of the Sample Collection and Processing Form.
4. If using the optional GPS device, record the GPS coordinates and waypoint on **Question 1** of the Sample Collection and Processing form.
5. Record the name of the neighborhood on **Question 2**.
6. Record the type of water sample being collected (Sea or surface water) on **Question 3**.
7. If the sample is sea water, record on **Question 4** whether it is from an open sea site or from an inland estuary, inlet, bay or other area.
8. Put on the wader boots and then clean gloves.
9. Use a sterile bucket for collecting the sea/surface water. Wade out into the sea/surface water until the water surface is at least above the knee.
10. Collect some water in the bucket. Swirl the water around to rinse the bucket and then dump the rinse water out.



**Figure 22:** The rapid assessment team in Accra, Ghana collects an ocean water sample.

11. Gently move about 3 meters to the right, taking care to not stir up sand or sediment. Submerge the sterile bucket until it is just under the water surface, and fill it to the top. Make sure to collect the water from the top of the waves to avoid also catching large amounts of sand.
12. Set the bucket on the beach, cover it with a clean lid to protect it from exposure to sunlight and airborne contamination. Then allow the collected water to settle for 5 minutes.
13. Open the labeled Whirl-Pak bag, by pulling gently on the tabs on the side of the bag, without touching the mouth or inside of the bag.
14. Slowly pour the settled water into the 100mL Whirl-Pak bag, being very careful to not agitate the bottom layer of sand. Stop pouring the water when you see sand moving with the water towards the 100 mL Whirl-Pak bag.
15. Fill the Whirl Pak bag carefully to slightly above the 100mL mark.
16. Close the Whirl-Pak bag by carefully and quickly rotating the bag, without spilling the sample, and then twisting the wire tabs together. Make sure that the bag is completely closed and not leaking (Turn it upside down to check).
17. Dump the remaining water and settled sand out of the bucket.
18. Be sure to collect samples for each Whirl-Pak bag from a different sample site.
19. Confirm that the printed labels are still firmly in place and place in the samples in the ice chest with frozen ice packs.
20. Sign the Sample Collection and Processing Form.
21. Transport samples to the lab within 6 hours of collection and deliver samples to one of the designated laboratory personnel.
22. Immediately transfer the sample (s) into a 4°C refrigerator until they are ready to be analyzed. Samples should be stored no longer than 6 hours before analysis

## Sample collection of open drain and flood water

The materials and equipment needed to collect samples from open drains are as follows:

1. Gloves
2. Ice chest with frozen ice packs
3. Sterile 100ml Whirl-Pak bags
4. 70% ethanol
5. Drain or Flood Water Environmental Sample Collection and Processing Form
6. GPS device
7. Extra batteries for the GPS device
8. Sterile hand bailer/bucket with rope
9. Pen
10. Permanent Marker
11. Clipboard
12. Blank adhesive labels
13. Lighter



## Preparation for field work

The day before fieldwork make sure all sampling materials are clean, sterile and of adequate quantity and quality. Generate unique sample identification codes (IDs) for labeling Data Collection Forms, and Whirl-Pak bags of samples collected. For example, PDRXXX, the X represents the sample number (i.e. the 5<sup>th</sup> public drain sample taken will be PDR005). Prepare four labels for each unique sample ID using a permanent marker.

- Affix one label to the top leftmost corner of the drain collection form.
- Staple the remaining three pre-coded adhesive labels to the Drain or Flood Data Collection Form.

If collecting optional GPS data, be sure to read the instructions for operating your device carefully. Be sure to record *all* the numbers in the GPS coordinates.

## Sampling protocol for drain or flood water

1. Retrieve a Drain or Flood Water Sample Collection and Processing Form that has been pre-labeled with a Sample ID and confirm that the Sample ID on the label matches the Sample ID label on the strip of extra printed labels stapled to the form.
2. Remove a printed label from the strip and affix it to the sterile 100ml Whirl-Pak bag.
3. Record the date and time of the sampling location on the space provided on the Sample Collection and Processing Form.
4. If using the optional GPS device, collect and record the GPS coordinates and waypoint on **Question 1** of the Sample Collection and Processing Form.
5. Check the box for the appropriate neighborhood on **Question 2**.
6. Record any interesting observation in the space provided in the notes section.
7. Put on clean gloves, spray them with 70% ethanol, and air dry.
8. Collect the water sample using the sterile hand bailer/bucket on a rope. If the source is shallow and the bailer cannot be submerged, turn the hand bailer/bucket horizontally to fill, but take care to not scoop up sediment or trash in the water.



**Figure 23:** The rapid assessment team in Vellore, India collects a water sample from an open drain.

9. Open the labeled Whirl Pak bag by pulling gently on the tabs on the side of the bag without touching the mouth or inside of the bag.
10. Carefully pour the drain water sample from the bailer into the 100mL labeled Whirl-Pak bag.
11. Close the Whirl-Pak bag by carefully and quickly rotating the bag, without spilling the sample, and then twisting the wire tabs together. Make sure that the bag is completely closed and not leaking (Turn it upside down to check).
12. Confirm that the barcode label is still affixed to the bag. Place the 100mL Whirl-Pak in the cooler with ice packs.
13. Clean the bailer by spraying it with alcohol and then igniting the alcohol with a lighter. Take care to do this well away from any flammable liquids or dry environments that could catch on fire (like grass). Keep hands well away from the mouth of the bucket.
14. Sign the Sample Collection and Processing Form.
15. Transport samples to the lab within 6 hours of collection and deliver samples to one of the designated laboratory personnel.
16. Immediately transfer the sample(s) into a 4°C refrigerator until they are ready to be analyzed. Samples should be stored no longer than 6 hours before analysis.

## Sample Collection of Produce (Fruits and Vegetables)

The materials and equipment needed to collect produce samples are below:

1. Gloves
2. Ice chest with frozen ice packs
3. 70% ethanol
4. Sterile 2liter Whirl-Pak bags
5. Produce Environmental Sample Collection and Processing Form
6. GPS device(optional)
7. Extra batteries for GPS device
8. Pen
9. Permanent Marker
10. Clipboard
11. Blank adhesive labels
12. Money for purchasing produce

## Preparation for field work

The day before fieldwork, make sure all sampling materials are clean, sterile and of adequate quantity and quality. Generate unique sample identification codes (IDs) for labeling Data Collection Forms, and Whirl-Pak bags of samples collected. For example PVGXXX, where X represents the sample number (i.e. the 5<sup>th</sup> public produce sample collected will be PVG005). Prepare four labels for each unique sample ID using a permanent marker.

- Affix one label to the top leftmost corner of the Produce Data Collection form.

- Staple the remaining three pre-coded adhesive labels to the Produce Data collection Form.

If collecting optional GPS device, be sure to read the instructions for operating your device. Be sure to record *all* the numbers in the GPS coordinates.

### Sampling protocol for produce (fruits and vegetables)

1. Retrieve a Produce Sample Collection and Processing Form that has been pre-labeled with a Sample ID and confirm that the Sample ID matches the Sample ID on the printed extra label stapled to the form.
2. Record the date and time of the sampling location on the space provided on top the Sample Collection and processing form.
3. Using the optional GPS device, collect and record the GPS coordinates and waypoint on **Question 1** of the Sample Collection and Processing Form.
4. Check the box for the appropriate neighborhood on **Question 2**.
5. Record any interesting observations on the notes provided on **Question 3**.
6. Open the labeled Whirl-Pak bag by gently pulling out the tabs of the side of the bag without touching the mouth or inside of the bag.
7. Collect the produce sample and indicate the type and number on **Question 4**.
8. If you are selecting produce at a market vendor's stall, carefully open the Whirl-Pak bags without touching the mouth of the bag. Ask the vendor to place the produce in the bag. Quickly close bag.
9. Confirm that the barcode label is still affixed to the bag. Place the Whirl-Pak bag in the ice chest with ice packs.
10. Sign the sample collection and processing form.
11. Transport samples to the lab within 6 hours of collection and deliver samples to one of the designated laboratory personnel.
12. Immediately transfer the sample(s) into a 4°C refrigerator until they are ready to be analyzed. Samples should be stored no longer than 6 hours before analysis.



Figure 24: Produce (fruits/vegetables) for sale in Accra, Ghana.

### Sample Collection of Swabs

Materials and equipment needed for collecting swab samples:

1. Gloves
2. Ice chest with frozen ice packs

3. 70% ethanol
4. Framing square or a ruler with marks at 2.5cm, 5cm, 10cm, and 20cm on each arm.
5. EnviroMax plus Sterile Environmental Sampling Swabs (#25-88050). (or comparable swab)
6. GPS device (optional)
7. Swabs Environmental Sample Collection and Processing Form
8. Extra batteries for GPS device
9. Pen
10. Permanent Marker
11. Clipboard
12. Blank adhesive labels
13. Kitchen paper towel

### Preparation for field work

The day before fieldwork, make sure all sampling materials are clean, sterile and of adequate quantity and quality. Generate unique sample identification codes (IDs) for labeling the Swab Sample Collection and Processing Form and swabs collected. For example, PSWXXX, where the X represents the sample number (i.e. the 5<sup>th</sup> public swab sample collected will be PSW005). Prepare four labels for each unique sample ID using a permanent marker.

- Affix one label to the top leftmost corner of the Swabs sample collection and processing form.
- Staple the remaining three pre-coded adhesive labels to the Swab Sample Collection and Processing form.

If collecting optional GPS data, be sure to read the instructions for operating your device carefully. Be sure to record *all* the numbers in the GPS coordinates.

### Sampling protocol for swab samples

1. Retrieve a Swab Sample Collection and Processing Form that has been pre-labeled with a Sample ID and confirm that the Sample ID matches the Sample ID on the printed extra labels stapled to the form.
2. Record the date and time of the sampling location on the space provided on top of the Sample Collection and Processing Form.
3. If using the optional GPS device, record the GPS coordinates and waypoint on **Question 1**.
4. Check the box for the appropriate neighborhood on **Question 2**.
5. Write the best description that identifies the type of object/s being swabbed in the notes section provided on **Question 3**.
6. Check the best description that identifies the type of latrine on **Question 4**. If “other” specify in the box provided.
7. Rate the amount of visible feces on latrine walls and slabs for the entire latrine block on **Question 5**.

8. Check the appropriate box for the presence/absence of a handwashing station on **Question 6**.
9. If a latrine attendant/owner is present, ask them the average number of daily users at the latrine block. Record the answer on **Question 7**. If you do not know the answer, enter 9999.
10. Remove a printed Sample ID from the strip of labels attached to the Sample Collection and Processing form and affix it lengthwise to the EnviroMax Environmental Sampling tube.
11. Put gloves on clean gloves and spray them with 70% ethanol and then air dry.
12. Sterilize the framing square by spraying it with 70% ethanol and wiping it down with a clean paper towel.
13. Grasp the orange cap of the EnviroMax swab and twist off the lid. DO NOT touch the stem or swab surface or the open mouth of the tube to your gloves or any other object.
  - a. If the item is flat, hold the framing square against the surface and swab an area of at least 5 cm<sup>2</sup> (5cmx5cm) on each arm of the framing square.
  - b. If you are right-handed, start at the bottom right corner of the object and press one side of the swab firmly to the surface. Hold the swab at a slight angle to the object so that the swab surface is in maximal contact with the object but your gloves do not rub against the object (~30° angle). Move the swab from right to left in horizontal lines, overlapping the upper row over the bottom row. At the midway point, turn the swab over and use the opposite side to finish swabbing the upper half of the object. If you are left-handed, swab from left to right starting at the bottom left corner and overlapping rows from bottom to top.
  - c. If the item is small (size of an orange) and round or irregular, then carefully hold the object between two fingertips and swab the entire surface of the object, starting at the point closest to you and swab away from you so that the palm of your hand moves over an area that has already been swabbed. After half of the object has been swabbed, turn the swab over and swab the remaining area with the opposite side.
  - d. If the item is round or irregular, and is larger than a grapefruit or softball but equal to or smaller than a soccer ball, then swab half of the surface area, starting at the point closest to you and work the swab away from you so that the palm of your hand moves over an area that has already been swabbed. After half of the object has been swabbed, turn the swab over and swab the remaining area with the opposite side.
  - e. If the item is not flat, but is larger than a soccer ball, use the framing square to estimate an area of approximately 10 cm by 10 cm and swab the area as instructed in instructions 9a.
14. For public latrines swab a composite of door handles and walls of the latrine.
15. Carefully insert the swab back into the tube and screw the cap on tightly. Confirm that the label is still affixed to the tube.
16. For public latrines swab a composite of door handles and walls of the latrine.
17. Place the swab into the cooler immediately after collection.
18. Sign the Swab Sample Collection and Processing Form.
19. Transport samples to the lab within 6 hours of collection and deliver samples to one of the designated laboratory personnel.

20. Immediately transfer the sample(s) into a 4°C refrigerator until they are ready to be analyzed. Samples should be stored no longer than 6 hours before analysis

## Sample Collection of Soil and Sand

Materials and equipment needed for collecting soil and sand samples:

1. Gloves
2. 70% alcohol
3. Sterile spatula
4. Sterile 100 mL Whirl-Pak bags
5. Ice chest with frozen ice packs
6. GPS device (optional)
7. Soil and Sand Environmental Sample Collection and Processing Form
8. Pen
9. Permanent marker
10. Extra batteries for GPS device (optional)
11. Clipboard
12. Blank adhesive labels

## Preparation for field work

The day before fieldwork make sure all sampling materials are clean, sterile and of adequate quantity and quality. Generate unique sample identification codes (IDs) for labeling Data Collection Forms and Whirl-Pak bags of samples collected. For example, PSLXXX, where the X represents the sample number (i.e. the 5<sup>th</sup> public soil or sand sample collected will be PSL005). Prepare four labels for each unique sample ID using a permanent marker.

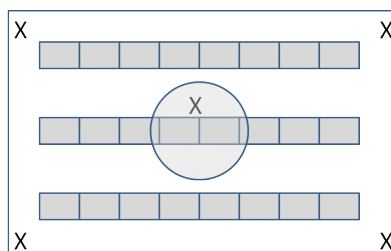
- Affix one label to the top leftmost corner of the Soil or Sand Data Collection Form.
- Staple the remaining three pre-coded adhesive labels to the particulate data collection form.

If collecting optional GPS data, be sure to read the instructions for operating your device carefully. Be sure to record *all* the numbers in the GPS coordinates.

## Sampling protocol for collecting soil and sand samples

1. Retrieve a Soil and Sand Sample Collection and Processing Form that has been pre-labeled with a Sample ID and confirm that the Sample ID matches the Sample ID on the printed extra labels stapled to the form.
2. Record the date and time of the sampling location on the space provided on top of the Sample Collection and Processing Form.
3. If using the optional GPS device, record the GPS coordinates and waypoint on **Question 1**.

4. Check the box for the appropriate neighborhood on **Question 2**.
5. Select the site you will collect samples from. Take precautions to avoid contamination of the samples by not walking through the area.
6. Record any interesting observations on the notes provided on **Question 3**.
7. On **Question 4**, check the appropriate box if the sampling site is:
  - a. Within 3 meters of feces
  - b. Within 30 meters of a latrine or defecation area.
8. On **Question 5**, check if the sample type is soil or sand.
9. On **Question 6** record a description of the location from where the particulate sample was taken.
10. Affix a printed Sample ID from the strip of labels attached to the Sample Collection and Processing Form to a sterile 100mL Whirl-Pak bag.
11. Put on clean gloves and spray them with 70% ethanol.
12. Grasp the end of a sterile spatula, taking care to not touch the tip. Insert the spatula into the soil/sand/sediment at a 45° angle to a depth of 5cm (about half the length of the spatula). If the sample is hard-packed, use the scoop to gently break up the sample at the area before inserting. If the area is so hard packed that the soil/sand/cannot be dislodged, stop attempts to collect a sample at that spot and attempt to find another spot within the sample area.
13. Gradually lift the spatula until it is parallel with the ground. Insert the spatula halfway into the bag and carefully empty the contents into the 100mL Whirl-Pak bag. If some of the sample sticks to the scoop, place your fingers on the outside of the bag and gently press them against the top of the scoop and press downwards until the sample is removed into the bag.
14. Repeat steps 11 to 12, collecting a composite of up to 7 samples. Attempt to collect samples from a variety of locations, including wet soil and dry soil.
15. For beaches, areas near rivers and ponds, drains, public latrines, or any other similar area, a composite should be collected from an area of approximately 3 meters squared.
16. For markets, collect 5 composite samples from a central location, and at each of the boundary corners into the market as indicated in the diagram below



17. Close the Whirl-Pak bags. Confirm that the printed labels are still firmly in place and place the 100 mL sample bag in the cooler with the ice packs.
18. Sign the Soil and Sand Sample Collection and Processing Form
19. Transport samples to the lab within 6 hours of collection and deliver samples to one of the designated laboratory personnel.
20. At the lab, weigh the bag with the sample and record the results on in the laboratory section of the Sample Collection and Processing Form.

21. Immediately transfer the sample(s) into a 4°C refrigerator until they are ready to be analyzed. Samples should be stored no longer than 6 hours before analysis.

### Environmental Sampling Data Collection Forms



**Software Instructions:** Data collection forms for the types of environmental samples listed below can be printed from the “Environmental Sampling” module under the “Download Sampling Forms” link.

- Particulate samples
- Swabs samples
- Produce samples
- Piped Water samples
- Ocean Water samples
- Surface Water samples
- Bathing Water samples
- Drain Water samples



**Figure 25:** Soil samples are collected in Vellore, India.



## Appendix 6: Procedures for Sample Processing and Quantifying *E. coli* contamination

### Processing of drinking water samples

Drinking water samples should have very low levels of contamination but may have some contamination depending on the area. No special handling should be required to prepare samples for microbial assays, but ten-fold or hundred-fold dilutions may be necessary in order for the colonies to be counted. Refer to the section on Dilution Protocols on page 6 and assess whether you have the field or laboratory capabilities to follow these simple protocols. Microbial assays should be conducted with 100 ml, 10 ml, or 1 ml volumes depending on the chosen dilution protocol.

### Processing of non-drinking water samples from oceans, lakes, rivers, and other surface waters

Non-drinking water samples from oceans, lakes, rivers and other surface waters could have moderate to high levels of contamination. Microbial analyses of 100 ml sample volumes will likely result in more colonies than can be counted, but knowing whether contamination exceeds 250 (membrane filtration) or 2419.8 (Colilert and Quantitray 2000) fecal bacteria per 100 ml can still be informative. If possible, we recommend preparing hundred-fold or thousand-fold dilutions for microbial analysis. Refer to the section on Dilution Protocols on page 6 and assess whether you have the field or laboratory capabilities to follow these simple protocols. These protocols are for testing 1 ml and 0.1 ml volumes, which allow you to determine whether concentrations of fecal bacteria exceed 250,000 (membrane filtration) or 2419,800 (Colilert and Quantitray 2000) fecal bacteria per 100 ml. This information may be more meaningful for exposure assessment.

### Processing of non-drinking water samples from drains

Non-drinking water samples from drains are likely to have high levels of contamination. Microbial analyses of 100 ml sample volumes will likely result in more colonies than can be counted, but knowing whether contamination exceeds 250 (membrane filtration) or 2419.8 (Colilert and Quantitray 2000) fecal bacteria per 100 ml can still be informative. If possible, we recommend preparing serial (i.e. back-to-back or consecutive) thousand-fold dilutions for microbial analysis. Refer to the section on Dilution Protocols on page 6 and assess whether you have the field or laboratory capabilities to follow these simple protocols. By testing 100ml and 10ml volumes of the diluted samples, you can determine concentrations of fecal bacteria up to  $2.5 \times 10^9$  (membrane filtration) or  $2.4 \times 10^{10}$  (Colilert and Quantitray 2000) fecal bacteria per 100 ml. This information may be more meaningful for exposure assessment.

## Processing of produce (Fruit or Vegetable) samples

Produce samples could have a wide variety of contamination. However, since produce tends to be consumed in significant quantities (at least one fruit or one vegetable), meaningful information about risk can be obtained from rinsing whole pieces of produce and testing 100 ml volumes of the rinse. For example, a single piece of produce contaminated with more than 100 or 1000 fecal bacteria should be considered high risk and unacceptable. Dilutions can be performed, if desired, using the Dilution Protocols on page 6. The following processing steps will rinse bacterial contamination from the surface of produce items, and estimate the contamination per item.

### Materials and Equipment:

- Sterile (autoclaved or sterile filtered) water or PBST (phosphate buffered saline, pH 7.2 with 0.04% Tween-80)
  - Sterile graduated cylinder that can measure 500 mls
  - Gloves
  - 70% ethanol
  - Felt tip Pen
  - Produce sample in bag
  - 37°C incubator
  - 4°C refrigerator
  - Produce Environmental Sample Collection and Processing Form
1. Put on gloves and spray hands with 70% ethanol. Rub hands together to sanitize all surfaces of the gloves.
  2. Check that the sample ID on the Produce Environmental Sample Collection and Processing Form and the sample are the same. Record the date and time of sample processing on the Produce Environmental Sample Collection and Processing Form.
  3. Prepare your work surface by cleaning it with 70% ethanol.
  4. Samples should arrive at the lab in a large Whirl-Pak bag. Spray the outside of the bag with 70% ethanol and rub it well. Inspect the bag to determine whether liquid can be added without overflowing. The bag should be no more than 2/3rds full with produce. You should be able to add 500 mL of buffer and still close the bag without it overflowing. If you suspect that the bag is too full, open the bag by untwisting the ties and pulling them gently outwards until the mouth of the bag opens. Remove the extra produce items one at a time by pressing upward underneath them on the outside of the bag, and move them to the top, leaving the bag about 2/3rds full of produce. **Never stick your hands into the bag.** Discard the removed produce. Only record the produce remaining in the bag on the Data Recording Form.
  5. Add 500 mL of sterile water or PBST to the bag. Seal the bag, trapping minimal amounts of air inside. Incubate for 10 minutes at 37°C.
  6. Vigorously shake the bag with the produce for 30 seconds. Next gently massage the surface of each piece of produce item through the bag for 60 seconds. For delicate items like lettuce or

- onions, try to rub at least the outer leaves. Try not to break open any items. Shake the bag again for 30 seconds.
7. To remove the produce, open the Whirl-Pak bag, gently press upwards underneath the item and move it to the top. Take care not to lose any water or smash any produce. Remove the produce at the top of the bag and set aside
  8. Close the Whirl-Pak bag.
  9. Weigh the produce and record the weight on a Produce Environmental Sample Collection and Processing Form.
  10. Store all samples at 4°C until they are ready for processing.

## Processing of Swab samples (some laboratory facilities required)

Swab samples could have a wide variety of contamination, due to the effects of sunlight, desiccation, wind, and type of material on bacterial survival. Many samples may have no detectable contamination. This protocol will elute bacteria from a swab used on a specific object or 100 cm<sup>2</sup> surface area. The entire swab elute should be processed for microbial assays. Note that the final volume obtained by this protocol is not 100 mL. If you will be using membrane filtration to count fecal bacteria, this entire volume can be added directly to the filter prior to filtration. If you will use an alternative assay, like the IDEXX Colilert assay, combine the swab elute with 90 mL of water or buffer, as stated in the 1:10 Dilution Protocol on page 6. The resulting bacterial counts will represent the total bacteria per object or surface area.

### Materials and Equipment:

- Sterile water or PBST (phosphate buffered saline, pH 7.2 with 0.04% Tween-80)
  - One 15 ml sterile conical tube
  - Felt tip Pen
  - Gloves
  - 70% ethanol
  - 1-2 sterile 10 ml Pasteur pipets per sample (or other disposable pipet with 10ml capacity)
  - Vortex
  - 4°C refrigerator
  - Pipet Aid
  - Swab Environmental Sample Collection and Processing Form
1. Put on gloves and spray hands with 70% ethanol. Rub hands together to sanitize all surfaces of the gloves.
  2. Check that the sample ID on the swab and the sample ID on the Swab Environmental Sample Collection and Processing Form are the same. Record the sample processing date and time.
  3. Prepare your work surface by cleaning it with 70% ethanol.
  4. Label a sterile 15 ml conical tube or small autoclave-sterilized container with the Sample ID, the date, and your initials.

5. Carefully unscrew the cap of the tube with the swab, taking care not to touch the swab itself, nor any other part of the swab aside from the lid.
6. Using a sterile 10 ml pipet, add 7mls PBST to the swab container, and place the swab back into the tube, screwing the lid down well.
7. Vortex the tube containing the swab for 30 seconds, then incubate for 5 minutes at room temperature and vortex for another 30 seconds.
8. Reopen the swab container and pour the swab elute into the empty labeled 15 ml conical tube.
9. Repeat steps 4 to 7. Press the swab against the side of the tube to squeeze out as much remaining wash solution as possible, and discard the swab. Transfer the second elute solution to the 15 ml conical tube (there should be a total of ~12-14mls of swab elute).
10. Store all samples at 4°C until they are ready for processing.

### Processing of Soil, Sand, Sediment samples (Particulates) (some laboratory facilities required)

Generally, soil, sand and sediment samples are moderately contaminated with fecal bacteria, but some samples will have much higher contamination levels. These samples are rinsed with 20 mL of buffer to wash the bacteria off of the soil particles. We recommend diluting this rinse solution 1:10 and 1:100 prior to filtration or IDEXX testing, using the Dilution Protocols on page 6.

#### Materials and Equipment:

- PBS (phosphate buffered saline, pH 7.2)
- One 50 ml sterile conical tube
- One 15ml sterile conical tube
- Gloves
- 70% ethanol
- Felt tip pen
- Autoclaved metal spatula, or sterile-wrapped disposable spatula
- 1 Autoclave-sterilized graduated cylinder or 10 ml Pasteur pipet per sample
- Pipet or other type of dropper
- 0.1 N NaOH
- pH meter or pH test strips
- Shaker
- Scale
- Vortex
- 4°C refrigerator
- Pipet Aid
- 1 ml pipet
- Particulate Environmental Sample Collection and Processing Form

1. Put on gloves and spray hands with 70% ethanol. Rub hands together to sanitize all surfaces of the gloves. Check that the sample ID on the sample and the sample ID on the Particulate Environmental Sample Collection and Processing Form are the same. Record the date and time of processing.
2. Prepare your work surface by cleaning it with 70% ethanol.
3. Samples should arrive at the lab in a small Whirl-Pak bag. Spray the outside of the bag with 70% ethanol and rub it well.
4. Label the sterile 50 ml conical tube and the 15ml conical tube with the Sample ID on the barcode label of the bag, the date, and your initials.
5. Rotate the Whirl-Pak bag with the sample five times to mix the sample.
6. Using a weighing scale and a sterile spatula, measure 10 grams of sample into the one of the labeled 50 ml tubes. Using a graduated cylinder or pipet, add 20 ml of PBS to the measured sample.
7. Screw the cap on the tube firmly and vortex for 30 seconds, then slowly adjust pH to 9.0 by adding drops of 0.1N NaOH. Test the pH after each series of drops using a pH meter or pH test strips.
8. Shake **vigorously** on a rotator or shaker for 30 minutes at room temperature.
9. Let the sample settle for 30 minutes. With a sterile pipette, carefully remove 12 mL of supernatant from the top and transfer it to the labeled 15 ml tube. Take care to not suck up particulate matter or debris.
10. Store all samples at 4°C until they are ready for processing.

## Dilution Protocols

### Note:

Below, we have provided recommended dilutions for the Rapid Assessment Tool Lab Standard Operating Procedures. We recommend two different dilutions per sample type from either 1:1, 1:10, 1:100 or 1:1000. While these are our recommendations, they may not be the best for your setting. Therefore, we encourage users of this protocol to adapt the dilution methods and use any two of the four dilutions on the lab data entry form for their work. Please use your best judgment.

For all diluted samples, the full 100ml dilution volume will be processed by membrane filtration or IDEXX.

Recommended dilutions by sample type:

Sample Type	Dilution 1	Dilution 2
Particulate(Soil, sand or sediments)	1:10	1:100
Ocean	1:10	1:100
Piped Drinking Water	1:1 (no dilution)	1:10
Drain Water	1:1000	1:1,000,000 (serial 1:1000)
Flood Water	1:100	1:1000

Produce	1:100	1:1000
Latrine Swabs	1:10	1:100

Due to the time and resource constraints of conducting a rapid assessment we do not recommend processing replicates of samples.

### A. Field or lab method for very basic dilutions

#### Materials and Equipment:

- Autoclaved or sterile filtered water or PBS (phosphate buffered saline, pH 7.2)
- 2 Sterile unopened Whirl-Pak bags with 100 ml volume mark. See picture below
- Gloves
- 70% ethanol
- Felt tip Pen
- Disposable transfer pipet with graduated lines indicating volume, or a notation of drops per ml on packaging (available from pharmacy, laboratory, or medical supply stores). See picture below
- 4°C refrigerator



1. Prepare your work surface by cleaning it with 70% ethanol.
2. Put on gloves and spray hands with 70% ethanol. Rub hands together to sanitize all surfaces of the gloves.
3. Prepare your dilution containers
  1. For each sample dilution, label a Whirl-Pak bag with the sample ID and the dilution (i.e. 1:10, 1:100, etc.)
  2. Carefully pour the water or PBS into each Whirl-Pak bag up to the 100 ml mark.
  3. Use a plastic disposable syringe or pipet with a graduated line on the side to remove the appropriate volume of water based on your intended dilution:

Intended Dilution	Volume to Remove
<b>1:10</b>	10 ml
<b>1:100</b>	1 ml
<b>1:1000</b>	0.1 ml

4. Samples should have been collected in a Whirl-Pak bag. Spray the outside of the packaging/bag with 70% ethanol and rub it well.
5. Mix the contents of the bag by turning it end over end 5 times.
6. Open your bag of sample water, and use a new sterile transfer pipet to transfer the appropriate volume of sample water to the prepared bag.

Intended Dilution	Sample Volume to Add
1:10	10 ml
1:100	1 ml
1:1000	0.1 ml

7. Close the bag thoroughly by rolling the top down and twisting the ties together. Shake gently.
8. For drain samples, prepare a 1:1000 dilution first. Prepare another Whirl-Pak bag according to the directions for a 1:1000 dilution (step 3). Add 0.1ml from the first 1:1000 dilution to the second bag and mix gently. This will be a 1:1,000,000 dilution.
9. Store all samples at 4°C unless they are ready for processing. For all diluted samples, the full 100ml dilution will be processed by membrane filtration or IDEXX.

### ***B. Dilutions for more equipped laboratories***

#### Materials and Equipment:

- Autoclaved or sterile filtered water or PBS (phosphate buffered saline, pH 7.2)
  - 2 autoclave-sterilized or sterile disposable beakers or flasks with 125 ml or greater capacity
  - Gloves
  - 70% ethanol
  - Felt tip Pen
  - Pipet with 1 ml tips, Pipet Aid and 1 ml transfer pipets, or Disposable transfer pipet with graduated lines indicating volume, or notation of drops per ml on packaging (available from pharmacy, laboratory, or medical supply stores).
  - 4°C refrigerator
  - 100 ml graduated cylinder or 25 ml serological pipet
1. Prepare your work surface by cleaning it with 70% ethanol.
  2. Put on gloves and spray hands with 70% ethanol. Rub hands together to sanitize all surfaces of the gloves.

3. Prepare your dilution containers.
  1. For each sample dilution, label a beaker or flask with the sample ID and the dilution.
  2. Using a graduated cylinder or 25 ml pipet, add the appropriate volume of water or PBS to the container.

Intended Dilution	Volume to Add
<b>1:10</b>	90 ml
<b>1:100</b>	99 ml
<b>1:1000</b>	99.9 ml

4. Samples should have been collected in a Whirl-Pak bag. Spray the outside of the packaging/bag with 70% ethanol and rub it well.
5. Mix the contents of the bag by turning it end over end 5 times.
6. Open your bag of sample water, and use a new sterile serological or transfer pipet to transfer the appropriate volume of sample to your dilution container.

Intended Dilution	Sample Volume to Add
1:10	10 ml
1:100	1 ml
1:1000	0.1 ml

7. Mix the diluted sample by swirling gently.
8. If the samples will not be processed immediately, cover or seal the container to prevent evaporation and store all samples at 4°C until they are ready for processing. For all diluted samples, the full 100ml dilution will be processed by membrane filtration or IDEXX.

### Recommended methods for measuring fecal *E. coli* are:

1. Membrane filtration and plating on BBL MI agar, mColiBlue, or Chromocult
  - Works well for all sample types
  - For mColiBlue and Chromocult, see the manufacturer's instructions for use and identification of *E. coli* colonies
2. IDEXX Quantitray and Colilert media
  - Not recommended for swabs

#### Important note on microbiological assays:

Be sure to use 100 mls of sterile water or PBS used for washing items or making dilutions as a negative control in each assay. This is especially important if you are purchasing bottled water from a vendor, rather than using lab-prepared filtered or autoclaved water, as sterility of bottled water can be quite variable.



## Membrane Filtration Protocol

### A. Preparation – MI plates

Materials and Equipment:

- BBL MI agar powder
  - Cefsulodin
  - 100% ethanol
  - 15 x 60mm Petri dishes
  - Distilled or deionized water
  - 5 or 10 ml serological pipets
  - 0.22 um syringe-driven filter
  - 5 or 10 ml syringe
  - Autoclave
  - Water bath
  - Hot plate
1. Mix 36.5 g of BBL MI powder in 1 L of distilled or deionized water.
  2. Heat with frequent agitation and boil for 1 minute to completely dissolve the powder.
  3. Autoclave at 121°C for 15 minutes and cool in a 50°C water bath.
  4. Prepare a 1 mg/ml solution of cefsulodin by dissolving 5mg cefsulodin in 5ml distilled or deionized water. Sterilize the solution by passing through a 0.22 um syringe-driven filter.
  5. Add 5 mL of a freshly prepared 1 mg/mL filter-sterilized solution of cefsulodin per liter of tempered agar medium (final concentration of 5 µg/mL).
  6. Dispense 5-7 mL amounts into 15 × 60 mm plates and allow them to solidify and dry.
  7. Place plates back into the sleeve jackets and store at 4°C until use.

Note: Prepared MI agar in 15 x 60 mm Petri plates can be purchased and stored at 4°C until use. No other preparation is necessary prior to use.

### B. Preparation

1. Wipe down bench or hood with 10% bleach followed by 70% ethanol.
2. Assemble the filter equipment, making sure all filter membrane holders have been autoclaved
3. Attach vacuum tubing to side arm of 1 liter flask and the vacuum source.
4. Attach tubing from output on side of manifold or vacuum flask to mouth of filter flask.
5. Insert filter base into mouth of manifold.
6. Prepare alcohol burner with lighter.
7. Prepare a small beaker with 100% ethanol for sterilizing the tips of the forceps. The ethanol should be 2-3 cm deep, just enough to cover the tips of the forceps when they are resting in the beaker. NOTE: The alcohol burner and ethanol should be on the same side as your dominant hand for easy forceps sterilization.

8. Label MI plates with date, dilution, sample ID, and initials. Be sure to include a plate for the negative control.

### *C. Sample Processing:*

#### Materials and Equipment:

- MI plates, purchased or prepared
  - 100% ethanol
  - Distilled or deionized water
  - 1 x PBS
  - 70% ethanol
  - 10% bleach
  - 10 ml serological pipets
  - Vacuum manifold or vacuum flask and tubing
  - Vacuum pump
  - Autoclaved membrane filter holder and vacuum funnel
  - Sterile filters, mixed cellulose esters, 0.45um pore size, white gridded, 47mm diameter
  - Flat blade forceps
  - 1 liter side-arm flask
  - Hot plate
  - Small beaker (50 or 100 mL)
  - Alcohol burner
  - Lighter
1. Flame forceps for ~5 seconds to sterilize. Take care to hold the forceps horizontally to avoid burning your hand.
  2. Remove a sterile filter from the packaging with sterile forceps.
  3. Remove the filter holder and place the filter on the filter base, grid side up. Affix filter holder to the base.
  4. Pour 10mL sterile PBS on the filter.
  5. Turn on vacuum, open the valve and close the manifold valves.
  6. Pour another 10 mL of PBS on the filter and vacuum it through.
  7. Carefully, remove membrane filter from filter base with sterile forceps, avoiding contact with the center of the membrane.
  8. Place the filter, gridded side up, onto a MI Agar plate labeled "Negative Control". By rolling the filter onto the plate, you can avoid the formation of bubbles between the membrane and the agar surface, which can invalidate your results.
  9. Replace the lid of the Petri plate.
  10. Repeat steps 2 to 5

11. Add a minimum of 10 mL and up to 100 ml of liquid containing the highest dilution of the sample to the filter. Note: always start with highest dilution (lowest concentration) of sample to avoid introducing significant contamination from higher concentrations. If the aliquot of sample is less than 10 mL, add 10 mL PBS and spike the PBS with the sample aliquot. This ensures that the solution is dispersed evenly around the filter surface.
12. Open the manifold valve and vacuum the liquid through the filter.
13. Use a 10 ml serological pipet to rinse the sides of the filter cup with 10ml PBS.
14. Close valve on manifold and remove filter cup.
15. Flame forceps for ~5 seconds to sterilize.
16. Remove filter from base using sterile forceps, taking care not to disturb inner area of filter.
17. Place the filter onto a MI Agar plate labeled with the Sample ID, date, dilution, and your initials. Take care to avoid the formation of bubbles between the filter and the agar.
18. Replace the Petri plate lid.
19. Repeat steps 10 to 18 for every dilution of sample, using the same filter holder, going from most dilute to least dilute.
20. For each new sample you will need to re-sterilize gloves with alcohol and use a new filter holder.
21. Finish by processing the positive control.
22. Invert the Petri plates and incubate at 37°C for 20 to 24 hours.
23. Record the date and time that the sample was placed in the incubator and your name (Lab Operator) on the Data Collection Form.

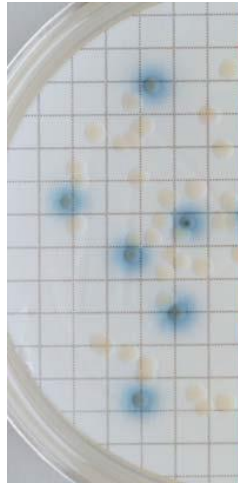
#### *D: Counting and recording colonies*

1. Retrieve the Data Collection Form for your sample.
2. On the laboratory section of Data Collection Form, check the box of the concentration of sample tested.
3. Retrieve the incubated samples and record the date and time the samples were removed from the incubator on the Data Collection Form.
4. Examine each plate under normal/ambient light. Begin with the plate showing the lowest dilution/highest concentration and move to the highest dilution/lowest concentration.
5. Count and record the number of blue or indigo colonies for each sample dilution in the row that corresponds to the dilution factor.
  - i. If there are > 200 colonies, record the results as 999 for “too numerous to count (TNTC)” and move to the next highest dilution.
  - ii. If individual concave blue or indigo colonies cannot be clearly distinguished from each other and from background growth or dirt on the filter, record the result as 998 (“too dirty to count”(TDTC)), and move to the next highest dilution.
  - iii. If any blue or indigo colonies are found on the Negative Control plate, indicate the results next to “Blank”. Record 0 for no colonies.
  - iv. The goal is to identify the plate containing a dilution of the sample that produce between 20 and 80 colonies, with a maximum of 200 colonies per membrane. In

the column “Selected for *E. coli* average”, check the box that reflects the best dilution for counting blue *E. coli*.

#### D. Reference information

1. *E. coli* produces blue or indigo colonies under normal/ambient light.
2. The presence of some lateral diffusion of blue color away from the target *E. coli* colonies can affect enumeration and colony picking on plates with high concentrations of *E. coli*. If the diffuse zone for two colonies overlap, but the individual colonies are non-overlapping, count as two colonies.
3. Colonies that are tiny, flat or peaked pinpoint blue, with a size of less than 0.5 mm in diameter on filters containing less than 200 colonies may be due to species other than *E. coli*. These colonies occur occasionally in low numbers and should be excluded from the count of *E. coli* colonies, which are usually much larger in size (1 - 3 mm in diameter). The small colonies have never been observed in the absence of typical *E. coli*, but, if they should occur, the sample should not be considered *E. coli*-positive unless at least one colony has been verified by another method.
4. USEPA Microbiology Methods Manual, Method 1604.
5. Appendix



*E. coli* in ambient light

## Data Recording Forms

Laboratory data will be recorded on the sample collection forms (Appendix 6) for each sample in the box labeled “Laboratory” at the bottom of each form. This box is the same on all collection forms, regardless of the sample type. The diagram below illustrates how to fill in the laboratory processing information.

**Laboratory**

Sample processing date and time  
 yyyy-MM-dd hh:mm

(1) Date and time placed in incubator  
 yyyy-MM-dd hh:mm

Date and time removed from incubator  
 yyyy-MM-dd hh:mm

Plate	Dilution (mL)	E. coli Count	TNTC *	TDTC **
Plate 1	<input type="radio"/> 1:1 <input type="radio"/> 1:10 <input type="radio"/> 1:100 <input type="radio"/> 1:1000	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plate 2	<input type="radio"/> 1:1 <input type="radio"/> 1:10 <input type="radio"/> 1:100 <input type="radio"/> 1:1000	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blank		<input type="text"/>		

(2) (3)

(4) Collector Name

Lab Operator Name

\* TNTC = too numerous to count (> 200 E. coli)      \*\* TDTC = too dirty to count

- (1) The processing date and time, as well as the dates and times the sample was put in and taken out of the incubator, will be recorded in the top six boxes.
- (2) For the two dilutions made, select the appropriate checkboxes (one in each row). While there are four dilution options available, you will only be making two dilutions for each sample.
- (3) Record the number of *E. coli* colonies for each of the two plates, as well as the blank, in the “*E. coli* Count” column. If the number of colonies is too numerous to count, record 999. If the plate is too dirty to read, record 998.
- (4) Record your name at the bottom of the form, on the line marked “Lab Operator.”



**Software Instructions:** All environmental sampling forms can be found in the “Environmental Sampling” module under the “Download Sampling Forms” Link.

## Appendix 7: The SaniPath Guide to GPS Mapping

### Table of contents:

1. Overview of mapping
2. Preparing for the field
3. Intro to Google Earth
4. GPS Unit Basics
5. Organizing Data
6. Analyzing data: Using ArcGIS Explorer
7. Converting Data
8. Sample Data Log
9. **Appendix:** Drain Characterization Tool
10. **Appendix:** Glossary of Terms

## 1. Overview of Mapping

Geospatial mapping can be a powerful tool with which to communicate environmental health data to local stakeholders and policy makers. While mapping resources are not necessary to use the SaniPath Rapid Assessment Tool, should users have the funds and personnel, we recommend completing this optional module.

This appendix contains instructions for getting started with geospatial mapping, and includes basic instructions for GPS point collection, data organization and conversion, as well as the use of Google Earth and ArcGIS Explorer (free software that can be downloaded from the Internet). The purpose of this protocol is to enable you to collect GPS points as part of the rapid assessment transect walk, environmental sampling, or if you choose to characterize floods or drains.

Using these GPS points you will be able to use this protocol to create maps of key points of interest, as well as "hot spots" of environmental contamination in the city. These maps can be used in reports and presentations to help advocate for programs and policy.

## 2. Preparing for the field

### ***Purpose: To orient yourself to the study site***

Work done before entering the field can make fieldwork less challenging and more effective. By visualizing the area of interest via Google Earth, collecting shapefiles or physical maps of the area, doing transect walks, and walking the area many times, you can orient yourself well to your study site.

Ask your community liaison questions as you walk, to better understand your surroundings and the community in which you're working. As you're walking, take GPS points at landmarks and other points of interest, recording them in your data log as you go. Always take a compass with you into the field for navigating. The more time you spend walking the area, the easier the mapping will be.

If available, gather shapefiles or physical maps from governmental offices, other NGOs in the area, and begin mapping them onto Google Earth. Instructions on how to do that are outlined in the following sections.

## 3. Introduction to Google Earth

### ***Purpose: To visualize area before going into the field***

Google Earth is a free, downloadable program that uses satellite images to visualize areas around the globe. It requires an internet connection to operate.

**Download:** <http://www.google.com/earth/download/ge/agree.html>

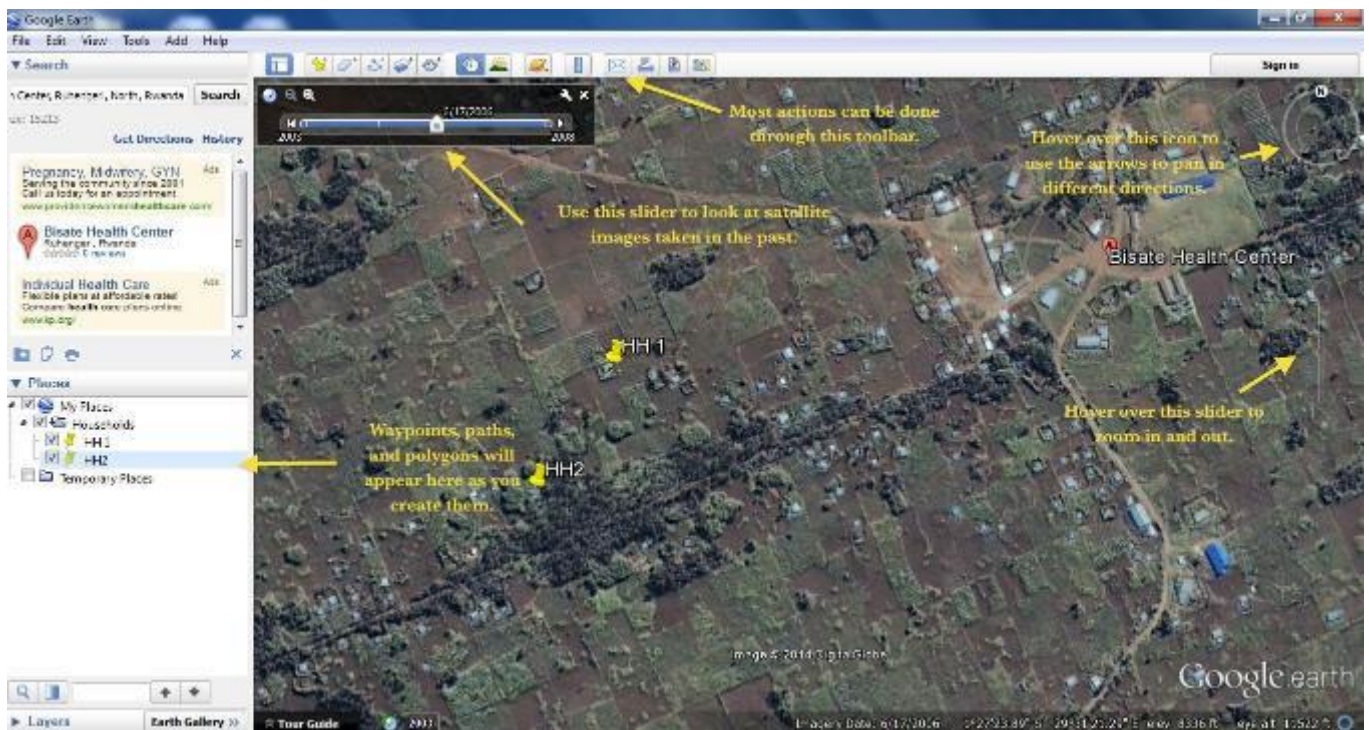
#### **Compatible Platforms:**

PC (Windows XP, Windows Vista, or Windows 7)

Mac - Mac OS X 10.6.0 or later  
 Linux - LSB 4.0 (Linux Standard Base) libraries

**The Basics:**

1. Using the Search box in the upper left hand corner, search the city of your study site.
2. If the image is blurry or cloudy, click on the clock icon in the toolbar at the top of the page.
3. Now move the slider left or right to a different date. This allows you to look at satellite images taken at different points in time. Remember, the older the image, the less accurate it is of what the site is truly like today.
4. Record the date of the image you will use in your notes.
5. Use the arrows in the top right hand corner of the program to pan left, right, up, and down.
6. You can change the orientation of North by rotating the “N” icon in the compass.
7. Zoom in and out with the slider below the arrows on the right side of the screen.



**Saving files in Google Earth:**


1. Google Earth uses kml files and kmz files as its data saving format.  
 (kml=keyhole markup language, kmz is a zipped (compressed) file of kml)

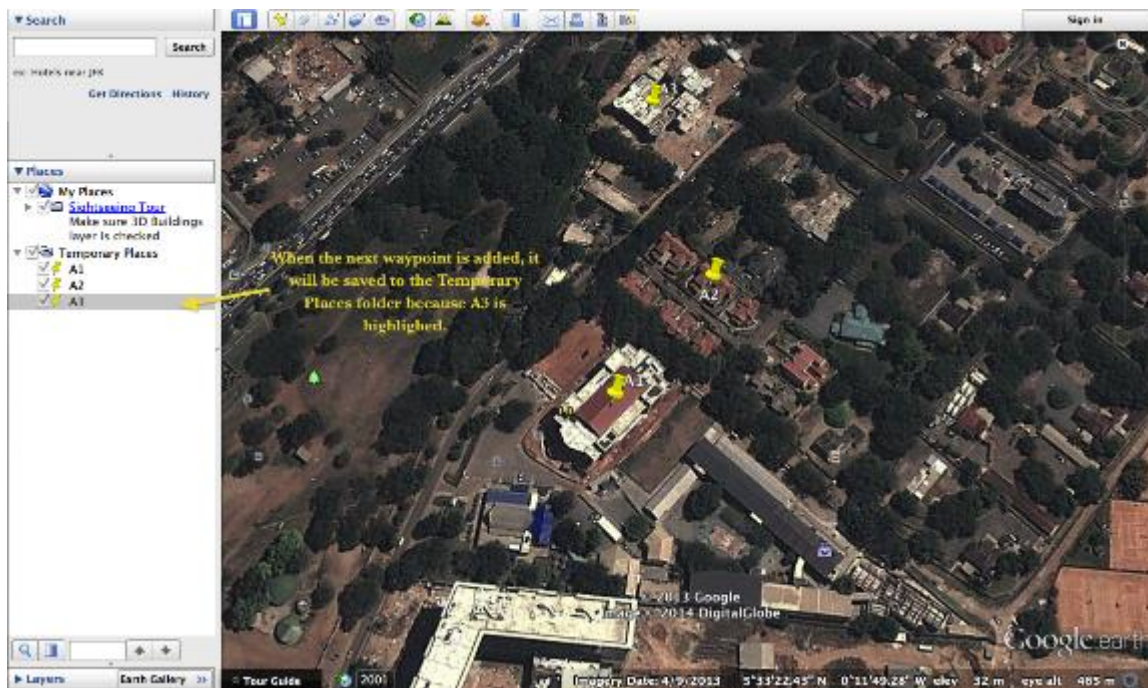


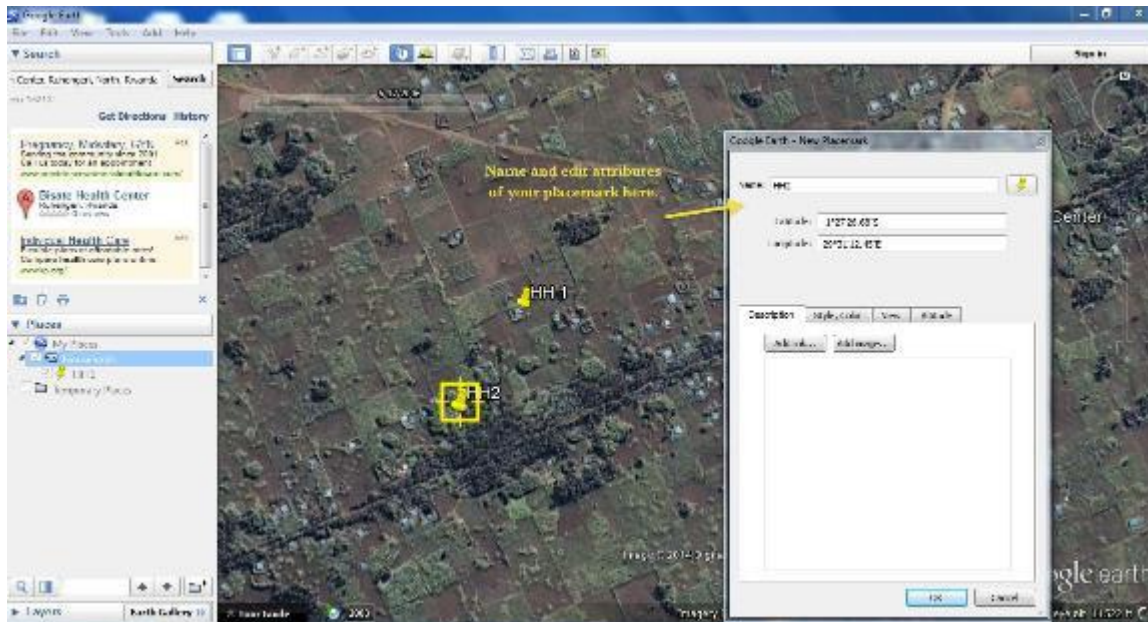
2. To save a folder, right click on the folder in the left hand **Places** box, go to **Save Place as...** and save in the above formats.
3. To save an image of the area, go to **File > Save > Save Image**.
4. If you have shapefiles of the city, convert\* them to kml files and open them in Google Earth

## Drawing Waypoints, Paths, and Polygons


Waypoints:

1. Click on the yellow pin  in the toolbar at the top of the page.
2. A yellow pin is now placed on your map, and a box is open for naming and formatting your pin.
3. Drag your pin to the point of interest and name it.
4. Format your pin by clicking on the "Style, Color" tab in the box.
5. Create a folder by right-clicking in the left hand box called "Places" and go to **Add>Folder**.
6. Select the folder in which you wish to save your waypoints.






**Paths:**

1. Click on the path icon  in the toolbar.
2. Again, a box will open, and the cursor will change, indicating the path tool.
3. Click on where you want to begin the path.
4. Click on the second point in the path. A line should now appear.
5. You can continue clicking to make the path along the map. Paths can be used for roads, drains, and many other things.
6. Use the up-down areas on the top right of the screen to move the map around.
7. Save and name as you would for waypoints.

\*You can see the change in elevation of a path by right-clicking on the path and selecting **Show Elevation Profile**.

\*You can also reveal the length of the path by right clicking on the path, selecting **Get Info** and selecting the “Measurement” tab in the box that appears.

**Polygons (can be used to delineate cities, towns, etc.) :**

1. Click on the polygon icon  in the toolbar.
2. A box will open which you can use to name.
3. You can format the polygon by clicking on the “Style, Color” tab and adjusting the opacity of the polygon, the boundary, the color, etc.
4. Begin clicking on the boundary of the area for the polygon.

5. Complete the entire polygon.
6. Save as above.

#### 4. GPS Unit Basics

Most GPS units function similarly, regardless of model. GPS uses satellites to pinpoint your location on Earth. Most manufacturers have a basic guide to using their GPS on their website. Reference the appropriate guide if you have difficulty, and attempt to use the GPS unit before going into the field to ensure that it works.

Using GPS, you can record points of interest, track boundaries and paths, and navigate. With some models, you can also upload kml files or other basemaps to the GPS to use directly in the field. If that function is unavailable, you may upload paths and waypoints to the GPS unit that can then serve as a guide for you in the field.

##### ***Taking Waypoints and Tracks:***

1. Turn on GPS outside to allow GPS to acquire the satellites.
2. Once the satellites are acquired, navigate the menu and click on “Mark Waypoint.”
3. A latitude and longitude should be displayed and a number associated with that waypoint (i.e. 01). Record all of these data with the timestamp in the transect walk data recording form. This form can be downloaded from the “Download Forms” link within the “Preliminary Assessment” module of the SaniPath Rapid Assessment Tool. Make sure that your GPS is recording coordinates in **decimal degrees**.
4. To turn on the track function, go to “Setup” and switch the track function from “Off” to “On”. The track function traces your path as you’re walking, a very useful tool when doing a transect walk.
5. You can save the track at any time by clicking “Save Track”.

##### ***Downloading Coordinates from GPS:***

1. Prior to connecting, download a coordinate reading software such as MapSource. This is the interface between the GPS and computer. It can be downloaded from [http://www8.garmin.com/support/download\\_details.jsp?id=209](http://www8.garmin.com/support/download_details.jsp?id=209).
2. Connect the GPS to the computer with a USB and turn it on.
3. Open Mapsource, go to **Transfer > Receive from Device**.
4. All the points and paths should now appear in the left hand box under the respective tabs. Save this as a .gpx file.
5. Begin creating a spreadsheet from each day with the latitudes, longitudes (in degrees), date, and point ID. This will later become your .csv for data analysis.

##### ***Uploading Data to the GPS:***

***Purpose: To orient yourself in the field***

1. You can use polygons and waypoints to guide your transect walk. If you know that a polygon is the boundary of a village, by uploading it to your GPS, you can make sure you are staying within the boundary using your GPS.
2. Paths and polygons created in Google Earth can be converted from .kml files to .gpx files and then uploaded to the GPS.
3. Convert your file from .kml to .gpx.
4. Connect GPS to computer with USB and turn it on.
5. In Mapsource, select **Transfer > Send to Device**.
6. Often, the GPS will turn off once download is complete. Turn it on to ensure the download was complete.

## 5. Organizing your Data

### ***Purpose: To easily manipulate data during analysis***

In the field, use the log sheets to record the GPS ID, time stamp, description, and **decimal points** of your GPS point. **It's very important that you record all the decimal points of the GPS coordinate.** Otherwise, you may record a point that is in an entirely different location.

Upon returning, enter log sheets into an excel spreadsheet. Upload GPS points and save them by date (i.e. 06\_26\_13\_Village name.gpx), but **do not delete them**. This will help with data analysis. If you delete the GPS points, the next time you take a waypoint, it will start back at **01**. In your record, you will then have two points labeled **01**. Though the date will differentiate them, it will make subsequent analysis more difficult. Delete tracks on the GPS if space seems to be running out.

## 6. Analyzing Data with ArcGIS Explorer

**Software needed:** ArcGIS Explorer (download available at: <http://www.esri.com/software/arcgis/explorer/download>)

**Platforms:** PC or Unix. See following website for further requirements:

<http://resources.arcgis.com/en/help/system-requirements/10.1/index.html#/0151000009400000>

ArcExplorer is a free product of ESRI with countless capabilities. It can import excel files, gpx data, kml files, shapefiles, and layers. From creating waypoints, polygons, and polylines to linking data to points, the possibilities are endless. Its functionality is very similar to Google Earth.

If you have difficulty with Arc GIS Explorer, Arc GIS Map Viewer has similar capabilities. That can be found at: <http://www.arcgis.com/home/webmap/viewer.html>

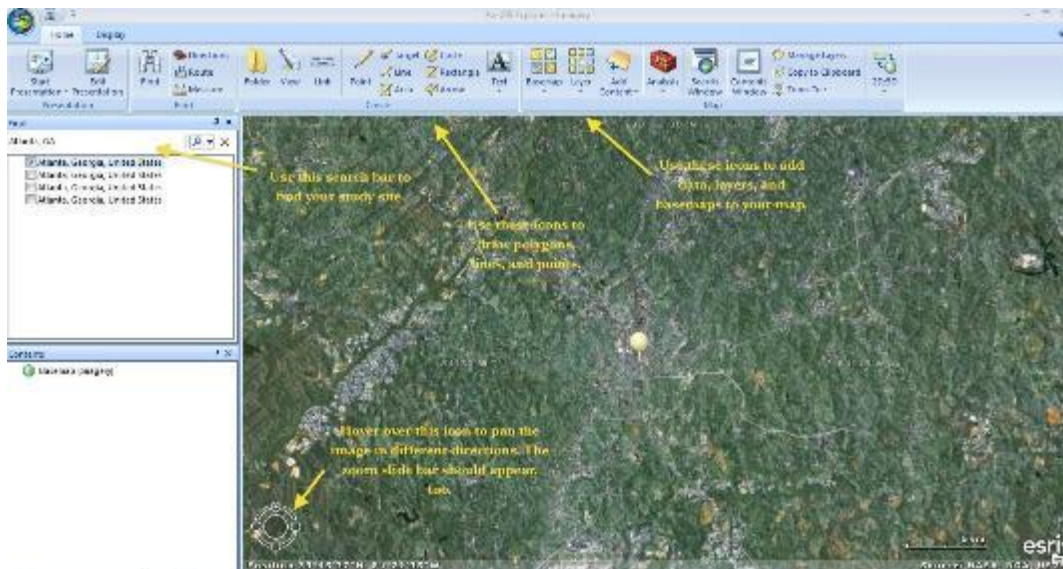
### **Setting up ESRI Global Account**

*Setting up an ESRI account is useful for creating, storing, sharing, and managing maps. It provides access to maps and applications created by others too. For more information, see <http://www.esri.com/software/arcgis/arcgisonline/features/free-personal-account>.*

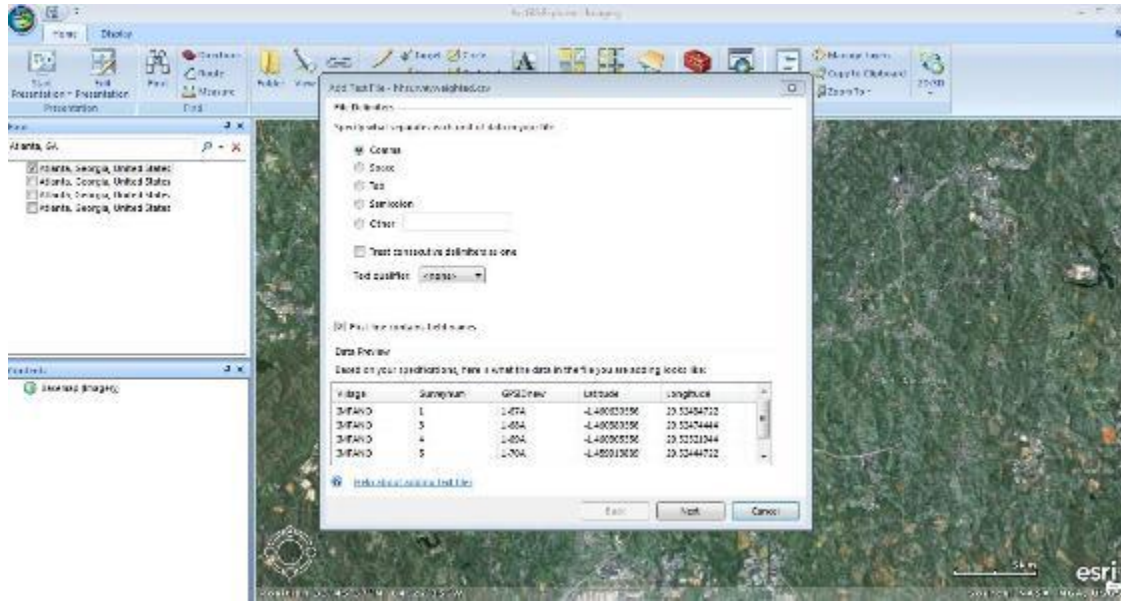
1. Follow this link: <https://www.arcgis.com/home/createaccount.html>
2. Fill in fields.
3. Use this login for ArcExplorer Online or ArcGIS Map Viewer.

**The Basics:**

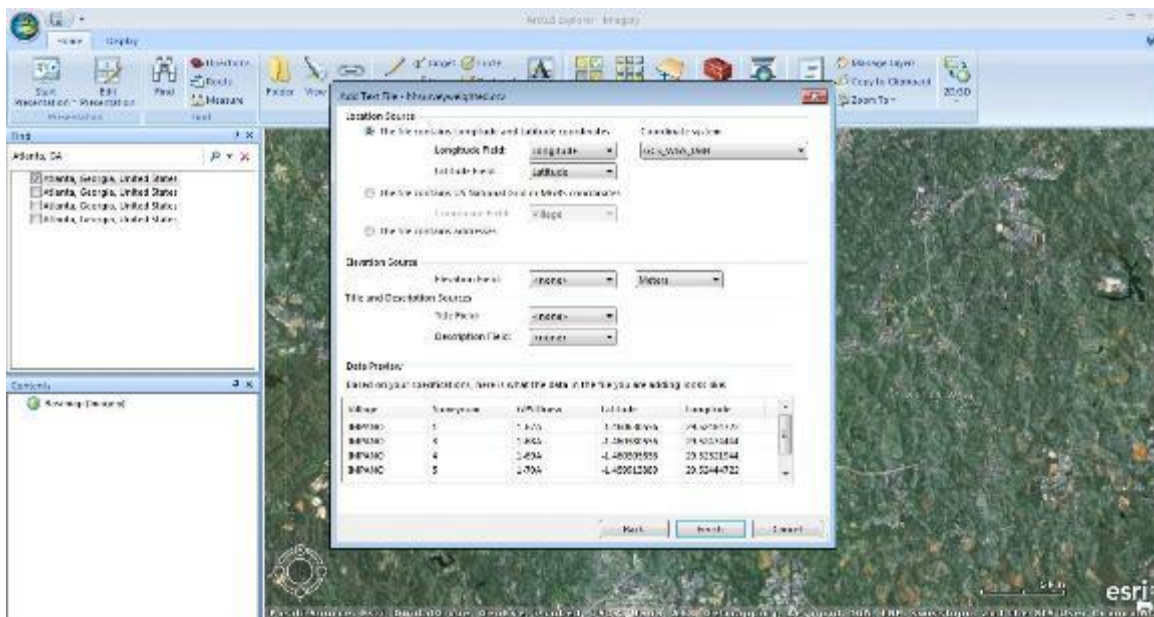
1. Use the Find toolbar to find your study site on the left hand column in the screen.
2. At the bottom left corner of the screen, there is a set of arrows that allow you to pan north, east, south, and west. Hover over them, and the zoom slide bar will also appear.
3. To choose a basemap, click on the **Basemap** icon in the toolbar at the top of the page. Play with the different basemaps until you find the one you like.
4. You can also add a layer by clicking the **Layer** icon in the toolbar.
5. To add data to the map, click **Add Content** in the toolbar. You can add kml files from Google Earth, shapefiles, and a number of other types of data.



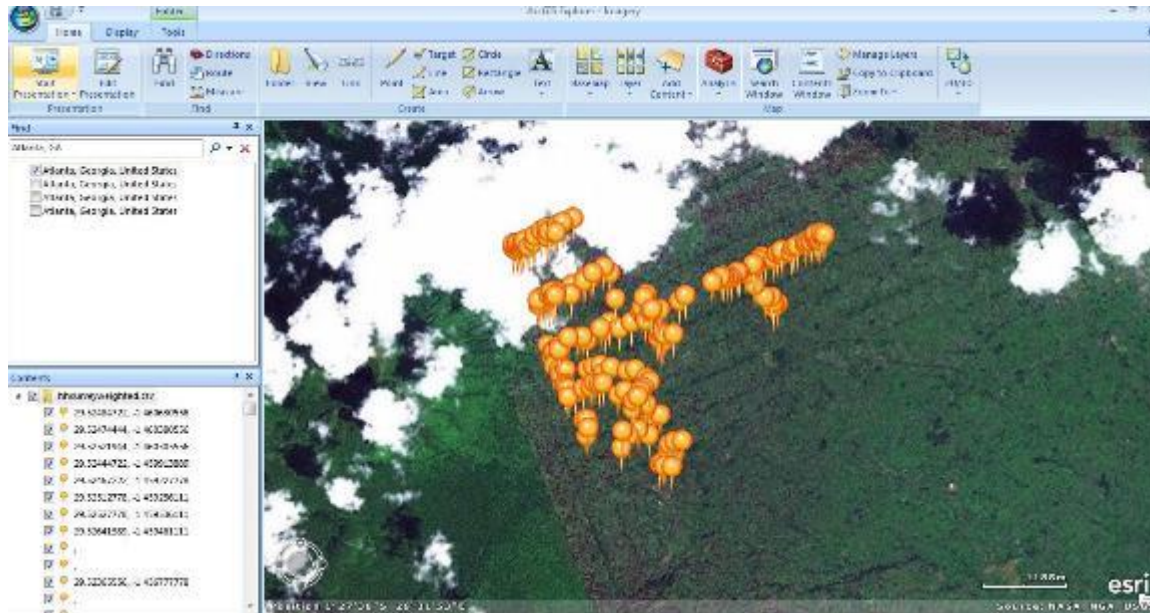
6. To upload a .csv, go to **Add Content** icon in the tool bar. Go to **Text** and select your file.
7. A box will open, asking how your data is separated and giving a display of what your data looks like. Click **Next**.



8. The next page shows the type of coordinates. Select *GCS\_WGS\_1984* as your coordinate system. Click **Finish**.



9. Your data should appear now on the map and in the *Contents* box on the left hand side.



10. Click on the drop down arrow next to your data. Here you can display the table of data below your map, save the data as a layer and edit the features by selecting from the drop down menu.
11. Right click on any of the points in the *Contents*.  
Here, you can remove, rename, organize, label, and change the symbols of the points.
12. You can also edit your points by clicking on the *Appearance* tab. There, a menu of options to modify symbols, size, color, and popup content will appear.
13. To manage the layers of your map, click on **Manage Layers** in the toolbar.
14. Much like Google Earth, you can draw points, lines, shapes, and write text on the map by using the icons in the **Create** box in the toolbar.
15. To save your map, click on the ArcGIS Explorer icon and click save. It is now saved as an .nmc file. You can also right click on any of the folders in your *Contents* box and save it as a kmz, layer package, or .nmc. You can also save it to your ESRI account and access it from other computers.

## 7. Converting Data

***Purpose: To interchange data between different mapping programs and your GPS unit***

One of the most complex parts of mapping is data conversion. The GPS saves data in certain formats that are not compatible with Google Earth, which is not compatible with Arc GIS explorer, etc.

Using GPSBabel will solve this problem. The link to this website is <http://www.gpsvisualizer.com/gpsbabel/>.

Here, you can upload a file and it will convert it to the file necessary for your task.

**The Basics:**

1. Open website and fill in all data fields from beginning to end.
2. Select **Waypoints [W]** from the drop down menu.
3. For input file format, select the type of file that matches the one you are converting.
4. For output file format, select the type of file you wish to convert into.
5. Upload your file by selecting **Choose File**.
6. Select to NOT convert the file into a .zip archive.
7. Select **yes** to outputting ALL types of data.
8. Click "Convert the File" and download the file that it creates.

**Converting from kml to gpx:**

*When would I need to do this?*

- If you want to upload paths or points you made in Google Earth onto your GPS.
- If you want to use the paths or points from Google Earth as data in your map, instead of just a layer\*.

*\*Remember, layers are not actual data. When using them in Arc GIS, or Arc GIS explorer, you will have to set the data source for all layers.*

**Converting from gpx to kml:**

*When would I need to do this?*

- If you want to visualize your collected GPS data in Google Earth

## 8. Sample Data Log

When logging your data, any format that includes the GPS number, GPS point ID, latitude, and longitude will do well. Below are some examples of how to log your data, but as long as the above information is included, find the format that works for you.

Date:	Neighborhood:			
GPS #:	GPS ID:	Latitude	Longitude:	Notes:
1	56	1°27'24.40"S	29°31'25.16"E	Water source



## 9. Appendix: Drain Characterization Tool

## 10. Appendix: Glossary of Terms

Mapping uses language that may not be commonly used, so below is a glossary of terms that are helpful to understand. If there are any words missing here, follow this link to the ArcGIS dictionary:

<http://support.esri.com/en/knowledgebase/GISDictionary/term/basemap>

**Basemap**- a map that displays reference information like political boundaries, roads, landmarks, etc. This map serves as a background to which other data can be added.

**Elevation**-the height above the ground, typically in reference to sea level.

**Latitude**- the distance North or South of the equator. It is an angular distance, therefore, measured in decimal degrees.

**Layer**-a reference to a data source, such as a shapefile, coverage, geodatabase feature class, or raster that defines how the data should be symbolized on a map. A layer is not data, only references it. It can be converted to a shapefile within ArcGIS

**Longitude**- the distance East or West from the Prime Meridian. Measured in decimal degrees

**Shapefile**-A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

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Visit the Center for Global Safe Water at Emory University for more information!

<http://web1.sph.emory.edu/CGSW/>

Visit the SaniPath Website for more information!

[www.SaniPath.com](http://www.SaniPath.com)

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