Protecting Drinking Water: A Workbook for Tribes

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The Water Education Foundation is an impartial nonprofit organization dedicated to creating a better understanding of water issues and helping to resolve water problems through educational programs.

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Section One: Introduction

> *Water is the life-giving source that sustains our crops, fish, and wildlife, from which we drink, bathe, and worship in ceremony*. – Chehalis Tribe, Washington State

Recent census data indicate that Native Americans are the fastest growing population group in the United States. Keeping this growing population healthy now and in the future requires that Indian Tribes take steps to ensure that sources of drinking water are clean and adequately protected against contamination.

With many other issues competing for the attention of Tribal leaders and members, why should drinking water source protection receive high priority? Here are a few of the benefits of source water protection:

- Safeguard the health and welfare of Tribal members against water-borne diseases and other contaminants
- Protect the cultural and ceremonial importance water has for many Tribes
- Protection is almost always more cost-effective and health-protective than cleaning up contamination after it has occurred
- Clean, reliable drinking water is critical to any Tribe's economic development plans
- Drinking water source assessment and protection can be integrated with, and strengthen, existing Tribal environmental activities
- Tribes with drinking water source assessment and protection programs in place may qualify for waivers of EPA monitoring requirements

A source water assessment program (SWAP) includes several steps that when completed describe a Tribe's drinking water sources and possible contaminants that could degrade those sources. The information gathered in the SWAP process is used to develop a source water protection program (SWPP), which consists of strategies for long-term management of water sources to protect them against contamination. Community involvement is a key part of both SWAP and SWPP.

Many Tribes already have taken steps to protect their sources of drinking water through efforts such as wellhead protection programs. For those Tribes that

have some experience with drinking water source assessment and protection, Section Three of this guide provides a complete, step-by-step workplan with worksheets that can be copied and used to keep records of each step. For Tribes with little or no experience with drinking water source assessment and protection, or limited resources, Section Two offers a simplified approach that focuses on identifying potential contaminant sources and then taking direct action to deal with those sources or seeking help for additional studies.

This guide is intended for use by Tribal environmental officers or persons responsible for Tribal water supplies. In most cases, they will lead the Tribe's source water program, with overall direction from the Tribal governing body.

A. How to Use This Workbook

This workbook is organized into several sections to help you pick the features that will be most useful to your Tribe. This **Introduction** stresses the importance of protecting drinking water sources and explains how to use this workbook to start a new protection program or strengthen an existing one.

Section Two describes a simplified method for identifying potential contamination threats to your drinking water and includes pointers to resources you can use to seek funding for additional help to protect your drinking water sources from those potential threats. It includes a checklist of the most common potential contaminants likely to be found on Indian reservations. If your Tribe has little or no experience with drinking water source assessment and protection, or has limited personnel or resources to devote to those tasks, then the simplified approach contained in Section Two will help get you started. This approach focuses on three basic tasks:

- locating sources of drinking water on the reservation;
- identifying potential contaminant sources located near those drinking water sources;
- communicating assessments results to Tribal members; and
- documenting the findings for further actions such as cleanup or additional study.

Note: Completing the steps described in Section Two does not constitute a complete source water and protection program, and will not qualify a Tribe for a waiver of EPA monitoring requirements. It is included in the guide as a way to help Tribes with limited personnel or resources take affirmative steps to protect their drinking water sources.

Section Three describes a more detailed approach that follows traditional methods of assessing potential threats to drinking water and developing strategies to protect drinking water sources against contamination. This approach uses easy-to-follow forms and checklists to complete these steps:

- Forming a team;
- Delineation;
- Inventory of potential contaminants;
- Determining susceptibility to contamination;
- Communicating the results to the Tribe; and
- Building a protection program.

The forms and checklists are presented in the order in which they are intended to be completed. All of the forms and checklists included in this workbook can be copied and made part of the Tribe's records of its efforts to protect drinking water supplies.

Finally, **Section Four** lists a variety of sources of additional information on drinking water source assessment and protection, such as EPA publications, government agencies, Indian groups, private and professional organizations, and web sites. This section can help you find maps, data sources, and technical information to support your drinking water source assessment and protection program.

This workbook was prepared by the Water Education Foundation under a grant from the U.S. Environmental Protection Agency. It is intended to encourage Tribes that have not done so to undertake programs to assess and protect their drinking water sources and to provide tools that will help Tribes carry out those functions. The authors wish to thank the following groups and their member Tribes for their valuable insights: Inter-Tribal Council of Arizona, the Colorado River Indian Tribes, the Native American Environmental Protection Coalition, and EPA Tribal coordinators.

Section Two: A Simple Approach

A. Introduction

All Indian Tribes are interested in preserving their natural and cultural resources, such as drinking water, that sustain their communities. However, some Tribes may lack the resources or personnel to carry out all of the steps needed to make the kind of detailed assessment of potential threats to their drinking water sources described in Section Three.

Recognizing those limitations, this section describes a simplified approach to gathering basic information about potential contamination threats. This basic information can be used either to take direct action by the Tribe to reduce the contamination threats, or to seek funding or additional help to analyze the findings in more detail. Some suggestions for additional action are described in Section F on p. II-19. No special equipment or training is required to use this method, and its costs are very low.

The goal of this section is to encourage Tribes to actively seek out and identify potential contaminant threats to their water supplies, and to take some basic steps to neutralize those threats. At its simplest, this approach may identify improperly stored chemicals, a problem that easily could be remedied by storing the materials in proper containers or facilities. Tribes that wish to take additional steps can consult the more detailed approach described in Section Three.

To use this simplified approach to assessment, follow these steps:

- ¬ Make copies of Checklists B and D and the Drinking Water Source Location Form (C) for each drinking water source;
- ¬ Complete Checklist B to collect tools and information you'll need;
- ¬ Complete the Drinking Water Source Location Form on p. II-3;
- ¬ Starting at the drinking water source (wellhead or surface water intake), check off any potential contaminant sources listed on Checklist D beginning on p. II-4 that are observed within 1,500 feet* of a well and 0.25 miles of a surface water body;
- ¬ Determine the susceptibility of drinking water sources to contamination using one of the methods discussed in Section III;
- ¬ Return all completed paperwork to Tribal environmental officer or other designated person; and
- ¬ Make assessment results available to the Tribe in understandable form.

**Some settings may require greater distances; consult your EPA regional office for local guidance on establishing fixed radius distances.*

B. Checklist for Simplified Approach to Source Water Assessment

Use this checklist to collect the tools and information needed to identify potential sources of contamination to drinking water supplies.

- ¬ Map of area to be surveyed (e.g., topographic map available from USGS or map dealers)
- ¬ Approximate locations of known drinking water sources (check Tribal records, IHS data, talk to Tribal watermaster or department, talk with Tribal members about private wells)
- ¬ Checklist for recording sources or activities that could contaminate drinking water
- ¬ Tape measure or other means for measuring distance of possible contaminant sources from drinking water sources
- ¬ Camera to photograph possible contaminant sources (optional)

A topographic map is recommended because it shows features such as hills or valleys that could affect the movement of water and contaminants. Topographic maps (also called "quad" maps) are available from the U.S. Geological Survey through local map dealers. Look under Map Dealers and Services in the Yellow Pages of the telephone book.

The locations of active public drinking water sources usually are easy to identify from Tribal or other records. However, finding private wells or intakes can be difficult because no records may exist of when wells were drilled or intake structures installed. Older Tribal members can be good sources of information to find these drinking water sources. The Tuscarora Nation in upstate New York, for example, inquires about private water sources as part of its oral history project.

It is important to know the distance between a potential contaminant and a drinking water source. Generally speaking, the closer a potential contaminant is to the drinking water source, the more likely it is to pose a threat to that water source. Measuring the distance between a potential contaminant and a drinking water source (using tape measure or other means) can help you decide which contaminants may pose the greatest threats.

Using a camera to document potential contaminant threats is an option, but one that some Tribes find is useful to build interest among Tribal members in drinking water source protection, or to help persuade Tribal officials to take direct action to order removal of suspected contaminant threats.

C. Drinking Water Source Location Form

Use this form to record the location of each drinking water source. Use one copy of this form for each drinking water source.

Name of person who located source:
_____

Date: _____

Water source (well owner, surface water body, etc.):
_____

For Wells (Groundwater)

Location (check one):

_____ USGS quad map

_____ Global Positioning System (GPS)

Latitude: _____

Longitude: _____

_____ Other (describe location):

_____

For Surface Water Body

_____ USGS quad map

_____ Global Positioning System (GPS)

Latitude: _____

Longitude: _____

_____ Other (describe location):

_____

D. Checklist of Potential Contaminants

Place a check mark (☐) in the left column to identify each potential contaminant source within a 1,500-foot radius of each drinking water source. The potential contaminant sources are grouped into categories such as naturally occurring sources, agricultural sources, etc. Briefly describe the possible contaminant sources (e.g., gas station, illegal dump). Measure the distance of each potential contaminant source from the drinking water source (i.e., well or surface water intake) using a tape measure, foot pacing, or other means and describe the location (address of other identifier) of the potential contaminant source. Return the completed checklist to the Tribal environmental officer or other designated official. An example of a completed page from this checklist appears on p. II-17. The checklist below is adapted from **Wellhead Protection: A Guide for Small Communities**, published by U.S. EPA (EPA/625/R-93/002, February 1993).

Naturally Occurring Contaminants

☐	Naturally Occurring Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Rocks and soils	e.g., metals, iron, arsenic, magnesium, sulfates, fluorides, etc.		
	Contaminated water	e.g., bacteria, salts, viruses		
	Decaying organic matter	bacteria		
	Radioactive materials	e.g., main tailings, radon gas		
	Natural geological processes	e.g., salt water infiltration of wells		

Agricultural Contaminants

Agricultural	Potential	Potential	Location (distance

☐	Sources	Contaminants	Contaminant Source(s)	from drinking water source)
	Animal feedlots, burial areas	e.g., livestock sewage wastes, chemical sprays/dips, viruses, coliform and noncoliform bacteria		
	Livestock waste disposal areas	livestock sewage wastes, nitrates		
	Crop areas; irrigation sites	e.g., pesticides, motor oil and gasoline from chemical applicators		
	Chemical storage	e.g., pesticides, fertilizers, fuels, solvents		
	Farm machinery	e.g., fuels, grease, oil, pesticides		
	Agricultural drainage wells and canals	e.g., pesticides, fertilizers, bacteria		

Residential Contaminants

☐	Residential Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Household chemicals	e.g., cleaners, bleach, paint and varnish removers, motor oils, kerosene, heating oil, etc.		
	Lawn or gardens	e.g., fertilizers, pesticides, gasoline		
	Swimming pools	pool maintenance chemicals such as chlorine		
	Septic systems and sewage lines	e.g., septage, bacteria, viruses, metals, oils, household chemicals		
	Underground storage tanks	home heating oil		
	Apartments and condominiums	e.g., pool chemicals, pesticides, fertilizers, household wastes		

Municipal Contaminants

☐	Municipal Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Parks	e.g., fertilizers, pesticides		
	Pest control	insecticides		
	Highways, roads	herbicides, road salt, fuels, oil		
	Municipal sewage	e.g., bacteria, sludge, viruses, treatment chemicals		
	Schools, government buildings and grounds	solvents, pesticides, fuels, general building wastes		
	Storage, treatment, and disposal ponds and other surface impoundments	e.g., sewage wastewater, liquid chemical wastes, bacteria, viruses		
	Sewer overflows	e.g., bacteria, viruses, oil		
	Recycling facilities	e.g., waste oil, metals		
	Landfills	e.g., chemicals, oils		

Municipal Contaminants (cont'd)

☐	Municipal Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Illegal dumps and open burning areas	e.g. chemicals, metals, oils, solvents		
	Municipal incinerators	e.g., metals, chemicals, sulfur		
	Abandoned wells	e.g., fuels, oils, surface runoff		
	Water supply wells, livestock wells, abandoned wells	e.g., surface runoff, effluent from feedlots, septic tanks, used motor oil		
	Drainage wells	e.g., pesticides, bacteria		
	Sumps and dry wells	e.g., storm water runoff, spilled liquids, fuels, pesticides		
	Artificial groundwater recharge	e.g., storm water runoff, excess irrigation water, treated sewage effluent that may contain metals, detergents, bacteria, chemicals		

Commercial Contaminants

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Airports, abandoned airfields	e.g., aircraft fuels, solvents, de-icers, automotive wastes		
	Auto repair shops	e.g., waste oils, solvents, acids, paints, antifreeze		
	Barber and beauty shops	e.g., perm solutions, dyes, miscellaneous chemicals in hair rinses		
	Boat yards and marinas	e.g., diesel fuels, septage from boat waste disposal areas, wood preservatives, paints, waxes		
	Bowling alleys	e.g., epoxy, floor finishes		
	Car dealerships	e.g., auto wastes, oils, solvents, miscellaneous wastes		
	Car washes	e.g., soaps, detergents, waxes		

Commercial Contaminants (cont'd)

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Carpet stores	e.g., glues and other adhesives, fuel from storage tanks if forklifts used		
	Cemeteries	e.g., leachate, lawn and garden maintenance chemicals		
	Construction areas	e.g., solvents, asbestos, paints, glues, waste insulation, tars, sealants, chemicals		
	Dry cleaners	solvents, spotting chemicals		
	Furniture repair and finishing	e.g., paints, solvents		
	Gasoline services stations	e.g., oils, gasoline, solvents		

Commercial Contaminants (cont'd)

☐	Commercial Sources (continued)	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Hardware and lumber stores	e.g., hazardous chemical products in inventories, wood stains and preservatives		
	Heating oil suppliers	e.g., heating oil, storage tanks, waste from truck maintenance areas		
	Horticultural practices	e.g., herbicides, insecticides, fungicides		
	Jewelry/metal plating	e.g., sodium and hydrogen cyanide, metallic salts, acids		
	Laundromats	e.g., detergents, bleaches, fabric dyes		

Commercial Contaminants (cont'd)

☐	Commercial Sources (continued)	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Medical institutions	e.g., X-ray developers, infectious wastes, disinfectants, radioactive wastes		
	Office buildings	e.g., building wastes, lawn and garden maintenance chemicals		
	Paint stores	e.g., paints, stains, solvents, wood treatment chemicals		
	Pharmacies	e.g., spilled and returned products		
	Photography shops and labs	e.g., silver sludges, cyanides		
	Print shops	e.g., inks, solvents, photographic chemicals		

Commercial Contaminants (cont'd)

☐	Commercial Sources (continued)	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Railroad tracks and yards	e.g., diesel fuel, herbicides for rights-of-way, wood preservatives		
	Research laboratories	e.g., X-ray developers/ fixers, infectious wastes, radioactive waste, disinfectants, drugs		
	Scrap and junk yards	e.g., any wastes from businesses or households		
	Storage tanks	e.g., heating oil, gasoline, diesel fuel		
	Transportation services	e.g., waste oil, solvents, gasoline, diesel fuel		
	Veterinary services	e.g., solvents, infectious wastes, vaccines, disinfectants		

Industrial Contaminants

☐	Industrial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Materials stockpiles (coal, metallic ores, etc.)	e.g., acid drainage		
	Waste tailing ponds	e.g., acids, metals, radioactive ores		
	Transport and transfer stations Storage tanks (above or underground)	e.g., fuel tanks, repair shop wastes e.g., heating oil, diesel and gasoline, other petroleum products		
	Storage, treatment, or disposal ponds and other surface impoundments Chemical landfills	e.g., sewage wastewater, liquid chemical wastes, bacteria, viruses e.g., hazardous and nonhazardous liquid wastes		

Industrial Contaminants (cont'd)

☐	Industrial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Radioactive waste disposal sites	e.g., radioactive wastes from medical facilities, power plants, or defense operations		
	Dry wells	e.g., saline water from wells pumped to keep them dry		
	Injection wells	e.g., oil-field brines, industrial wastes		

Industrial Process Contaminants
(presently operating or abandoned)

☐	Industrial Process	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Asphalt plants	e.g., petroleum derivatives		
	Communications equipment manufacturers	e.g., acid wastes, metal sludges, etchants, cutting oils, plating wastes		
	Electric and electronic equipment manufacturers	e.g., cyanides, solvents, acids, paints, PCBs, etchants		
	Foundries and metal fabricators	e.g., heavy metals, paint wastes, plating wastes, solvents, oils		
	Furniture and fixtures manufacturers	e.g, paints, stains, solvents, degreasers		
	Machine and metal-working shops	e.g., solvents, lubricants, degreasers, metals		
	Mining operations	e.g., mine spoils or tailings, acids, corrosive mineralized waters		
	Paper mills	e.g., metals, acids, chlorine		

Industrial Process Contaminants (cont'd)
(presently operating or abandoned)

Industrial	Potential	Potential	Location (distance

☐	Processes (continued)	Contaminants	Contaminant Source(s)	from drinking water source)
	Petroleum production and storage companies	e.g., petroleum products and derivatives, oil-field brines		
	Unsealed abandoned mines used as waste pits	e.g., metals, acids, minerals, sulfides		
	Industrial pipelines	e.g., corrosive fluids, hydrocarbons		
	Photo processing laboratories	e.g., silver sludges, cyanides		
	Plastics materials and synthetics producers	e.g., solvents, oils, cyanides, acids, formaldehyde		
	Primary metal industries (blast furnaces, rolling mills)	e.g., heavy metal wastewater sludge, pickling liquor, waste oil, degreasers		
	Publishers, printers and allied industries	e.g., inks, dyes, solvents, photographic chemicals		
	Public utilities	e.g., PCBs from transformers and capacitors, oils, solvents, metal plating solutions		

Industrial Process Contaminants (cont'd)
(presently operating or abandoned)

☐	Industrial Processes (continued)	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Sawmills and planers	e.g., treated wood residue,		

		wood preservatives, paints, glues		
	Stone, clay and glass manufacturers	e.g., solvents, oils and grease, glazing materials, metal sludges		
	Welders	e.g., oxygen, acetylene		
	Wood-preserving facilities	e.g., wood preservative chemicals, creosote		

Example of Completed Checklist Page

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Carpet stores	e.g., glues and other adhesives, fuel from storage tanks if forklifts used		
	Cemeteries	e.g., leachate, lawn and garden maintenance chemicals		
☐	Construction areas	e.g., solvents, asbestos, paints, glues, waste insulation, tars, sealants, chemicals	*open containers of paints and solvents stored in uncovered yard*	*Route 7 residential housing project; 1,200 feet west of Tribal Well #2*
	Dry cleaners	solvents, spotting chemicals		
	Furniture repair/finishing	e.g., paints, solvents		
☐	Gasoline services stations	e.g., oils, gasoline, solvents	*underground gasoline storage tank*	*12345 Old Stagecoach Rd.; 1,000 feet north of Buckeye Creek, tributary to Blue River*
	Hardware and lumber stores	e.g., hazardous chemical products in inventories, wood stains and preservatives		

E. Susceptibility Determination

Once the locations of potential contaminant sources have been identified, some assessment should be made of the susceptibility of nearby drinking water sources to those contaminants. In general, the closer a contaminant source is to a drinking water source, the more likely it is to pollute that drinking water source.

Susceptibility of a drinking water source to contamination can be determined by the Tribal environmental officer using the information collected in the previous steps and one of the methods described in subsection B.4 of Section Three of this workbook. The narrative approach described there generally is considered to be the simplest of the susceptibility determination methods. It combines data about the hydrologic setting (for surface water systems) or hydrogeologic setting (for groundwater systems) with water-quality data for the drinking water source and the results of the contaminant inventory described in subsection C above to produce a narrative description of the susceptibility of each drinking water source. The narrative description also could include discussion of pollution controls that could reduce chances for contamination.

Examples of narrative descriptions are provided in Section Three.

F. Communicating Results to the Tribe

The results of the assessment process can be communicated to Tribal members in several ways. If narratives were prepared for the susceptibility analysis, they can be made available at a central location, or provided to stakeholders such as the utilities manager, environmental officer, or water manager. In either case, the availability of the results should be publicized to make community members aware of them.

Another way to communicate the results of the assessment process is to present a written and/or oral report to the Tribal governing body. Such a report will give the governing body important information it may need to develop protective measures or direct action by Tribal officials.

Still another way to make assessment results available is to include a summary in Consumer Confidence Reports (often called "CCR Reports") sent to water system customers. States are required to include summaries of assessment results in CCRs distributed in local water utility bills.

G. Following Up

Once the checklists are completed for all known active and abandoned water supplies, the potential contaminant sources identified on the checklists can be plotted on a map. Several follow-up options can then be pursued to remove or manage the potential contaminant sources. Following are some of the steps Tribes can take after they have identified possible threats to their drinking water sources:

- If they have sufficient authority, Tribal environmental officials might consider direct action to remove the contaminant threats, such as ordering landowners to clean up dumps and storage sites, or requiring gasoline stations to repair or replace leaking underground storage tanks.
- Make assessment findings available to Tribal members in an understandable format, and refer the findings to the Tribal governing body for action, if necessary.
- Seek additional help from government agencies such as EPA, Rural Communities Assistance Program (RCAP), or state rural water associations to do further studies of possible threats to drinking water sources and how they can be removed or managed.

Following are some of the organizations* that work with Tribes to assess threats to drinking water sources and can help develop ongoing programs to address those threats:

- U.S. Environmental Protection Agency (EPA) provides technical assistance and makes grant funds available under Section 106 of the Clean Water Act and other programs for improvements to Tribal drinking water systems.
- U.S. Department of Agriculture's Water 2000 program makes available grants and low-interest loans through its Rural Utilities Service for improvements to water and wastewater systems.
- Rural Communities Assistance Program (RCAP) and Rural Communities Assistance Corporation (RCAC). These organizations work directly with Tribes on drinking water issues such as wellhead assessment and protection programs.
- State rural water associations. These organizations assist rural water system operators with training, wellhead protection programs, etc. Some state associations, such as California's, have staff who specialize in working with Indian Tribes.
- Groundwater Foundation. This organization provides training and technical assistance through the Groundwater Guardian program and publishes educational materials on groundwater protection.

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* For contact information on these and other organizations, see the Resources Section of this workbook.

Section Three: A Complete Approach

Table of Contents for Section Three

A. Introduction

This section presents a complete approach to drinking water source **assessment** and **protection**. It uses a series of worksheets to guide you through the steps of analyzing possible threats to drinking water and developing long-term protection measures. The goal of both phases is to provide long-term protection for the Tribe's drinking water supplies.

Each worksheet is preceded by an explanation of how to complete it. The worksheets are designed to be copied and used as often as needed. Completing the worksheets in the order presented will yield a complete source water program. Completed worksheets also are useful records that can be used later to avoid repeating steps you've already taken.

The approach described in this section is adapted from EPA guidance developed for source water protection and wellhead protection programs. It should be emphasized that drinking water source assessment and protection need not be new activities for a Tribe. Tribes that have conducted wellhead protection or watershed assessment programs can use data already collected for those programs in their source water assessment and protection programs.

The **assessment** phase, or SWAP, follows these four steps:

- ***Delineation*** – identifying areas around drinking water sources where contaminants could pollute those sources.
- ***Contaminant Inventory*** – identifying specific activities that could release contaminants into the delineated area.
- ***Susceptibility Determination*** – integrating the delineation and inventory data to determine the sources of contamination of most concern.
- ***Making Results Available to the Tribe*** – communicating the results of the assessment process to Tribal members and officials.

A SWAP takes a snapshot of a Tribe's or community's sources of drinking water and evaluates possible contaminant threats to those sources. The results of the assessment process are used to develop a source water **protection** program, or SWPP. The protection phase consists of deciding which protection strategies to pursue and implementing them, and developing long-term strategies for protecting drinking water sources from possible contamination.

Many communities have found that public participation plays a key role in the success of their SWAP and SWPP efforts. Involving a broad spectrum of Tribal members and interests will help ensure that assessment steps are completed in their entirety and will help build interest in seeing that protective measures are successful in keeping water sources as safe and healthy as possible.

Most source water program guidance recommends that public participation be afforded through an advisory committee or planning team charged with overseeing the SWAP activities. More information on forming an advisory committee or planning team is included in Section B.1 beginning on p. III-6.

This guide includes worksheets for completing each of the elements of a SWAP. Completing all the worksheets in the order presented will yield a complete SWAP. Use the checklist on **Worksheet 1** to check off tasks as they are completed.

Worksheet 1

Use this worksheet to help organize the SWAP tasks. Place a ☐ mark in the left column after each activity or worksheet listed below is completed.

☐	**Public Participation**
	Form planning team or advisory committee to carry out SWAP activities (complete Worksheet 2)
	Adopt mission statement for the planning team or advisory committee, with goals for the assessment process (complete Worksheet 3)
	Publicize activities of the planning team or advisory committee using Tribal newsletter, community bulletin boards, etc. (see p. III-6 for more information)
	Draft ordinances or codes, if necessary or desired, delegating responsibility for SWAP activities to the planning team or advisory committee (see p. III-7 for example language)
	Notify Tribal members and leaders of the results of the SWAP process

☐	**Delineation**
	Gather information and maps needed for delineation (complete Worksheet 4)
	Identify locations of all known wells, operating or abandoned, and all surface water bodies used for drinking water (complete Worksheet 5)
	Select delineation method for each water source (complete Worksheet 6)
	Calculate protected area for each delineated water source (complete Worksheet 7)

Worksheet 1 (continued)

☐	**Contaminant Inventory**
	Review Tribal records to identify possible contaminant sources located near water sources that have been delineated (complete Worksheet 9)
	Conduct a "windshield survey" by driving through the delineated areas to identify any possible contaminant sources not found in the records review (complete Worksheet 10)
	Survey residents who live within or near the delineated areas to identify past or present activities that could cause contamination, such as illegal dumps, abandoned wells, or septic systems (complete Worksheet 11)
	Walk or drive through delineated areas looking for unreported abandoned wells that could allow contaminants to reach aquifers (complete Worksheet 12)
	Combine all of the information on possible contaminants from Worksheets 9-12 (complete Worksheet 13)

☐	**Susceptibility Determination**
	Plot the locations of all potential contaminant sources listed on Worksheet 13 on map
	Enter each potential contaminant source located within delineated areas on Worksheet 14
	Evaluate each potential contaminant source using one of the methods described in Section B.4 beginning on p. III-48
	Using narrative or risk-ranking approaches described in Section B.4, develop priorities for which potential contaminant sources should be addressed first
	Prepare assessments for distribution to public in understandable format
	Make assessment results available to Tribal members

B. Assessment
B.1 Public Participation

Assessing the susceptibility of drinking water resources to contamination is an opportunity to involve a broad cross section of Tribal members in an important part of community resource management. In many communities, this is accomplished by forming an advisory committee or planning team to assist in development of the SWAP and SWPP.

The makeup of an advisory committee or planning team can be determined by each Tribe based on its needs and practices. It is desirable that the membership include some persons with expertise on water or related issues to evaluate the feasibility and effectiveness of assessment options from a technical perspective. It also could include community members at large who can provide input as to the appropriateness and desirability of various SWAP/SWPP options. Finally, stakeholder representation is important to ensure that a broad spectrum of the Tribal community has input to the decisionmaking process.

Possible technical members of a SWAP advisory committee or planning team could include representatives from a Tribe's environmental management department, its utilities manager, and its planning department. Stakeholder and community members might include business representatives, community health officials, and groups or individuals interested in environmental protection. **Worksheet 2** on p. III-9 lists some of the Tribal officials and other stakeholders who could be members of a planning team or advisory committee.

The cooperation and commitment of community members often is critical to the success of SWAP efforts. Workshops or meetings to solicit input from Tribal members can help build that commitment and promote cooperative solutions to potentially divisive issues. Consider other channels that may be particularly effective in your community, such as a Tribal radio station or newsletter.

The advisory committee or planning team should set goals and objectives for its SWAP/SWPP activities. Some goals may be set by Tribal leadership, but others could come from team members or the community. Goals could include things like educating Tribal members about the importance of clean drinking water, or strengthening Tribal management of water resources. Complete **Worksheet 3** on p. III-10 to list goals and objectives for your program.

Some Tribes, such as the Oneida of Wisconsin, have developed detailed statements that describe goals and objectives and assign responsibilities. The Oneida Tribe's description of responsibilities for its wellhead protection program appears on the next two pages.

Worksheet 2

Drinking Water Source Assessment and Protection Team

Use this worksheet to list the members of the team that will oversee SWAP/SWPP activities. Potential members might include Tribal officials with responsibilities for water supply, environmental protection, regulatory compliance, as well as business leaders and Tribal members with interests in clean drinking water.

Group to be represented	Name, position, and contact information	How will this person be involved?
Environmental Manager		
Planning Dept.		
Fire Dept.		
Natural Resources Dept.		
Indian Health Service		
Business/ Community Groups		
Watermaster/ Utilities Manager		
Other		

Worksheet 3

Setting Goals and Objectives

Use this form as part of your public participation process to solicit from planning team members and the community at large what they would like to see the drinking water source protection program accomplish and how they suggest those goals be achieved.

Mission Statement for_____Source Water Assessment	
Goal	**Ideas to accomplish goal**

Worksheet 3 (continued)

Setting Goals and Objectives

Goal	Ideas to accomplish goal

B.2 Delineation

Water pumped from a well or a surface water body may travel several miles before it reaches the wellhead or intake structure. The water that feeds an underground aquifer may come from a variety of sources, including surface precipitation that percolates through the soil and streams that are hydraulically connected to an aquifer. Similarly, surface water bodies are supplied by smaller upstream tributaries. Both of these processes -- movement through soil and movement across land to tributaries -- remove or neutralize some contaminants, but others, such as synthetic chemicals or bacteria, can remain and contaminate water.

Delineation is the process of determining how much time it will take for water or contaminants to move through soil or tributary streams to reach a water source. The size of the delineated areas around a water source will vary according to a variety of hydrogeologic or hydrologic factors such as amount of precipitation, soil porosity, topography, etc. Delineations for groundwater are usually expressed in terms of time-of-travel, or TOT, measured in two-, five-, and 10-year increments for groundwater. Thus, a five-year TOT refers to the distance from a well's intake where it will take five years for water or contaminants to reach the well. Surface water systems measure TOT in hours, usually expressed a two-hour TOT.

Each delineation method has advantages and disadvantages that should be considered before using it. Factors to consider include local conditions, cost, time, complexity, and need for precision. Use **Worksheet 6** on p. III-22 to document your choice of delineation method.

Delineation Methods for Groundwater

There are several methods of delineating groundwater sources. This workbook explains two of the most commonly used methods, **arbitrary fixed radius** and **calculated fixed radius**. Other, more complex methods are mentioned briefly on p. III-16. The delineation methods for groundwater will be described in order of increasing complexity, starting with the simplest, arbitrary fixed radius.

1. Arbitrary Fixed Radius

The simplest method for delineating wells is to draw a circle with an arbitrary fixed radius around each well as the delineated area. The radius of the circle is determined by an evaluation of local hydrogeological conditions (groundwater flow rate, soil conditions, etc.). For instance, some communities arbitrarily have established a 1,500-foot radius around every well; others have set a one-mile radius around wells drilled in confined aquifers and a two-mile radius for wells in unconfined aquifers. The choice of an arbitrary fixed radius should reflect some evaluation of the local geology.

EPA 1997 guidance recommends a standard 1,500-foot radius, but that distance may need to be increased depending on local hydrogeology and other factors. If unsure about what arbitrary radius to use in your area, check with your EPA regional office (see the Resources Section for a list of EPA regional offices and telephone numbers).

Advantages of the Arbitrary Fixed Radius method:

- Fast and inexpensive (under $100 per well), allowing many wells to be done quickly
- Requires minimal information on local geology
- May be suitable as temporary measure until more sophisticated method can be used

Disadvantages of the Arbitrary Fixed Radius method:

- Limited accuracy means greater risk than other methods of overprotection or underprotection

2. Calculated Fixed Radius Method

The Calculated Fixed Radius Method is the method EPA recommends for delineating wellhead protection areas. It uses an algebraic equation with readily available data inputs to determine the size of the protected area around each well. The equation can be solved using a handheld calculator.

Advantages of the Calculated Fixed Radius Method:

- Relatively low cost (about $100 per well)
- Simple formula uses readily available data inputs
- Takes some account of local geological conditions
- No special technical expertise needed

Disadvantages the Calculated Fixed Radius Method:

- Moderate accuracy may not be suitable for geologically complex areas
- Limited accuracy may lead to overprotection or underprotection

To use the Calculated Fixed Radius Method, complete **Worksheet 5** on p. III-21 for each well to be delineated. The source location information will be used to plot the location of each well on a map so that an inventory can be made of potential contaminant sources within those areas.

The formula for the Calculated Fixed Radius Method is the following:

R_t = R_2 (radius, measured in feet from wellhead, corresponding to two-year time of travel - TOT), R_5 (five-year TOT), or R_{10} (10-year TOT)
Q = maximum pumping capacity of well in cubic feet per year (cu.ft/yr.) (to get cu.ft/yr, multiply a well's gallons per minute pumping rate by 70,267)
t = time of travel (in years), calculated for two years, five years, and 10 years
π = 3.1416
η = effective porosity (decimal percent) (If unknown, assume 0.2)
H = screened interval of well (in feet) (If unknown, assume 10% of gallons per minute pumping rate for well, 10-foot minimum)

Figure 1 below illustrates the variables used in the calculated fixed radius equation.

Figure 1 (Source: EPA)

Using the formula above, you can calculate three radii that will approximate the two-, five-, and 10-year TOTs for each well. Using sample figures, here is how the equation works for each radius:

For two-year TOT, assuming:

Q = 84,320,400 cubic feet/yr (1,200 gallons per minute x 70,267)
t = 2 years
η = 0.25
π = 3.1416
H = 100 feet

Using a calculator, the equation reduces to the following:

Dividing the numbers under the radical yields the following:

Calculating the square root of 2,148,290 square feet yields a radius for the two-year TOT of **1,466 feet** in this example.:

Experts in wellhead delineation recommend rounding the equation result up to the nearest 100, which makes the delineation lines easier to draw on a map and provides an extra margin of safety. In this example, the recommended two-year radius would be **1,500 feet**.

Substituting the number 5 for t in the equation will yield the radius for a five-year TOT as follows:

As with the two-year example, the five-year radius for this well would be rounded up to **2,400 feet**.

To calculate a 10-year radius, substitute the figure 10 for t in the example as follows:

Rounding up to the nearest 100 would yield a 10-year radius for this well of **3,300 feet**.

For the data inputs, maximum well pumping capacity and well depth may be available from well logs. If not, measurements can be made at a well to obtain these figures. Reviewing the drinking water source location information on **Worksheet 5** on p. III-21 with a soil map or other geologic data can provide an estimate for the soil porosity figure.

Use **Worksheet 7** to document the delineation results for each well.

3. Other Methods

Other, more sophisticated methods (e.g., variable shapes, computer modeling) can be used to delineate wellhead protection areas. These methods generally use complex analytical models that require more data inputs than either the Calculated Fixed Radius or Arbitrary Fixed Radius methods. These methods may be useful for delineations in unusual or complex geological settings such as karst (regions characterized by rock dissolution) or fractured rock aquifers that are rapidly recharged.

Advantages

- Greater accuracy than arbitrary fixed radius or calculated fixed radius methods
- May be useful in complex geological conditions

Disadvantages

- Some methods can be costly ($150 to $7,000 per well)
- Complexity

Delineation Method for Surface Water Systems

1. Watershed Area Delineation

Surface water systems present different delineation challenges from groundwater systems. Surface water typically moves much faster than groundwater, and there are fewer natural barriers to filter out contaminants. For those reasons, and others, delineation areas for surface water systems are almost always much larger than for groundwater systems.

The default delineation area for a surface water system is the entire watershed that supplies that system. The watershed delineation area generally is described using a topographic map (one that shows elevations) and connecting the highest points uphill of the drinking water intake structure from which overland flow drains to the intake.

Figure 2 below illustrates a watershed area delineation

Figure 2
(Source: EPA State Source Water Assessment and Protection Programs Guidance, 1997, p. 2-14)

Some Tribes may already have initiated watershed assessments, and data from these activities can be used in delineating a watershed. Use **Worksheets 4-7** to document delineation information for surface water systems.

Advantages of Watershed Delineation:

- Simple, requires only topographic map
- Low cost

Disadvantages of Watershed Delineation:

- Covers large area that may result in overprotection

As noted above, delineating a large land area such as a watershed can make unwieldy the ensuing steps of identifying contaminant sources and managing those sources. Once they have identified the watershed that drains to a drinking water intake, many communities opt to focus their attention on smaller pieces of the watershed, a process called **segmentation**. The areas that are subject to segmentation are referred to as stream segments or sub-watershed areas. Watershed segments closest to an intake structure are likely to be the areas of highest concern for contamination.

Advantages of Segmentation:

- Low cost
- Requires only a good map of area upstream of intake
- Focuses inventory and susceptibility analysis steps on manageable areas
- Most useful in large watershed areas

Disadvantages of Segmentation:

- Lacks precision; may overprotect in some areas, underprotect in others

Figure 3 below illustrates watershed areas segmented for assessments.

Figure 3
(Source: EPA State Source Water Assessment and Protection Programs Guidance, 1997, p. 2-17)

To segment a watershed, begin by delineating the entire watershed, then identify the segments (in rank order from closest to farthest) that contribute water to the intake. In the illustration above, Segment 1 is the area closest to the intake, and Segment 4 areas are farthest from the intake.

Once the watershed is segmented, the contaminant inventory described in Section III-B.3 can be conducted using **Worksheets 8-14** to identify activities within each segmented area that may contribute contaminants to the water system. For segments close to the intake structure, most types of contamination may be found to be significant because there is less opportunity for dilution.

Another useful tool for delineating surface water areas is the **Two-Hour**

Time-of-Travel (TOT) for a stream or river. This figure represents the time it takes water to flow to an intake structure from a point upstream. Real time stream flow data that can be used to calculate two-hour TOT figures are readily available for most major rivers in the U.S. via EPA's "Surf Your Watershed" web site.

Knowing the two-hour TOT for a river is particularly useful in spills or emergencies because it gives a known amount of time before contamination will reach an intake structure. This allows water system personnel to implement emergency measures to mitigate the potential effects of contamination on the water supply.

Worksheet 4

Information Needed for Delineation

Use this worksheet to help collect information that will be used in the delineation process.

DOCUMENTS

- ¬ Well logs for community wells
- ¬ Well logs for private and/or residential wells
- ¬ Topographic map(s) of Tribal lands where wells or surface water intakes are located
- ¬ Geologic or soil maps of areas where wells are located
- ¬ Copies of any previous aquifer studies or watershed studies
- ¬ Copy of wellhead protection program, if any
- ¬ List of all local, state, federal, or Tribal agencies with responsibilities that could affect drinking water sources (e.g., IHS, EPA, BIA, Tribal water resources and environmental protection offices)
- ¬ Copies of recent sanitary surveys, if available
- ¬ Copies of any Tribal ordinances or codes relating to drinking water utilities, groundwater protection, or source water protection
- ¬ Copies of any intergovernmental agreements (e.g., treaties or memoranda) that could affect source water protection program or activities
- ¬ Description of public participation process developed to involve Tribal members in planning and carrying out assessment activities (e.g., hold public hearings, distribute information on assessment activities, etc.)
- ¬ Descriptions of pertinent natural features of Tribal lands such as major lakes, rivers, wetlands, mountain ranges, etc.

DATA

- ¬ Flow rate(s) for surface water bodies used for drinking water; local precipitation data
- ¬ Population served by Tribal water system
- ¬ Service area of Tribal water system
- ¬ Pumping rates for community wells and private wells to be delineated
- ¬ Well depth information

Worksheet 5

Drinking Water Source Location Form

Use this worksheet to record location information about wells or surface water bodies that supply your drinking water. This information will be used to plot the locations of these sources on a map.

Public water system: _____

Name of source (for surface water body): _____

Location date: _____
Source located by (name of person): _____

Organization (if any): _____
Telephone number: (___)_____

Method of determining location:

_____ USGS quad map (7.5 minute series, 1:24,000 scale) hand calculated

_____ USGS quad map (7.5 minute series, 1:24,000 scale) computer calculated

_____ Global Positioning System (GPS)

Unit (manufacturer/model): _____

Accuracy of GPS unit (+/- _____ ft.)

_____ Other method _____

Accuracy of method (+/- _____ ft.)

Location of well/intake (decimal degrees):
Latitude: _____
Longitude: _____

Physical description of well/intake location (name of surface water body, pertinent landmarks, or address):

Worksheet 6

Delineation of Drinking Water Source Protection Area
Use this worksheet to document the method(s) used to delineate protective areas around drinking water wells and/or surface water bodies used for drinking water. See pp. III-12 through III-19 for more information.

A. Delineation method used *(see pp. III-12 - 16 for more information on specific methods)*:

_____ Arbitrary Fixed Radius

_____ Calculated Fixed Radius (show calculations below)

_____ Other (modeling, hydrogeologic mapping, etc.)

B. Explain choice of delineation method and attach documentation supporting that choice:

A. Delineation method used *(see p. III-17 - 19 for more information on specific methods)*:

_____Watershed area delineation
(includes entire watershed uphill of intake)

_____ Watershed area segmented

_____ Time of travel (TOT) calculated

B. Explain choice of delineation method and attach documentation supporting that choice:

Worksheet 7

Delineation Report

Use this worksheet to record the results of your delineations.

Public water system: _____ Date: _____

Well location or number:_____

Well owner:
_____

Delineation conducted by: _____

Delineation method used:_____ Arbitrary Fixed Radius

_____ Calculated Fixed Radius

_____ Other

Delineation for this well:

Two-year TOT = _____ ft.

Five-year TOT = _____ ft.

Ten-year TOT = _____ ft.

Remarks:

Worksheet 7 (cont'd)

Delineation Report

Public water system: _____ Date: _____

Intake structure location:
_____

Delineation conducted by:
_____

Flow rate for this water body: _____

Protected area is: _____ entire watershed upstream of intake
_____ sub-watersheds or segments (describe below)
_____ other (e.g., two-hr TOT with 1,000 foot setback)

Remarks:

B.3 Contaminant Inventory

Once the area around a drinking water source has been delineated, an inventory is made of activities within that area that could release contaminants into the water source. The aim of the inventory is to identify all of the possible contaminant sources using written records (e.g., permits business licenses, land use decisions, etc.), drive-through inspections, interviews with long-time residents, and any other means that will yield as complete a picture as possible about the extent and nature of activities that could contaminate drinking water supplies. In the vulnerability analysis section, an evaluation will be made of which sources are likely to contribute contaminants and which are not.

There are many lists of potential contaminants available from sources such as U.S. EPA and the states. The list included in this section was adapted from the EPA publication, *Wellhead Protection: A Guide for Small Communities* (EPA/625/R/-93/002, February 1993). It has been adapted for this guide into a checklist format that can be used in the field for making your contaminant inventory. A more detailed list of specific chemical and biological contaminants listed by potential source is available on EPA's web site at **www.epa.gov/ogwdw/swp/sources1.html.**

The planning team or advisory committee should define what will be considered "significant sources" for purposes of the inventory and susceptibility analysis. For instance, an aboveground heating oil storage tank located within a delineated area probably would be considered a significant source, while a low-density housing area probably would not.

Use **Worksheet 9** on p. III-27 to document records reviewed for the contaminant inventory. Use **Worksheet 10** on p. III-28 to document potential contaminants observed during the windshield survey, or drive-through inspection. Use **Worksheet 11** on p. III-29 to record information on potential contaminants received from residents living in or near delineated areas. Use **Worksheet 12** on p. III-31 to list abandoned wells found by residents' survey, windshield surveys, or other means. Use **Worksheet 13** beginning on p. III-32 as a checklist for identifying potential contaminant sources. Use **Worksheet 14** on p. III-46 to compile a list of the potential contaminant sources noted on Worksheet 13.

Worksheet 8

Checklist of Contaminant Inventory Activities

Use this checklist to help identify activities or land uses that could be sources of contamination for your water supplies. Check off each task after it is completed.

¬ Review Tribal records for the location and status of potential contaminants (enter this information on Worksheet 9)

¬ Check federal and state data bases for information on Superfund sites and permitted facilities that could be potential sources of contaminants (enter this information on Worksheet 9)

¬ Take a "windshield" (drive-through) survey of delineated areas and note the location of any activities that could be potential sources of contaminants (enter this information on Worksheet 10)

¬ Contact long-time residents to obtain information on historical activities (e.g., abandoned wells or tanks) that could be sources of contamination (enter this information on Worksheet 11)

¬ Make a search for abandoned wells within delineated areas (enter this information on Worksheet 12)

¬ Enter the information gathered in the records review, windshield survey, interviews with long-time residents, and abandoned well survey on the Combined Inventory of Possible Contaminant Sources (Worksheet 13)

Worksheet 9

Records Review for Contaminant Inventory

Use this worksheet to document the records reviewed to identify potential contaminant sources within delineated areas. See Worksheet 13 for a list of potential contaminant sources.

Potential Contaminant Site	Location/ Address	Potential for being contaminant source	Notes

Worksheet 10

Windshield Survey

Use this worksheet to document observations of possible contaminating activities made during a drive-through inspection of delineated areas around drinking water sources. See Worksheet 13 for a list of potential contaminant sources.

Potential Contaminant Site	Location/ Address	Potential for being source of contamination	Notes

Worksheet 11

Residents' Survey

Use this worksheet to document information provided by long-time residents about present or former activities that could contribute contaminants to delineated areas. See Worksheet 13 for a list of potential contaminant sources.

Resident Surveyed	Potential contaminant site(s)	Location/ address	Potential for being source of contamination
Notes:			

Resident Surveyed	Potential contaminant site(s)	Location/ address	Potential for being source of contamination
Notes:			

Worksheet 11 (continued)

Residents' Survey

Resident Surveyed	Potential contaminant site(s)	Location/ address	Potential for being source of contamination
Notes:			
Resident Surveyed	**Potential contaminant site(s)**	**Location/ address**	**Potential for being source of contamination**
Notes:			
Resident Surveyed	**Potential contaminant site(s)**	**Location/ address**	**Potential for being source of contamination**
Notes:			

Worksheet 12

Abandoned Well Survey

Improperly abandoned wells can be a major pathway for contaminants to reach wells. Use this worksheet to document the location(s) of abandoned wells.

Potential contaminant site	Location/address	Notes

Worksheet 13

Contaminant Inventory Checklist

Place a check mark (☐) in the left column to identify each potential contaminant source located within a delineated area. The potential contaminant sources are grouped into categories such as naturally occurring sources, agricultural sources, etc. For each potential source, examples are given of potential contaminants that could be released by that source. Complete the checklist by describing the potential contaminant source(s) (e.g., gasoline station) for each source with a check mark filling in the location data. This checklist is adapted from **Wellhead Protection: A Guide for Small Communities**, *published by U.S. EPA* (EPA/625/R-93/003, February 1993).

Naturally Occurring Sources

☐	Naturally occurring sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Rocks and soils	e.g., metals, iron, arsenic, magnesium, sulfates, fluorides, etc.		
	Contaminated water	e.g., bacteria, salts, viruses		
	Decaying organic matter	bacteria		
	Radioactive materials	e.g., mine tailings, radon gas		
	Natural geological processes	e.g., salt water infiltration of wells		

Agricultural Sources

☐	Agricultural Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Animal feedlots, burial areas	e.g., livestock sewage wastes, chemical sprays/dips, viruses, coliform and noncoliform bacteria		
	Livestock waste disposal areas	livestock sewage wastes, nitrates		
	Crop areas; irrigation sites	e.g., pesticides, motor oil and gasoline from chemical applicators		
	Chemical storage	e.g., pesticides, fertilizers, fuels, solvents		
	Farm machinery	e.g., fuels, grease, oil, pesticides		
	Agricultural drainage wells and canals	e.g., fertilizers, pesticides, bacteria		

Residential Sources

☐	Residential Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source
	Household chemicals	e.g., cleaners, bleach, paint and varnish removers, motor oil, kerosene, heating oil		
	Lawns/gardens	e.g., fertilizers, pesticides, gasoline		
	Swimming pools	pool maintenance chemicals such as chlorine		
	Septic systems and sewage lines	e.g., septage, bacteria, viruses, metals, oils, household chemicals		
	Underground storage tanks	home heating oil		
	Apartments and condominiums	e.g., pool chemicals, pesticides, fertilizers, household wastes		

Municipal Sources

☐	Municipal Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Schools, government buildings and grounds	e.g., pesticides, solvents, fuels, general building wastes		
	Parks Highways, roads	e.g., fertilizers, pesticides e.g., herbicides, road salt, fuels, oil		
	Municipal sewage	e.g., bacteria, viruses, sludge, sewage treatment chemicals such as chlorine		
	Storage, treatment, and disposal ponds and other surface impoundments Sewer overflows	e.g., sewage wastewater, liquid chemical wastes, bacteria, viruses e.g., bacteria, viruses, oil		
	Recycling facilities Landfills Illegal dumps and open burning areas	e.g., waste oil, metals e.g., chemicals, oil e.g., chemicals, metals, oil, solvents		

Municipal Sources (cont'd)

☐	Municipal Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Municipal	e.g., metals,		

	incinerators Abandoned wells	chemicals, sulfur e.g., fuels, oils, surface runoff		
	Water supply wells, livestock wells Drainage wells Sumps and dry wells	e.g., surface runoff, effluent from feedlots, septic tanks, used motor oil e.g., pesticides, bacteria e.g., storm water runoff, spilled liquids, fuels, pesticides		
	Artificial groundwater recharge	e.g., storm water runoff, excess irrigation water, treated sewage effluent that may contain metals, detergents, bacteria, chemicals		

Commercial Sources

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Airports, abandoned airfields	e.g., aircraft fuels, solvents, de-icers, automotive wastes		
	Auto repair shops	e.g., waste oils, solvents, acids, paints, antifreeze		
	Barber and beauty shops	e.g., perm solutions, dyes, miscellaneous chemicals in hair rinses		
	Boat yards and marinas	e.g., diesel fuels, septage from board waste disposal areas, wood preservatives, paints, waxes		
	Bowling alleys	e.g., epoxy, floor finishes		
	Car dealerships	e.g., auto wastes, oils, solvents, paints, miscellaneous wastes		
	Car washes	e.g., soaps, detergents, waxes		

Commercial Sources (cont'd)

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Campgrounds	e.g., septage, gasoline, pesticides, household hazardous wastes		
	Carpet stores	e.g., glues and other adhesives, fuel from storage tanks if forklifts used		
	Cemeteries	e.g., leachate, lawn and garden maintenance chemicals		
	Construction areas	e.g., solvents, asbestos, paints, glues, waste insulation, tars, sealants, chemicals		
	Dry cleaners	e.g., solvents, spotting chemicals		
	Furniture repair and refinishing	e.g., paints, stains, solvents		
	Gasoline service stations	e.g., oils, gasoline, solvents		

Commercial Sources (cont'd)

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Hardware and lumber stores	e.g., hazardous chemical products in		

		inventories, wood stains and preservatives		
	Heating oil suppliers	e.g., heating oil, storage tanks, waste from truck maintenance areas		
	Horticultural practices	e.g., herbicides, insecticides, fungicides		
	Jewelry/metal plating	e.g., sodium and hydrogen cyanide, metallic salts, acids		
	Laundromats	e.g., detergents, bleaches, fabric dyes		
	Medical institutions	e.g., X-ray developers/fixers, infectious wastes, disinfectants, radioactive wastes, drugs		

Commercial Sources (cont'd)

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Office buildings	e.g., building wastes, lawn and garden maintenance chemicals		
	Paint stores	e.g., paints, stains, solvents, wood treatment chemicals		
	Pharmacies	e.g., spilled and		

		returned products		
	Photography shops and labs	e.g., silver sludges, cyanides		
	Print shops	e.g., inks, solvents, photographic chemicals		
	Railroad tracks and yards	e.g., diesel fuel, herbicides for rights-of-way, wood preservatives		
	Research laboratories	e.g., X-ray developers/fixers, infectious wastes, radioactive wastes, disinfectants, drugs		

Commercial Sources (cont'd)

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Scrap and junk yards	e.g., any wastes from businesses or households such as metals, chemicals		
	Storage tanks	e.g., heating oil, gasoline, diesel fuel		
	Transportation services	e.g., waste oil, solvents, gasoline, diesel fuel		
	Veterinary services	e.g., solvents, infectious wastes, vaccines,		

		disinfectants		

Industrial Sources

☐	Industrial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Materials stockpiles (coal, metallic ores)	e.g., acid drainage		
	Waste tailing ponds	e.g., acids, metals, radio-active ores		
	Transport and transfer stations	e.g., fuel tanks, repair shop wastes		
	Storage tanks (aboveground and underground)	e.g., heating oil, diesel fuel, gasoline, other petroleum products		
	Storage, treatment, or disposal ponds & other surface impoundments	e.g., sewage wastewater, liquid chemical wastes, bacteria, viruses		
	Chemical landfills	e.g., hazardous and nonhazardous liquid wastes		
	Radioactive waste disposal sites	e.g., radioactive wastes from medical facilities, power plants, or defense operations		
	Dry wells	e.g., saline water		
	Injection wells	e.g., oil-field brines		

Industrial Process Sources

☐	Industrial Processes	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Asphalt plants	e.g., petroleum		

		derivatives		
	Communications equipment manufacturers	e.g., acid wastes, metal sludges, etchants, cutting oils, plating wastes		
	Electric and electronic equipment manufacturers	e.g., cyanides, solvents, acids, paints, PCBs, etchants		
	Foundries and metal fabricators	e.g., heavy metals, paint wastes, plating wastes, solvents, oils		
	Furniture and fixtures manufacturers	e.g., paints, stains, solvents, degreasers		
	Machine and metal-working shops	e.g., solvents, lubricants, degreasers, metals		
	Mining operations	e.g., mine spoils or tailings, acids, corrosive mineralized waters		
	Unsealed abandoned mines used as waste pits	e.g., metals, acids, minerals, sulfides		

Industrial Process Sources (cont'd)

☐	**Industrial Processes (continued)**	**Potential Contaminants**	**Potential Contaminant Source(s)**	**Location (distance from drinking water source)**
	Paper mills	e.g., metals, acids, chlorine		
	Petroleum production and storage companies	e.g., petroleum products and derivatives, oil-field brines		

	Industrial pipelines Photo processing laboratories	e.g., corrosive fluids, hydrocarbons e.g., silver sludges, cyanides		
	Plastics materials and synthetics producers Primary metal industries (blast furnaces, rolling mills) Publishers, printers, and allied industries	e.g., solvents, oils, cyanides, acids, formaldehyde e.g., heavy metal wastewater sludge, pickling liquor, waste oil, degreasers e.g., inks, dyes, solvents, photographic chemicals		
	Public utilities	e.g., PCB from transformers and capacitors, oils, solvents, metal plating solutions		

Industrial Process Sources (cont'd)

☐	**Industrial Processes (continued)**	**Potential Contaminants**	**Potential Contaminant Source(s)**	**Location (distance from drinking water source)**
	Sawmills and planers Stone, caly, and glass manufacturers	e.g., treated wood residue, wood preservatives, paints, glues e.g., solvents, oils and grease, glazing materials, metal sludges		
	Welders	e.g., oxygen,		

		acetylene		
	Wood-preserving facilities	e.g., wood preservative chemicals, creosote		

Example of Completed Checklist Page

☐	Commercial Sources	Potential Contaminants	Potential Contaminant Source(s)	Location (distance from drinking water source)
	Carpet stores	e.g., glues and other adhesives, fuel from storage tanks if forklifts used		
	Cemeteries	e.g., leachate, lawn and garden maintenance chemicals		
☐	Construction areas	e.g., solvents, asbestos, paints, glues, waste insulation, tars, sealants,	*open containers of paints and solvents stored in uncovered yard*	*Route 7 residential housing project; 1,200 feet west of Tribal Well #2*

		chemicals		
	Dry cleaners	e.g., solvents, spotting chemicals		
	Furniture repair and refinishing	e.g., paints, stains, solvents		
☐	Gasoline service stations	e.g., oils, gasoline, solvents	*single-wall underground gasoline storage tank*	*12345 Old Stagecoach Rd.; 1,000 feet north of Buckeye Creek tributary to Blue River*
	Hardware and lumber stores	e.g., hazards chemical products in inventories, wood stains and preservatives		

Worksheet 14

Combined Inventory of Potential Contaminants

Use this form to enter all of the potential contaminants checked off on Worksheet 13.

Site	Location/ address	Why is it a potential source?	Notes

Worksheet 14 (cont'd)

Site	Location/ address	Why is it a potential source?	Notes

B.4 Susceptibility Determination

The final step in the SWAP process is to make a determination of the susceptibility of each drinking water source to contamination. The goal of susceptibility determination is to identify those drinking water sources that are most vulnerable to contamination so that measures can be taken to protect them. There are several approaches to susceptibility determination, but they all look at the following factors:

- the structural integrity of the well or intake;
- the sensitivity of the natural setting (e.g., soil characteristics);
- the presence of potential sources of contamination (i.e., what kinds of contaminants are near the water source and how close are they?);
- historical water quality results for the drinking water source; and
- the relationships among these factors to estimate the probability that contamination will move from the potential sources into a drinking water system.

This section will summarize two methods of making a susceptibility determination, a narrative approach and risk ranking. State source water assessment and protection programs each have their own susceptibility determination methods, and these can be good sources of information. Links to each state's SWAP program and plan can be accessed from EPA's web site at **www.epa.gov/ogwdw/source/contacts.html**.

The narrative approach generally is considered to be the simplest method for susceptibility analysis. It gives a narrative description that summarizes the assessment results. The narrative process can be used to identify areas in the assessment that need more attention or evaluation and to provide pointers to actions that could be taken in the protection phase. Several states, including Ohio and Wisconsin, use this approach in their SWAP plans.

The narrative approach may be particularly useful for analyzing the susceptibility of surface water systems, which typically cover large land areas and may have more variable hydrologic conditions than groundwater systems.

The narrative process focuses on the same factors as those used in the risk ranking approach described below, but does not assign numerical weights to the different factors.

The four major areas of emphasis in the narrative approach are:

- understanding the hydrologic or hydrogeologic setting;
- summarizing the potential significant contaminant sources;
- reviewing the water quality data for the drinking water source; and
- assessing the relative susceptibility of drinking water sources to contaminants.

Understanding the hydrologic setting (for surface water systems) involves gathering data on the watershed area delineated in Section B.2 such as number of stream miles, stream flow, average precipitation and runoff, average stream gradient, general soil characteristics. For groundwater systems (hydrogeologic setting), it requires information about local soil and geologic conditions, well pumping rates, and aquifer characteristics (confined or unconfined).

The summary of potential significant contaminant sources presents the assessment findings reported on Worksheets 13 and 14 in narrative form. Factors discussed here include the distance of the potential contaminants from the drinking water source, the quantity and concentration of the contaminant, and its potential for release into the water supply (e.g., its mobility), and the effectiveness of source control measures to keep the potential contaminant out of the water system.

The review of water quality data examines testing records for the water source to see if contaminants identified in the inventory have appeared in the water supply and in what quantities. Documented water quality contamination usually is considered evidence of susceptibility. The narrative also should discuss the levels at which detected contaminants are considered to have water quality impacts. For instance, Ohio assumes that water quality is affected if synthetic organic compounds or volatile organic compounds are reported at or above the level of detection. For nitrates, the threshold is 3 milligrams per liter of water or greater.

Assessing the relative susceptibility of a drinking water source identifies which sources of contamination pose the most serious threats and should be addressed first. It may be useful to consult with other local water-quality agencies, or with U.S. EPA, for help in identifying which contaminant sources are of greatest concern.

The narrative approach to susceptibility analysis makes reporting assessment results to the Tribe a fairly simple matter. The narrative prepared for susceptibility analysis can be easily adapted for reporting assessment findings and recommendations to the Tribe.

Pages 50-52 present examples of narratives for susceptibility analysis included in Ohio's SWAP.

The second approach used in this workbook ranks potential contaminant sources using a matrix and values assigned to several factors that can affect water quality. Risk ranking generally is considered to be a more complex approach to susceptibility analysis than is the narrative approach described above. Several states, such as California and Arkansas, use this approach in their SWAP programs. The factors used in this approach include the following:

- **Potential Contaminant Source** – what is the source of the contaminant (see Worksheet 14)?
- **Contaminant(s)** - what specific contaminants are associated with the source, and at what concentration?
- **Location** - how far is the contaminant from the drinking water source?
- **Natural Barriers** - do the soil or surface conditions inhibit contaminants from reaching the drinking water source or reduce their toxicity?
- **Intake or Well Integrity** - how well is the drinking water system protected against potential contamination?
- **History** - have contaminants from this source been detected in the drinking water source at levels exceeding maximum contaminant levels (MCLs)?

An example (Figure 4) of a risk-ranking matrix appears on the next page. The higher the score, the more likely a contaminant source is to be a threat to drinking water quality. Page III-555 explains how to fill in the fields on the matrix.

Figure 4
Example of Risk-Ranking Matrix Used in Susceptibility Determination

A Potential Contaminant Source	B Contaminant* High Concern = 3 Moderate Concern = 2 Low Concern = 1	C Location within delineation area? Yes = 1 No = 0	D Natural barriers (e.g., clay layer above aquifer) Low = 2 Moderate = 1 High = 0	E Intake integrity (for surface water systems) 1 = more than 10 years old 0 = less than 10 years old	F Well Integrity (ground-water systems) 1 = poor condition 0 = good condition	G History contami-nant detected in this source? 1 = Yes 0 = No	H Total

*This factor includes the toxicity and quantity of the contaminant. A carcinogen or disease organism (e.g., *giardia lamblia*) present in large quantity would rank higher than a chemical that produces no systemic effects and is present in small quantities.

Here is how to complete this kind of matrix:

Column A - Enter the name of the contaminant and its source from Worksheet 14

Column B - Rank each contaminant as High, Medium, or Low. High-ranked contaminants are chemicals such as carcinogens, and chemicals or biological contaminants for which maximum contaminant levels (MCLs) have been established. Moderate-ranked contaminants are those that may cause health-related disorders, but are not as toxic as high-ranked contaminants. Low-ranked contaminants are those that do not produce systemic health effects.

Rankings should consider both the toxicity of the contaminant and the quantity present at the source site. Thus, even a small amount of a highly toxic contaminant such as arsenic may warrant a high ranking.

Column C - Sources located inside a delineated area are given a higher weight because distance from the wellhead or intake structure tends to reduce the concentration of contaminants.

Column D - Natural barriers are features such as subsurface clay layers that tend to block or slow down the movement of contaminants toward a drinking water source. The presence of these barriers can reduce the potential for contamination by reducing the concentration of a contaminant or neutralizing it through natural processes. Porous soils or karst aquifers tend to have low natural barrier effectiveness. Aquifers overlaid with clay layers, or surface water bodies surrounded by thick vegetation, tend to have higher natural barrier effectiveness. If you are unsure how to rank your water source, select moderate.

Column E - For surface water systems, this column includes conveyances (open canals or aqueducts), intake pumps, and distribution systems. Intake structures and distribution systems with cracks or leaks can allow contaminants to enter the system. For purposes of this matrix, intake structures more than 10 years old are presumed to be less well protected against contaminants than are structures less than 10 years old. A thorough inspection and testing of the intake structure and distribution system will identify areas where improvements may be needed to strengthen system integrity.

Column F - For groundwater systems, this column includes the wellhead apparatus and distribution piping. Faulty casing, cracks in sanitary seals, or loose pipe joints could allow contaminants to enter a well or distribution system. Well inspection and maintenance records, if available, can provide useful information for completing this column. Also, a visual inspection of each wellhead should be made to ensure that surface water drains away from the wellhead and the sanitary seal is intact.

Column G - The history of contamination detection at a water source can be an indication of its susceptibility. This column assigns a weighting if a contaminant has been detected in the water source before this assessment.

Column H - Totaling all the numbers across the matrix yields an approximation of how serious a risk each potential contaminant source poses to your drinking water supply. The totals can be used to rank the potential contaminant sources so they can be addressed during the protection phase in some kind of priority order. The higher the number in Column H, the more likely the drinking water source is to be susceptible to that contaminant source.

The ranking that results from using the matrix need not dictate which sources are addressed first in the protection phase, or what actions are taken. Rather, it is the starting point for further evaluation and discussion. Deciding which potential contaminant sources to address in the protection phase will depend on Tribal priorities, resources, and input from the community.

B.5 Communicating Results to the Tribe

The fourth and final step in the SWAP process is to communicate the results of the assessment to the Tribe. This can be done in several ways. If narratives were prepared for the susceptibility analysis, they can be made available at a central location, or provided to stakeholders such as the utilities manager, environmental officer, or water manager. If the more complex risk ranking approach was used, the results will need to be summarized using terms understandable to Tribal members.

A second way of communicating results to the Tribe is to include summaries of assessment results in Consumer Confidence Reports (often called "CCR Reports") sent to water system customers. States are required to include summaries of assessment results when CCRs are sent with local water utility bills. Again, narrative susceptibility analyses can be summarized easily for inclusion in CCR reports.

A third way is to communicate the results of the assessment process is to present a written and/or oral report to the Tribal governing body. Such a report will give the governing body important information it may need to develop protective measures or direct action by Tribal officials.

C. Building a Source Water Protection Program

Once the assessment phase is completed, the focus shifts to protection. Assessment activities may continue when new sources are discovered, or new drinking water sources are brought on line. **Worksheet 16** (Annual Source Water Protection Program Checkup) on p. III-63 helps track new drinking water sources and other changes that could trigger assessments.

The source water protection program, or SWPP, uses information collected in the assessment phase to develop community-based strategies for long-term protection of drinking water sources. Public notification and participation are key parts of the process, giving community members input into the decisionmaking process.

The protective strategies need not be new initiatives or major departures from existing Tribal policies. They could be as simple as enforcing existing codes or ordinances against activities that contribute to elevated susceptibility. For instance, reducing the susceptibility of a well to contamination by petroleum products may be as simple as helping a service station owner follow better housekeeping practices to prevent spills and leaks. Or it could be educating septic tank owners about proper use and maintenance practices.

The planning team or advisory committee plays a key role by weighing the pros and cons of various protective strategies against the susceptibility determinations and recommending the most health-beneficial and cost-effective strategies. Completing **Worksheet 15** on p. III-62 will help you evaluate the pros and cons of various strategies. Keeping those strategies consistent with the Tribe's culture and resources, its legal framework, and overall environmental policies will be important.

C.1 Strategies for Protecting Drinking Water Sources

Management strategies for protecting drinking water fall into two broad categories: nonregulatory strategies and regulatory strategies. The choices of which strategies to pursue will depend on a Tribe's resources, its legal framework, and nature of the contaminant sources. Tribes with well developed legal systems may be comfortable using tools such as zoning or land-use permits. However, other Tribes may find nonregulatory approaches more feasible and useful for their situations.

Protection need not mean developing new programs or legal regimes. Although some legalistic methods such as zoning and ordinances are discussed in this section, Tribes should consider using those strategies that will be effective, yet fit with their culture, legal structure, and enforcement capabilities.

a. Nonregulatory Strategies

Nonregulatory strategies are those that do not require enactment of any new codes or enforcement activities. Nonregulatory strategies usually are the least costly options, but their effectiveness in managing threats to drinking water quality can vary. Here are some nonregulatory strategies recommended by EPA:

- **Public education** – encouragement for voluntary protection and conservation measures by Tribal members.
  Examples: newspaper articles, pamphlets, community meetings, presentations to Tribal governing body. Post signs at the perimeters of source water protection areas advising Tribal members and others of the boundaries and the need to avoid activities that could cause contamination. Include source water protection as part of school curricula. Contact landowners with potentially contaminating activities (e.g., chemical or fuel storage, poorly constructed septic systems) within delineated areas and educate them about the importance of preventing release of materials that could contaminate water sources. Giving private well owners information on proper well maintenance procedures.

- **Acquire land in the wellhead protection area** – purchase by the Tribe of land inside a wellhead protection area or adjacent to a surface water body and dedication of that land to purposes with low potential for contaminating drinking water resources.
  Example: purchase former gasoline service station site, clean up any contamination such as underground storage tank leakage, and dedicate future land use to habitat preservation.

- **Install monitoring wells** – relatively expensive option that uses wells drilled outside the protection area to detect contaminants moving toward a drinking water well. If contaminants are observed through monitoring, the Tribe can take steps to provide alternate supplies or remediation.

- **Water Conservation** – an often overlooked, but important nonregulatory strategy. Conserving water can prolong the life of a well by reducing the pumping rate, which in turn reduces the rate at which contaminants are attracted to the well. Reducing the rate at which water is used will reduce wastewater discharges that could contribute contaminants to surface water bodies. In addition, conservation is something to which every Tribal member can contribute.
  Examples: distribute low-cost, water-saving showerheads to households; encourage or subsidize new, low-flush toilets

- **Hazardous materials collection** – encourage safe disposal of hazardous materials.
  Examples: sponsor a reservation-wide event to collect household hazardous wastes such as paints, stains, cleaners, solvents, etc., that if spilled within the protected area could contaminate groundwater; publicize the importance of proper storage, use, and disposal of pesticides and herbicides.

- **Best Management Practices (BMPs)** – this strategy encourages businesses to adopt standard industry practices for handling and using of hazardous materials.

b. Regulatory Strategies

Regulatory strategies are mandatory controls designed to protect drinking water sources against contamination. These strategies usually involve establishing standards or codes of conduct for activities that could contaminate water resources. Some of these strategies may require adoption by the Tribal governing body of codes or ordinances.

- **Zoning** – this strategy is commonly used by communities to regulate activities in specified areas (e.g., the type of housing or industry that can be built in a specific area). Zoning could enable a Tribe to prohibit activities such as pesticide storage within a designated area that potentially could affect a water source.

- **Health regulations** – setting health-based Tribal standards for the construction, location, and operation of facilities such as septic tanks and landfills that can be major sources of potential drinking water source contamination. The Tribe could consider adopting a permit system to regulate septic tanks or landfill operations.

- **Restricting storage and use of hazardous materials** – adopting codes or ordinances that regulate how and where businesses or individuals may store or use designated materials. If your Tribe has a hazardous materials (HAZMAT) plan or program, it may be possible to adapt that program for use in the source water protection program.

- **Wellhead abandonment regulations** – abandoned wells can be significant entry points for contaminants to reach groundwater. If your Tribe has a large number of abandoned wells, establishing requirements for owners to properly close and seal wells could help reduce this possible contamination source. Also, the Tribe could adopt an ordinance or regulations requiring owners to follow specified procedures when they close a well.

- **Establish buffer zones or setbacks** – designate areas around wells or surface water bodies that will be off-limits for activities that potentially could release contaminants to a water source. Setbacks can be particularly useful for surface water bodies to slow the velocity of moving water and encourage dropping of contaminated sediments on land before they reach the water body.

- **Leases** – review land leases to ensure that land uses are compatible with Tribal interests, and

negotiate changes if necessary.

Whatever strategies are adopted, it is important to review them periodically to see how effective they have been in protecting water sources against contamination.

Worksheet 15

Evaluation of Management Strategies

Use this worksheet to help evaluate the pros and cons of various strategies for minimizing or preventing contamination of drinking water sources.

Option	Advantages	Limitations	Resources Needed

c. Planning for the Future

Source water assessment and protection is a dynamic process that changes with time, economic fortunes, and sometimes even the weather. For those reasons, it is important to plan for future contingencies and periodically review and update SWAP and SWPP programs. Without regular review and updating, the programs could become outdated or ineffective.

Planning for the future has two parts: (1) identifying potential problems and devising solutions, and (2) developing contingency plans for emergencies.

A drinking water source assessment and protection program is a snapshot of a Tribe's water resources and the potential contaminants that could threaten it. It reflects conditions at the time the program was developed. What about future conditions? How might economic development plans or resource-management programs a Tribe is developing now affect its water resources later?

The source water protection program should try to anticipate developments that could affect the Tribe's drinking water resources in the future. These include everything from natural disasters (e.g., flooding), to plans for new housing developments, to economic development projects. Any of these potentially could affect the quality of drinking water resources.

For example, consider how a large housing development might affect groundwater resources. This may seem like a relatively "clean" development, but there are several aspects of construction and operations that could affect water resources, such as:

- increased pumping of groundwater resources to supply the housing project could attract potential contaminants to wellheads at faster rates;
- additional solid waste generated by the project could increase landfill size and runoff to recharge areas;
- additional wastewater generated by the project could exceed treatment capacity;
- new roads and parking areas could reduce recharge rates of underground aquifers and concentrate pollutants in runoff; and

- increased motor vehicle traffic could mean higher potential for spills of petroleum products and hazardous materials, or runoff to surface water bodies.

On the plus side, development of new housing might require construction of modern sewage treatment systems on reservations that could replace septic tanks that can be potential major sources of groundwater contamination. It also could spur development of centralized landfills outside of recharge areas that might reduce open dumping in protected areas. These are the kinds of issues that the Tribal planning team could address when considering future problems.

In some instances, delineated areas around Tribal water sources may extend beyond reservation boundaries or cover land not directly under the Tribe's control. Cooperative approaches to managing activities in such areas are desirable, but the Tribe may wish to consider including conflict-management procedures in its SWPP, such as arbitration or mediation, to resolve disputes.

A good place to look for possible future challenges to the drinking water source protection program is the Tribe's economic development plan. SWPP considerations can be integrated into overall community planning procedures to ensure that the potential effects of new development do not adversely affect groundwater supplies or surface water quality.

Updating information in your drinking water source protection plan each year will help track changes that could affect source water quality. **Worksheet 16** on p. III-66 provides a handy form for recording changes to your drinking water source protection program.

d. Contingency Planning

The second part of planning for the future is anticipating emergencies and devising appropriate responses to those situations. Just as communities employ fire departments to put out fires, there should be procedures in place to deal with emergencies that could affect drinking water supplies. These procedures should address both long-term and short-term situations.

An example of an emergency situation that could trigger a contingency plan is a highway spill of oil or gasoline near a tributary to a surface water body. Knowing the time of travel (TOT) discussed in the delineation section may be important in deciding if contingency measures need to be implemented.

A contingency plan should address the following issues raised by the spill:

- What is the time-of-travel (TOT) from the spill point to the drinking water intake structure?

- ¬ Who is the lead Tribal official for emergency response involving the water system?

- ¬ Who is responsible for cleaning up the spill?
- ¬ What steps will be taken to ensure that the drinking water source is protected (chain of actions)?

- ¬ Have arrangements been made for replacement water, if needed?

Using the gasoline or oil spill example, here are the response actions that a contingency plan would trigger:

- ¬ Immediately notify pre-designated Tribal officials. There should be a single Tribal official, such as the utilities manager, designated in advance to act as lead person for carrying out the contingency plan. However, other Tribal departments, such as law enforcement, hazardous materials release response, environmental protection, public health, and fire protection, also should be involved.

- ¬ Check right-of-way agreements for pipelines of transportation lines that cross Tribal lands to ensure that they clearly spell out responsibilities for spill cleanups and emergency response.

- ¬ Assess source and extent of contamination and potential risk to the Tribe's water supply. Determine time-of-travel from spill site to drinking water intake.

- ¬ Notify customers and appropriate federal, state, or local agencies, if necessary.

- ¬ Keep accurate records of each incident for later use in enforcement proceedings against parties responsible for the spill.

- ¬ Take prompt remedial action(s) to ensure continuing supply of safe drinking water, such as increased monitoring and testing, treatment or blending if necessary, or arranging for alternative supplies from stored water, groundwater, bottled water, etc.

- ¬ Review the spill incident and responses to it. Update or amend the surface water protection program as necessary to include new procedures or equipment.

Worksheet 16

Annual Source Water Protection Program Checkup

Public water system: _____ Date: _____

Your name: _____ Title: _____

Have delineations been completed for all drinking water sources?

- ¬ Yes
- ¬ No

List names and locations of new wells or surface water intakes installed since last update:

1. _____Date: _____

2. _____Date: _____

3. _____Date: _____

4. _____Date: _____

5. _____Date: _____

List delineations completed since last update:

1. _____Date: _____

2. _____Date: _____

3. _____Date: _____

4. _____Date:_____

5. ____Date: _____________

List any new facilities in protected areas since the last update:

1. _____

2. _____

3. _____

4._____

5. _____

List any changes in existing sites that may increase the potential to contaminate surface water bodies:

Describe any maintenance or changes performed on intake structures, well apparatus and conveyances since last update (e.g., new hardware installed, parts replaced, periodic maintenance performed):

Were contingency plans implemented at any time since last update?

- ¬ Yes
- ¬ No

If so, what changes, if any, are needed in the contingency plans?

Were any new management strategies introduced since last update?

- ¬ Yes
- ¬ No

Describe any new strategies and the reasons for their adoption:

Describe any environmental changes that have affected drinking water sources and surrounding land (e.g., erection of diversions such as dams, flooding, fire, etc.):

Section Four: Resources

This section lists a variety of resources that contain additional information or data that may be useful in drinking water source assessment and protection programs. Included in this section are publications, Internet sites, government agencies, and private organizations that provide information and assistance on drinking water quality issues.

A. Publications *(For ordering information, see end of this section)*

A.1 Groundwater

Case Studies in Wellhead Protection: Ten Examples of Innovative Wellhead Protection Programs, EPA 992 (813-R-92-002), 38 pp.

Consensus Building: A Primer for Local Leaders. The Groundwater Foundation. 1999. 16 pp.

Groundwater Reference Guide. Perlin, M. Elizabeth, K. Parker and L. Helstowski. 1991. Michigan State University, East Lansing, MI. To order free copy, call 517- 353-3742.

Guide to Groundwater Supply Contingency Planning for Local and State Governments: Technical Assistance Document, EPA 1990 (440-6-90-003), 83 pp.

Guidelines for Wellhead and Springhead Protection Area Delineation in Carbonate rocks. U.S. EPA May 1997. EPA 904

Handbook – Ground Water and Wellhead Protection, EPA 1994 (EPA 625-R-94-001)

Layperson's Guide to Drinking Water, Water Education Foundation, 1997

Layperson's Guide to Groundwater, Water Education Foundation, 1998

Nitrate in Ground Waters of the United States – Assessing the Risk, USGS 1996 (USGS Fact Sheet

092-96)

Pesticides in Ground Water, – Current Understanding of Distribution and Major Influences, USGS 1996 (USGS Fact Sheet 244-95-1996)

Planning for Wellhead Protection for Ground Water from Whippany*, Chatham, and Millburn Valleys of the Buried Valley Aquifer Systems.* Passaic River Coalition. Price: %19. 908-766-7550.

The Power to Protect: Three Stories About Groundwater*.* The Massachusetts Audubon Society. 1990. 32-minute video. Price: $20 plus $4 shipping and handling. 617-259-9500, ext. 7255.

Progress in Protecting Drinking Water Supplies, National Rural Water Association 1995

Protecting Local Ground-Water Supplies Through Wellhead Protection*.* U.S. EPA 1991. EPA 570/09-91-007.

State Source Water Assessment and Protection Programs, Final Guidance, EPA August 1997 (EPA 816-R-97-009), 140 pp.

Tribal Wellhead Protection Demonstration Projects, EPA July 1995 (EPA 813-R-95-001), 140 pp.

Wellhead Protection: A Guide for Small Communities, EPA February 1993 (EPA/625/R-93-1002), 144 pp.

Why Do Wellhead Protection? Issues and Answers in Protecting Public Drinking Water Supply Systems, EPA May 1995 (EPA 813-K-95-001)
-B-97-003.

A.2 Drinking Water

Consumer Confidence Report Fact Sheet*.* U.S. EPA August 1998. EPA 816/F-98-007. www.epa.gov/OGWDW/Pubs/new/bdwinf.html/

Drinking Water Protection Begins at Home*.* Farm*A*Syst/Home*A*Syst. 2000.

Drinking Water Quantity in Indian Country: Protecting Your Sources*.* U.S. EPA Office of Ground Water and Drinking Water. 2000. EPA 816-F-00-005.

Strategies for Effective Public Involvement: Drinking Water Source Assessment and Protection*.*

League of Women voters Education Fund. 1998. Cost: $10 .00 ($5.00 for members). Free copies also available from EPA, call 202-260-1905.

Twenty-Five Years of the Safe Drinking Water Act: History and Trends. U.S. EPA Office of Water. EPA916-R-99-007.

Water on Tap: A Consumer's Guide to the Nation's Drinking Water. U.S. EPA. July 1997. EPA B15-K-97-001.

A.3 Source Water

A Small Town Source Water Primer: Building Support for Protection Programs. National Center for Small Communities (NCSC). 2000. Available from NCSC (see "Organizations" section) or through URL site: www.natat.org/NCSC/Primer .

An Introduction to Drinking Water Source Assessment and Protection, Workshop Guide and Participant Materials. The Groundwater Foundation. 1999.

Catalog of Federal Funding Sources for Watershed Protection. U.S. EPA Office of Water, #EPA 841-B-97-008. September 1997. www.epa.gov/OWOW/watershed/wacademy/itsannot.html.

Protecting Sources of Drinking Water: Selected Case Studies in Watershed Management. U.S. EPA. April 1999. EPA 816-R-98-019.

Source Water Assessment and Protection, brochure. The Groundwater Foundation. 1999.8 pp.

Source Water Protection: An Ounce of Protection, (video), American Water Works Association Satellite Teleconference. 2 tapes, 2hrs. 10 min/tape.

Source Water Protection: What's In It for You? America Water Works Assoc. Opflow, v. 22, no. 4, April 1996.

Source Water 2000: Funding and Assistance Programs to Protect Small Town and Rural Drinking Water. National Center for Small Communities. 1998. natat.org/ncsc/Action%20Guide/source_water_2000.htm#3 .

State Source Water Assessment and Protection Programs, Final Guidance, EPA August 1997. EPA

816-R-97-009. 140 pp.

A.4 Internet Resources

Know Your Watershed. www.ctic.purdue.edu/Contacts/Contacts.html.

Model Ordinances to Protect Water Quality. U.S. EPA. Website addressing aquatic buffers, erosion and sediment control, open space development, stormwater control, operation and maintenance, illicit discharges and post-construction runoff control. www.epa/gov/owow/nps/ordinance

Surf Your Watershed. U.S. EPA. Maps and information on delineated U.S. watersheds. www.epa.gov/surf .

U.S. EPA Source Water Assessment and Protection Program.
www.epa.gov/safewater/protect/tribe.html.

A.5 Surface Water

Effective Watershed Management for Surface Water Supplies, AWWA Publication #90587

Investigation of Hydrogeologic Mapping to Delineate Protection Zones Around Springs: Report of Two Cast Studies, EPA July 1997 (EPA/600R-97-023), 60 pp.

State Methods for Delineating Source Water Protection Areas for Surface Water Supplied Sources of Drinking Water, EPA August 1997 (EPA 816-97-008), 36 pp.

State Source Water Assessment and Protection Programs, Final Guidance, EPA August 1997 (EPA-816-R-97-009), 140 pp.

A.6 Delineation

A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, Version 2.0, EPA 1991

Delineation of Source Water Protection Areas, A Discussion for Managers; Part 1: A Conjunctive Approach for Ground Water and Surface Water, EPA October 1997 (816-R-97-012)

Guidelines for Delineation of Wellhead Protection Areas, EPA 1987 (EPA/440/6-87-010)

Model Assessment for Delineating Wellhead Protection Areas, EPA 1988 (EPA/440/6-88-002), 267 pp.

State Methods for Delineating Source Water Protection Areas for Surface Water Supplied Sources of Drinking Water, EPA August 1997 (EPA 816-R-97-008), 36 pp.

A.7 Publication Ordering Information

American Water Works Association (AWWA)
6666 W. Quincy Ave.
Denver, CO 80235
800-926-7337

National Rural Water Association
2915 S. 13th St.
Duncan, OK 73533
580-252-0629

U.S. Environmental Protection Agency
National Service Center for Environmental Publications
800-490-9198

U.S. Geological Survey (topographic maps, satellite photos, etc.)
U.S.G.S. Information Services
Box 25296
Denver, CO 80225
1-888-ASK-USGS (275-8747)

Water Education Foundation
717 K St., Suite 317
Sacramento, CA 95814
916-444-6240

www.water-ed.org

B. Federal Agencies

A list of federal agencies and their web sites that contain either general information on protecting drinking water sources and/or information about programs to assist Tribes.

Bureau of Indian Affairs
Division of Water and Land Resources
202-208-1255
www.doi.gov/bureau-indian-affairs.html

Bureau of Reclamation
www.usbr.gov/water/water.html

Department of Agriculture, Rural Utilities Service (loans and grants for improving rural drinking water and wastewater treatment systems)
www.usda.gov/rus/water

Department of Commerce (grants for economically distressed areas, including drinking water and wastewater facilities)
www.doc.gov/eda

Environmental Protection Agency

American Indian Environmental Office 202-260-7939
www.epa.gov/indian/links.htm

Office of Ground Water and Drinking Water
401 M St., S.W.
Washington, DC 20460-0003
202-260-5543
www.epa.gov/safewater/

EPA Regional Offices

Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont)

1 Congress St.
Suite 1100
Boston, MA 02104-2023
617-918-1111
800-372-7341 (toll free from New England states only)
www.epa.gov/region01/eco/drinkwater

Region 2 (New York, New Jersey)
290 Broadway
New York, NY 10007
212-637-3000
Regional Indian Workgroup, call 212-637-3790
www.epa.gov/region02/water.htm

Region 3 (Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia)
1650 Arch St.
Philadelphia, PA 19103-2029
215-814-2322 (Drinking Water Branch office)
www.epa.gov/region3

Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee)
61 Forsythe St. S.W.
Atlanta, GA 30303-8960
404-562-9345 (Groundwater and Drinking Water Office)
www.epa.gov/region4

Region 5 (Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin)
77 W. Jackson Blvd.
Chicago, IL 60604
312-886-2504
www.epa.gov/r5water/

Region 6 (Arkansas, Louisiana, New Mexico, Oklahoma, Texas)
1445 Ross Ave.
Suite 1200
Dallas, TX 75202
214-665-2200
www.epa.gov/earth/r6/index.htm

Region 7 (Iowa, Kansas, Missouri, Nebraska)

726 Minnesota Ave.
Kansas City, KS 66101
800-223-0425
913-551-7423
www.epa.gov/region7

Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming)
999 18th St.
Suite 500
Denver, CO
303-312-6312
800-227-8917 (from Region 8 states only)
www.epa.gov/region08/coop/tribe/tap.html

Region 9 (Arizona, California, Hawaii, Nevada)
75 Hawthorne St.
Attn: Ground Water Office
San Francisco, CA 94105
415-744-2250
www.epa.gov/region09

Region 10 (Alaska, Idaho, Oregon, Washington)
1200 6th St.
Seattle, WA 98101
206-553-1200
Tribal office 206-553-6220
www.epa.gov/r10earth

Federal Emergency Management Agency
500 C St., S.W.
Washington, DC 20472
www.fema.gov

Geographic Data Service Center (maps, technical assistance for Tribes on GPS, GIS, etc.)
3000 Youngfield St., Suite 320
Lakewood, CO 80215
303-231-5100
303-231-5120 (Help Desk)
www.gdsc.bia.gov/cm.htm

Indian Community Development Block Grant Program (grants to improve housing, water systems, economic development, etc.)

www.codetalk.fed.us/

Indian Health Service

www.ihs.gov

U.S. Army Corps of Engineers (maps, bulletins)

U.S. Army Corps of Engineers Publication Depot
Attn: CEIM-IM-PD
2803 52nd Ave.
Hyattsville, MD 20851-1102
www.usace.army.mil

U.S. Geological Survey (topographic maps, satellite photos, other publications)

U.S.G.S. Information Services
Box 25296
Denver, CO 80225
1-888-ASK-USGS (275-8747)
www.usgs.gov

C. Organizations

These organizations publish informational materials on water-quality issues and/or provide technical assistance.

American Water Works Association
6666 W. Quincy Ave.
Denver, CO 80235
303-794-7711
www.awwa.org

Groundwater Foundation (groundwater protection information, including the community-based Groundwater Guardian program)
5561 South 48th
Lincoln, NE 68516
402-434-2740
www.groundwater.org

National Congress of American Indians
202-466-7767
www.ncai.org

National Drinking Water Clearinghouse
www.ndwc.wvu.edu

National Rural Water Association
2915 S. 13th St.
Duncan, OK 73533
580-252-0629
www.nrwa.org (Links to state rural water associations)

National Tribal Environmental Council (NTEC)
800-727-2175

Native American Environmental Protection Coalition
P.O. Box 248

Valley Center, CA 92082
760-751-8686
e-mail: naepc@primenet.com

Native American Water Association
702-782-6636

California State University, Sacramento (water system operator training materials)
www.owp.csus.edu

Rural Communities Assistance Corporation (RCAC)
3120 Freeboard Dr., Suite 201
W. Sacramento, CA 95691
916-447-9832
www.rcac.org

Rural Communities Assistance Program (RCAP)
722 East Market St., Suite 105
Leesburg, VA 22176
703-771-8638
888-321-7227
www.rcap.org

Water Education Foundation
717 K St., Suite 317
Sacramento, CA 95814
916-444-6240
www.water-ed.org