PROTECTING PUBLIC WATER SOURCES IN VERMONT

A Guidance Document in Reference to Section 1428 of the Federal Safe Drinking Water Act; 10 VSA, Chapter 56; and Vermont's Water Supply Rule

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Agency of Natural Resources
Department of Environmental Conservation
Water Supply Division

February 24, 1997

Dedication

This document, *Protecting Public Water Sources in Vermont*, is dedicated to David Butterfield. As a state employee, Dave worked for over 30 years protecting Vermont's groundwater and drinking water resources. One of Dave's greatest legacies to Vermont is the great number of people that he hired and trained. These people form a large network of environmental professionals in Vermont and New England who are educated and concerned about groundwater issues.

TABLE OF CONTENTS

List of Figures

Section 1 INTRODUCTION AND PROGRAM SUMMARY

1.1 Introduction

The 1986 Amendments to the Federal Safe Drinking Water Act (SDWA) directed the states to adopt and submit to the Administrator of the U.S. Environmental Protection Agency (USEPA) programs to protect public water supply wellhead areas from contaminants which "may have any adverse effect on the health of persons." Section 1428 of the SDWA provided a list of minimum elements for such programs and established a definition for the term "wellhead protection area" or WHPA. The focus of the federal directive was on groundwater sources including wells and springs which supply public water systems. The 1996 Amendments to the Federal Safe Drinking Water Act establishes a more comprehensive program for Source Water Assessments. An Assessment Program involves delineation of the boundaries of the areas providing source waters for public water systems, and identification (to the extent practicable) of the origins of regulated and certain unregulated contaminants in the delineated area to determine the susceptibility of public water systems to such contaminants.

This document, Protecting Public Water Sources in Vermont, outlines the steps that Vermont is and will be taking to protect its groundwater and surface water sources serving public water supply systems. It comprises Vermont's Public Water Source Protection Program and meets the requirements of the 1986 SDWA. It will also serve as the framework for developing the Source Water Assessment Program required by the 1996 SDWA Amendments. Vermont's authority to conduct a public water source protection program comes from 10 VSA, Chapter 56, and the Water Supply Rule, Chapter 21 of the Environmental Protection Rules.

The goal of Vermont's Public Water Source Protection Program is to minimize the risks of source contamination by providing a framework for identifying and managing these risks within a Public Water Source Protection Area (SPA). This framework is established through a Source Protection Plan (SPP) which is developed by the water supplier and then approved by the Water Supply Division (WSD).

1.2 Program Summary

Public water source protection began in Vermont in the late 1970's with the use of hydrogeologic methods to site new public community water supplies. A more formalized approach began in 1982 with the delineation of Wellhead Protection Areas (then called Aquifer Protection Areas or APA) for most municipal systems. Since 1985, the delineation of Public Water Source Protection Areas (SPA) has been required for all proposed new sources for public community water systems. Since 1992, a water system must have an approved Source Protection Plan (SPP) in order to receive an Operating Permit. Those Public Community Systems which do not have a SPP are issued a Temporary Operating Permit that includes a schedule of compliance for submission of a Source Protection Plan. Non-

community Systems are strongly encouraged to develop a Source Protection Plan and must do so in order to qualify for monitoring waivers.

Below is a profile of Vermont's current Public Water Source Protection Program:

- protection of public water sources is guided by Source Protection Plans (SPP);
- SPA and SPP which must include Contingency Plans are required for all new sources serving public community water systems;
- each public community water system is required to develop and implement a SPP before a Permit to Operate can be issued or reissued. For those public community water systems without a SPP, Temporary Permits to Operate are issued that include compliance schedules to complete for SPP and Contingency Plans;
- other water suppliers are encouraged to develop and implement SPP in order to protect their water source(s) and are required to develop and implement SPP as a condition for receiving chemical monitoring waivers;
- SPAs can be delineated and mapped by reasonable scientific methods and existing information;
- the SPA map and related water source data are stored and distributed electronically by WSD to facilitate protection by all interested parties;
- the potential sources of contamination (PSOCs) within the SPA will be identified, inventoried, assessed as to the level of risk, and then managed to reduce the risk;
- local governments are actively encouraged by the WSD to provide source protection via local authorities and actions;
- demonstration projects encouraging local governments to protect public water sources have been funded;
- SPP workshops and other outreach efforts have been and are being conducted;
- public participation is invited by public notices of opportunity for written comments and/or public meetings, and through attendance at Groundwater Coordinating Committee Meetings;

- protecting public water sources is part of a Comprehensive State Groundwater Protection Program (CSGWPP);
- technical assistance to water suppliers is available from the WSD; and
- financial assistance for the planning and construction of new sources for public water systems is available through the Drinking Water State Revolving Fund.

Assistance with all aspects of Vermont's Public Water Source Protection Program is available by calling the Water Supply Division at 1-800-823-6500 or (802) 241-3400.

Section 2 DEFINITIONS

2.1 Definitions

"AGENCY" means the Vermont Agency of Natural Resources.

"AQUIFER PROTECTION AREAS" or "APA" means those previously identified areas in Vermont that recharge public community water sources. The APAs were first mapped and created in 1980. The areas are now referred to as Wellhead Protection Areas (WHPA) or Public Water Source Protection Areas (SPA).

"CONTAMINANT" means any physical, chemical, biological, or radiological substance or matter in water.

"CONTINGENCY PLAN" means a plan for the location and provision of alternative drinking water supplies for a public water system in the event of source contamination or disruption of service. A Contingency Plan is a necessary part of a Source Protection Plan (SPP) and is required by the Water Supply Rule

"COMPREHENSIVE STATE GROUNDWATER PROTECTION PROGRAM" means the Vermont program which integrates existing regulatory programs for protection of groundwater in a coordinated statewide effort.

"DELINEATION" means the determination of a Source Protection Area boundary based on the analysis of all reasonably available hydrologic or hydrogeologic information such as groundwater flow, recharge, water source capacity, and other criteria acceptable to the Secretary.

"DEPARTMENT" means the Vermont Department of Environmental Conservation.

"DIGITIZE" means the process of converting point and line data from a source document to a computer readable format.

"DIVISION" means the Water Supply Division within the Vermont Department of Environmental Conservation, unless otherwise specified.

"DRINKING WATER" means non-carbonated, non-flavored water that is intended for human consumption or other consumer uses whether provided by a public water system or in a container, bottle or package or in bulk, including water used for production of ice, foodstuffs or other products designed for human consumption.

"GEOGRAPHIC INFORMATION SYSTEM" or "GIS" means the computer system by which the Water Supply Division manages information about Source Protection Areas and other geographical features.

"GROUNDWATER" means water below the land surface in a zone of saturation.

"MAXIMUM CONTAMINANT LEVEL" means the maximum permissible level of a contaminant in water which is delivered to any user of a public water system (see Primary Drinking Water Standard).

"OPERATOR" means the person responsible for the day-to-day operation and maintenance of a public water system.

"PERMIT" means a written document issued by a state agency giving a designated person permission to operate, construct, alter, and/or renovate a specific activity or facility.

"PERSON" means an individual, partnership, fire district, association, cooperative, syndicate, company, firm, trust, corporation, government corporation, municipal corporation, institution, state, federal, or municipal government department, division, bureau, agency, or any other entity recognized by law.

"POTABLE WATER" means water free from impurities in amounts sufficient to cause disease or harmful physiological effects, and having bacteriological, chemical, physical and radiological quality conforming to applicable regulations and standards of the Agency.

"POTENTIAL SOURCE OF CONTAMINATION" or "PSOC" means any activity or condition which may adversely affect water quality.

"PRIMARY DRINKING WATER STANDARD" means a standard which:

a. applies to Public and Non-Public water systems and drinking water;
b. applies to contaminants which may have an adverse effect on the health of persons;
c. specifies for each such contaminant either:
    1. a maximum contaminant level (MCL), if, in the judgment of the Secretary, it is economically and technologically feasible to ascertain the level of such contaminants in drinking water and Public and Non-public water systems; or
    2. if, in the judgment of the Secretary, it is not economically or technologically feasible to ascertain the level of such contaminant, each treatment technique known to the Secretary which leads to a reduction in the level of the contaminants identified in Subchapter 21-6 of the Water Supply Rule; and
d. contains criteria and procedures to assure a supply of drinking water which dependably complies with such maximum contaminant levels or treatment techniques.

"PROPOSED PUBLIC WATER SOURCE PROTECTION AREA" means a Public Water Source Protection Area which has been submitted to the Water Supply Division as part of a Source Approval application (see Appendix A) or a Source Protection Plan.

"PUBLIC WATER SOURCE" means any surface water or groundwater source used, or permitted to be used, as a source of drinking water for a public water system.

"PUBLIC WATER SYSTEM" means any system(s) or combination of systems owned or developed by the same person for the provision to the public of piped water for human consumption, if such system has at least ten (10) service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year. Such term includes all collection, treatment, storage and distribution facilities under the control of the water supplier and used primarily in connection with such system, and any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. "Public water system" also means any part of a piped system which does not provide drinking water, if use of such a part could affect the quality or quantity of the drinking water supplied by the system. A public water system is either a 'community water system' or a 'non-community water system.'

(a) "PUBLIC COMMUNITY WATER SYSTEM" means a public water system which serves at least ten (10) service connections used by year-round residents or regularly serves at least 25 year-round residents.

(b) "PUBLIC NON-COMMUNITY WATER SYSTEM" means a public water system that is not a community water system.

(1) "PUBLIC NON-TRANSIENT NON-COMMUNITY WATER SYSTEM" (NTNCWS) means a public water system that is not a community water system and that regularly serves at least 25 of the same persons more than six months per year. Examples: schools, factories, office buildings.

(2) "TRANSIENT NON-COMMUNITY WATER SYSTEM" (TNCWS) means a public water system which serves 25 or more people (need not be the same people) more than 60 days a year. Examples: restaurants, motels, campgrounds.

"REGIONAL TEAM" means one of four such teams at the Water Supply Division responsible for the regulation of public water systems within a geographic region of the state (see page 108).

"SANITARY SURVEY" means an on-site inspection by Water Supply Division personnel of the water source, Source Protection Area, facilities, equipment, and operation and maintenance of a public water system or drinking water facility for the purpose of evaluating

the adequacy of the source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

"SECRETARY" means the Secretary of the Agency of Natural Resources or the Secretary's designee.

"SOURCE" means a public water supply source, usually a well, spring, infiltration gallery, or surface water intake.

"SOURCE PROTECTION AREA" or "SPA" means a Public Water Source Protection Area, which is a surface and subsurface area from or through which contaminants are reasonably likely to reach a public water system source. (Also see "Wellhead Protection Area," "Proposed Public Water Source Protection Area," "Public Water Source Protection Area," "Delineation.")

"SOURCE PROTECTION PLAN" or "SPP" means a plan developed by a public water supplier detailing the steps taken both to protect the water quality of the source(s) serving the water system and to provide for a "continency plan" which is updated on an annual basis. It must be reviewed and approved by the Water Supply Division to be acceptable.

"SURFACE WATER" means all water which is open to the atmosphere and subject to surface runoff.

"UNACCEPTABLE CONTAMINATION" means contamination resulting in drinking water quality parameters exceeding primary Maximum Contaminant Levels.

"WATER SUPPLIER" means any person who owns or operates a public water system, or who provides or sells bottled or bulk drinking water.

"WELL" means any hole drilled, driven or bored into the earth to extract water for use as a source for a Public Water Supply System.

"WELL ISOLATION ZONE" means a circular zone with a fixed radius around a groundwater source serving a public water system in which certain land uses are prohibited. For public non-transient, non-community wells, see Part 11 of Appendix A of the Water Supply Rule. The well isolation zone is referred to as Zone 1 of the Public Water Source Protection Area or Wellhead Protection Area.

"WELLHEAD PROTECTION AREA" means the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield. The term Wellhead Protection Area has been replaced in Vermont by "Public Water Source Protection Area" or "SPA".

2.2 Abbreviations

AAP	Accepted Agricultural Practices
ANR	Vermont Agency of Natural Resources
BMP	Best Management Practices
CSGWPP	Comprehensive State Ground Water Protection Program
DEC	Vermont Department of Environmental Conservation
FED	Facilities Engineering Division
GIS	Geographical Information System
GWPR&S	Vermont's Groundwater Protection Rule and Strategy
GWUDI	Groundwater Under the Direct Influence of Surface Water
MCL	Maximum Contaminant Level
PSOC	Potential Source of Contamination
PWS	Public Water System
RPC	Regional Planning Commission
SDWA	Safe Drinking Water Act
SPA	Source Protection Area
SPP	Source Protection Plan
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VCGI	Vermont Center for Geographic Information
VNRC	Vermont Natural Resources Council
VPIRG	Vermont Public Interest Research Group
WSD	Water Supply Division of the Department of Environmental Conservation
WHPA	Wellhead Protection Area
WSR	Vermont's Water Supply Rule

Section 3 DUTIES AND ROLES

3.1 Implementation Assistance

There are a wide variety of agencies and organizations that can assist a water supplier in developing and implementing a Source Protection Plan. The assistance can range from financial to technical to legal. Below is a brief summary of federal, state, regional, and local organizations that may be able to help you in developing and maintaining your Source Protection Plan.

3.1.1 State Government

Water Supply Division, Department of Environmental Conservation, Agency of Natural Resources

The Water Supply Division is the lead state agency for Vermont's Public Water Supply Program. Administration includes program management, coordination, funding procurement, and budget development. Section 1.2 also provides information on the Water Supply Division.

(a) Delineates Source Protection Areas (SPA) on a case by case basis as resources allow.

(b) Develops a list of sources of contamination appropriate for Vermont, (see Appendix B).

(c) Assists public water systems in identifying and inventorying sources of contamination in SPA in conjunction with others.

(d) Digitizes locations of sources of contamination into a Geographical Information System (GIS).

(e) Maintains GIS SPA database. The database is reported to the Vermont Center for Geographic Information (VCGI).

(f) Provides technical assistance to public water systems in developing Source Protection Plans. Facilitates the public notice and comment proceedings on Source Approvals and SPA redelineations.

(g) Through the Act 250 permit application process, reviews land uses proposed in a SPA.

(h) Responds to reports of threatening activities in SPAs.

(i) Provides guidelines on management techniques to reduce risk from potential sources of contamination.

(j) Manages water quality monitoring data generated by water suppliers.

(k) Implements a program of public education and awareness of public water source protection through seminars, presentations, media releases, and education at primary, secondary and post-secondary levels.

(l) Provides technical assistance in locating and testing potential public water sources.

(m) Administers well driller licensing program with requirements for well construction and abandonment.

Other Department of Environmental Conservation Divisions

Environmental Assistance Division (EAD) (802) 241-3589
Enforcement Division (ED) (802) 241-3820
Facilities Engineering Division (FED) (802) 241-3451
Waste Management Division (WMD)
Hazardous Materials Program (802) 241-3888
Solid Waste Management Program (802) 241-3444
Wastewater Management Division (WWMD) (802) 241-3822
Water Quality Division (WQD) (802) 241-3770

(a) Provides financial assistance to municipal systems for new source construction, including SPA delineation. (FED)

(b) Provide access to permit program files containing location of potential sources of contamination. (All, except ED)

(c) Produce statewide inventories of point and non-point pollution sources. (DEC and Agency of Natural Resources' GIS Programs, as appropriate.) (Also See Section 3.3.8)

(d) Investigate reports of releases of hazardous materials. (WMD, ED)

(e) Investigate reports of unauthorized dumping of solid waste and regulates landfills. (WMD, ED)

(f) Remediate or order the remediation of groundwater contamination problems. (ED, WWMD, WMD, WSD)

(g) Performs or requires the ongoing monitoring and management of permitted potential sources of contamination. (WSD, WWMD, WMD)

(h) Provides surface water quality planning documents. (WQD)

(i) Reports to WSD all spills of waste(s) greater than 100 gallons and all spills and/or releases that occur in Public Water Source Protection Areas. (WMD, FED)

(j) On a routine basis sends to WSD a listing of waste releases. (WMD)

(k) Responds to reports of threatening activities in SPAs. (All, as appropriate)

Public Service Board (Privately owned systems)
89 Main St. (City Center)
Drawer 20
Montpelier, VT 05620-2701
(802) 828-2358

(a) Allows water rates adequate for the delineation of Public Water Source Protection Area(s) and the development and implementation of source protection plans.

(b) Allows water rates adequate for appropriate management of SPA.

(c) Allows water rates that provide for the development of contingency plans and for meeting contingencies (i.e., replacement or remediation of sources, connection to an alternate source, etc.).

(d) Allows water rates adequate for water systems to gain approval for new wells, including controlling areas near the well if required.

Department of Agriculture, Food and Markets
116 State St., Drawer 20
Montpelier, VT 05620-2901
(802) 828-2500

(a) Provides information on agricultural chemical use in Vermont.

(b) Develops Acceptable Agricultural Practices (AAP) which are designed to minimize non-point source water quality impacts. Provides management techniques for minimizing other sources of contamination on farms, such as petroleum and

agricultural chemical storage and disposal, machinery storage, building construction, milkhouse wastes, barnyard runoff and infiltration, manure storage and use, etc.

(c) Provides technical assistance to farmers regarding proper use of agricultural chemicals.

(d) Provides water quality monitoring of agricultural chemicals in groundwater.

(e) Requires permits for proposed right-of-way, golf courses and aerial application of pesticide to minimize impact on water supplies. Coordinates with WSD on these reviews.

(f) Manages and enforces regulatory programs dealing with farming and other agricultural activities.

Water Resources Board
58 East State St., Drawer 20
Montpelier, VT 05620-3201
(802) 828-2871

(a) Determines classification of Vermont's surface waters.

(b) Serves as the appeals body for surface water and groundwater related permits.

Environmental Board and District Environmental Commissions
58 East State St., Drawer 20
Montpelier, VT 05620-3201
(802) 828-3309

(a) Administers Act 250, Vermont's land use and development control law. Reviews proposed land uses against ten criteria including waste disposal, water supply availability, impact on adjacent water supplies and location in a "watershed" of a public water supply to determine if there will be undue adverse impact. Issues permits based upon this impact evaluation.

(b) Enforces terms and conditions of land use permits.

Department of Public Safety, Emergency Management Division
103 S. Main St.
Waterbury, VT 05671-2101
(802) 244-8721

(a) Provides water buffalos (water trailers used to haul and store water) to PWS as a backup supply for contingency plans.

(b) Coordinates disaster and emergency response planning.

(c) May provide co-review of SPP contingency plans with WSD to ensure consistency.

Vermont Center for Geographic Information (VCGI)
206 Morrill Hall
University of Vermont
Burlington, VT 05405-0106
(802) 656-4277
(800) 474-8447

(a) Serves as the lead agency for the development and use of a geographic information system (GIS) within Vermont.

(b) With cooperating state agencies and the Regional Planning Commissions (RPCs), compiles data layers, two of which are sources of contamination and land uses.

(c) Establishes standards to ensure consistency in data collection.

(d) Distribute new and updated agencies and RPCs data layers.

3.1.2 Federal Government

Environmental Protection Agency
EPA-New England
JFK Federal Building
Boston, MA 02203
(617) 565-3585
(800) 906-3328

(a) Provides administrative, financial and technical support to states on a wide variety of environmental issues, including public water supplies.

(b) Assists in resolving multi-jurisdictional issues, both interstate and international.

U.S. Geological Survey, Water Resources Division
Field Headquarters
P.O. Box 628
Montpelier, VT 05601
(802) 828-4479

May provide technical support on wellhead protection area (SPA) delineation methods and criteria.

All Federal Agencies

Under the provisions of the SDWA §1428(h), all federal agencies shall comply with all requirements of state law regarding any potential sources of contamination within Wellhead Protection Areas.

3.1.3 Regional Planning Commissions

Regional government is basically limited in Vermont to the Regional Planning Commissions. The twelve Regional Planning Commissions (RPCs) serve as important links between the state and local governments and among local governments. Please see Appendix B for a complete listing of the RPC addresses.

(a) Incorporate public water source protection areas into regional plans.

(b) Provide technical assistance to towns regarding protection of groundwater and SPAs.

(c) Assist towns in writing plans, bylaws, or ordinances to protect SPAs and groundwater.

(d) Help coordinate protection mechanisms and town planning where SPAs involve more than one town.

(e) Promote regionalization of public water systems where appropriate and feasible.

(f) Identify future regional water supply sources and help develop protection mechanisms.

(g) Publish and distribute planning information.

3.1.4 Local Government

Towns, Cities and Fire Districts

Local government has a central role in public water source protection. Selectboards, Planning Commissions, Zoning Boards, and Health Officers all have various authorities to protect SPAs. Local government should devote resources to the protection of public water supplies, not only to protect public health, but also to protect property values which would be diminished if public water sources become contaminated. Several communities in Vermont have developed health ordinances and zoning bylaws for public water source protection areas. Such action at the local level has the potential to protect and enhance local economic interests, and is a role not available to state or federal governments. Local governments are not required to plan for or regulate land uses. However, the State and Regional Planning Commissions encourage planning, and the State offers some incentives to Towns that plan.

Fire Districts in Vermont are a creation of state law, and may be formed following a public petition by citizens living within a "district." The most common reason for creating a fire district is to provide for a public community water supply system to serve the residents in the district.

(a) Identify and recognize public water source protection areas and potential public water supply aquifers in the town plan, zoning bylaw, official map, or other similar documents.

(b) Work with local public water supply system(s) to develop and implement source protection plans.

(c) Enact appropriate local protective measures (health ordinance, sewage ordinance, zoning bylaw, public education, etc.) to prevent unacceptable contamination in any SPA. (This should include on-site sewage disposal areas, which should be located a minimum of two year travel time from a public water source.)

(d) Enforce local protective measures for SPAs.

(e) Periodic inspections of SPAs by Health Officer.

Public Water Systems

Public water systems have the most direct interest in maintaining acceptable water quality. **The ultimate responsibility for maintaining potable water lies with the public water system. No amount of federal, state or local regulation can supplant this responsibility.** Each public water system should take advantage of what the government agencies have to

offer and develop its own plan for protection tailored specifically to its source protection needs. Each public water system should develop a source protection plan (SPP), ideally, in cooperation with its local government. SPPs are required for Public Community Water Systems and recommended for Non-Community Systems. (See Appendix A and Section 5 of this document for additional guidance on developing Source Protection Plans.)

(a) Become familiar with location of SPA on ground surface.

(b) Inventory potential sources of contamination in SPA. Check permit status of the PSOCs, to insure that the land uses are in compliance with permit conditions. (See Appendix C.)

(c) Develop source protection plans with local officials.

(d) Assist in getting appropriate local regulations in place.

3.1.5 Other Organizations

University of Vermont (UVM) Extension Service
RR4 Box 2298
Comstock Road
Montpelier, VT 05602
(802) 223-2389

(a) Provides technical assistance on fertilizer and pesticide usage, water conservation, etc.

(b) Provides public education on water supply, groundwater and related issues.

UVM Water Resources Research Center
85 South Prospect St.
Burlington, VT 05401
(802) 656-4057

Conducts and funds research pertinent to Vermont water quality problems.

Environmental and Conservation Groups
Please consult your Yellow Pages Directory for local organizations.

(a) Serve as advocates for environmental protection and public health.

(b) Sponsor educational events, seminars, etc.

Land Trusts and Conservancies
Please consult your Yellow Pages Directory for local organizations.

(a) May purchase property for protection or conservation of water and other natural resources.

(b) May purchase development rights for conservation of water resources.

(c) May provide funding for projects involving water conservation.

Vermont Association of Soil Conservation Districts
RD 2, Box 3420
Middlebury, VT 05753
(802) 545-2142

(a) Provides mechanism for local support of land conservation.

(b) Does land use inventories (technical assistance from the Natural Resources Conservation Service, review agricultural activities, provide soil information).

(c) Provides technical assistance to towns regarding protection of groundwater and wellhead protection areas.

(d) Assists towns in writing plans, bylaws, or ordinances to protect SPAs and groundwater.

North East Rural Water Association (NeRWA)
6 Prim Road
P.O. Box 622
Colchester, VT 05446
(802) 660-4988

(a) Provides technical assistance and training for operators and managers of water systems.

(b) Provides assistance in developing SPA and SPP.

(c) Provides access to and training in the use of equipment, such as leak detectors, flow meters, confined space test kits and chlorinators.

(d) Publishes newsletter with technical articles and legislative updates.

Green Mountain Water Environment Association
c/o 12 ½ Main St.
Montpelier, VT 05602
(802) 229-9111

(a) Offers technical workshops to operators which may include training on public water source protection.

(b) Serves as facilitator for communication between operators and State government.

(c) May serve as a clearinghouse to disseminate source protection information to operators of public water systems.

Vermont League of Cities and Towns
12 ½ Main St.
Montpelier, VT 05602
(802) 229-9111

(a) Political advocacy for local government. May lobby for legislation/funding that would benefit local public water source protection efforts.

(b) Facilitates communication among local government officials.

3.2 Coordination

Vermont's Public Water Source Protection Program requires coordination among the various participants in order to be effective. The Agency of Natural Resources is responsible for the overall coordination of the program. Coordination is needed at the policy making, permitting, planning and education.

3.2.1 Policy Coordination

(a) Groundwater Coordinating Committee (GWCC)

This committee is established in state statute to advise the Secretary of the Agency of Natural Resources regarding Vermont's comprehensive ground water management program. The GWCC has representatives from the Department of Agriculture, Food & Markets; Department of Health; Department of Environmental Conservation; Agency of Transportation; Department of Forest, Parks, and Recreation; USEPA; and the public. Additional members may be appointed by the Secretary. The GWCC drafted the Groundwater Protection Rule and Strategy (GWPR&S, Chapter 12), and is developing Vermont's Comprehensive State Ground Water Protection Program (CSGWPP).

(b) Non-Point Source Task Force

A task force, if reconvened, would consist of representatives from State and local government, public interest/advocacy groups and industry for the purpose of addressing non-point sources of contamination in Vermont. Originally, this Task Force was convened to create the Non-Point Source Management Program. It met from 1987 to 1989. Currently, there are no plans to reconvene.

(c) Vermont Pesticide Advisory Council

The advisory council consists of a variety of representatives from state agencies, University of Vermont, and the public. The Council advises the Governor and Commissioner of Agriculture Food & Markets on issues involving pesticides. The Council coordinates permit applications for pesticides use with other state agencies. Maps showing proposed locations of pesticide use for rights-of-way are provided to the Vermont Pesticide Advisory Committee (VPAC) by the Department of Agriculture, Food, and Markets. Data regarding public water supplies is available from the Water Supply Division.

(d) Water Well Advisory Committee

The Water Well Advisory Committee consists of representatives from the Department of Environmental Conservation, the Department of Health, the State Geologist, a private citizen, and the well driller community. It advises and assists Agency personnel in the formulation of policy, including recommended statutory and regulatory changes, regarding the proper installation and maintenance of water wells, licensing of water well drillers, and groundwater issues impacted by well-drilling activities. Also, it is to promote and encourage cooperation and communication between governmental agencies, licensed well drillers and members of the general public.

(e) Memoranda of Understanding (MOU)

MOUs may be developed between the Department and other State Agencies which clearly define roles as they pertain to public water sources.

3.2.2 Permit Coordination

(a) Interagency Act 250 Review Committee:

The Committee is administered by the Agency of Natural Resources (ANR) Planning Division. The purpose of the Interagency Committee is to provide coordinated comments on a weekly basis to the District Environmental Commissions on proposed land uses needing Act 250 permits. The applications for Land Use Permits are screened by the WSD for proposed land uses in Public Water Source Protection Areas and potential impacts on groundwater quality. Comments, as appropriate, are made through the Interagency Committee to the District Environmental Commission for consideration in review of the application and setting permit conditions. Additional follow-up by the Department may or may not be needed.

(b) Groundwater Protection Rule and Strategy (GWPR&S)

The Ground Water Protection Rule & Strategy (GWPR&S) provides the criteria and standards used by the ANR to protect and classify groundwater in Vermont. Four classes of groundwater were described in statute (10 VSA, Chapter 48) to provide different levels of management according to the quality of the resource, the uses or future uses and the degree of risk. Groundwater Classes I and II are suitable for public water supply sources and have a high degree of protection due to the value of public drinking water. Class III is suitable for use as a source of water for individual domestic water supply, irrigation, agricultural use and general industrial and commercial use. Class IV is not suitable as a source of potable water. The statute further provides that all groundwater is Class III, until the Secretary classifies it otherwise.

The original version of the GWPR&S, however, did not connect Classes I and II with Public Water Source Protection, nor did the original Wellhead Protection Program make the necessary connection. Proposed revisions to the GWPR&S seek to more closely link Classes I and II with source protection areas (SPAs) in order to create a framework for better management and protection. Currently, no Public Water Systems have been reclassified to Class I or II.

3.2.3 Planning Coordination

(a) Public Water System Priority List

A prioritized list of municipal water systems needing improvements to protect public health is compiled annually by the Department of Environmental Conservation. The listing is used to prioritize funding of water systems based on documented deficiencies. Inadequate source protection is one criterion used in the ranking process. The program offers grants and loans to municipal water systems for planning documents, preliminary engineering studies, pump tests, final design plans and construction of needed improvements to the water system. The process follows the requirements of the Municipal Water Supply Project Priority System Rule, Chapter 3 of the Environmental Protection Rules.

(b) Pilot Projects

Pilot projects funded by USEPA and coordinated by the Department with regional and local planning commissions are an effective coordination tool. The Department has worked with several Regional Planning Commissions on projects involving public water source protection. Other projects have involved cooperation directly between the Department and the local community.

3.2.4 Education

Education is a coordinated effort and is supported by the Department in many different ways.

(a) Seminars on water quality and public water source protection areas.

(b) Operator Training

Training courses by the Department and NERWA for water system operators cover subjects including groundwater flow, well hydraulics, and wellhead protection area delineation and management.

(c) Water Supply News

The WSD generates news articles as appropriate to provide useful information in a non-regulatory format in addition to formal notices by letter.

(d) Other educational efforts which support public water source protection are encouraged and supported by WSD participation.

Section 4 DELINEATION OF PUBLIC WATER SOURCE PROTECTION AREAS (SPAs)

4.1 Introduction

Before a Source Protection Plan can be prepared, the water system must know where the boundaries of its Source Protection Area are. This section discusses a variety of methods which can be used to delineate the actual boundaries of a Public Water Source Protection Area (SPA). Any new public community water system source or any planned or requested increase in approved yield of an existing Public Community water system source is required to obtain Source Approval from the Water Supply Division (Appendix A). The Source Approval process includes the delineation, public notice, and approval of a SPA, among other things. Those systems which have been assigned a "default" SPA of a 3000 foot radius circle are not required, but are strongly encouraged, to redelineate their SPA to more accurately protect their source. This redelineation also requires public notice and WSD approval. A system with a "default" SPA must redelineate the SPA and obtain Source Approval in order to increase the approved yield of a source.

Non-transient, non-community (NTNC) systems (e.g., schools, factories, and commercial buildings), and transient, non-community systems (e.g., restaurants, summer camps, and motels) are not required to develop Source Protection Plans; however, the Water Supply Rule does require that these systems establish "adequate isolation distances between wells and potential sources of contamination" (Appendix A Part 11.4.0, Tables A & B). The WSD's policy is to encourage non-community systems to adopt Source Protection Plans and to delineate more accurate Source Protection Areas as resources and information allow. SPA and SPP are necessary for a NTNC Water System to obtain chemical monitoring waivers.

4.2 Delineations of Public Water Source Protection Areas (SPAs) for Surface Water Sources

Typically, public water systems (PWS) which use surface water as a source for their drinking water, do so by withdrawing that water from a lake, pond or stream through an intake structure. A surface water source includes all tributary streams and basins, natural lakes and artificial or natural impoundments above the point of a water supply intake.

As stated in the Water Supply Rule (Appendix A, Part 3.2.6.1), a surface water source protection area delineation shall include the following zones:

- **Zone 1** shall consist of an area 200 feet in radius around the intake or as otherwise determined by the Agency.
- **Zone 2** shall consist of areas within the watershed located within 200 feet of perennial surface water and limited to 17,000 acres.

- **Zone 3** shall consist of the remaining watershed area beyond Zones 1 and 2, except as may be reduced by the Agency on a case-by-case basis giving consideration to the size of the watershed and the likelihood of contamination of the source.

An example of a Surface Water Source Protection Area delineation is shown in Figure 1.

4.3 Delineation of Public Water Source Protection Areas (SPAs) for Groundwater Sources

According to the Water Supply Rule, a groundwater source may be a well, spring, or infiltration gallery. The delineation methods and examples for Public Community Water Systems are described in 4.3.1. The recommended delineation method for Non-Transient, Non-Community (NTNC) and Transient, Non-Community Systems are described in Sections 4.3.2 and 4.3.3, respectively.

4.3.1 Public Community Water Systems (PCWS)

The Water Supply Rule establishes requirements and recommendations for delineation of Public Water Source Protection Areas for groundwater sources. For those systems delineating a SPA as part of a Source Approval Process, the application forms and the Water Supply Rule should be reviewed for specific requirements, submittals and approvals relating to delineations. This information may also be useful for systems that are redelineating their source.

In using one of the delineation methods discussed below or a combination of methods, the water system should take into consideration and utilize all available information and resources. This information may include:

1. Hydrogeologic setting based on published and unpublished reports, well logs, fracture traces, onsite observations and other site specific information available.
2. Pump testing at design production rate.
3. Ambient non-pumping groundwater flow conditions based on topography and observation wells when available.
4. Topography using USGS topographic maps.
5. Structure (fracture patterns, jointing, lineaments).
6. Surficial and bedrock geology (rock types, depositional environment, etc.).
7. Soils (type, thickness, hydraulic properties).
8. The well's expected maximum use.
9. Elevation of the well intake.
10. Appropriate hydrogeologic models.
11. Seasonal maximum discharges of springs.

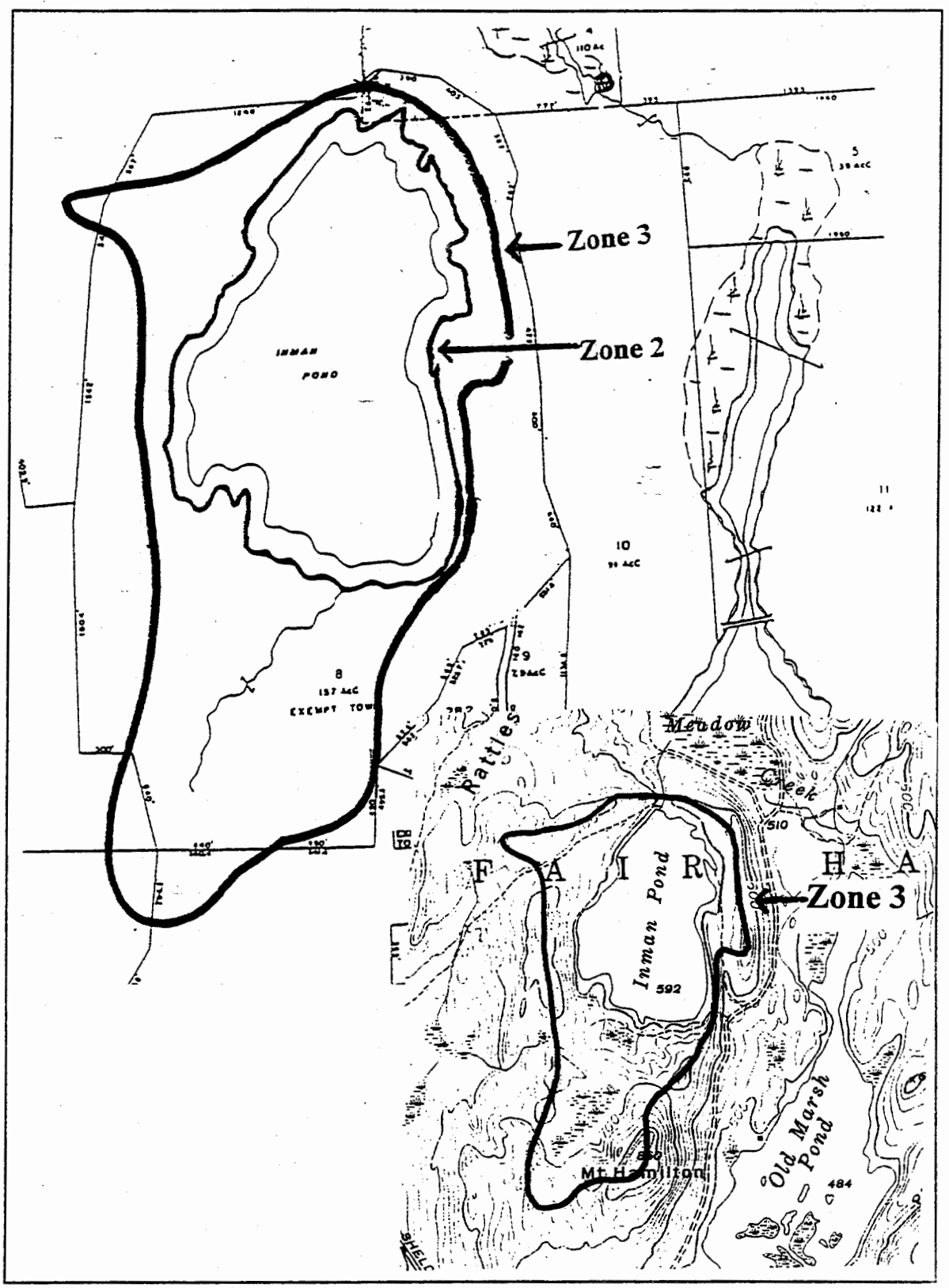


Figure 1 Example of a Surface Water SPA

As part of a delineation of a Public Community Groundwater Source Protection Area, the following zones of the SPA shall be delineated (see Appendix A, Part 3.3.6.3):

- **Zone 1** shall consist of a water system controlled 200 foot radius around the well. This is the area where impacts are likely to be immediate and certain.
- **Zone 2** shall consist of the contributions from the monitoring radius established as part of the Source Interference Testing for new systems and outside Zone 1 (see Appendix A, Part 3.3.5.2(c) for details on Source Interference Testing). This area is one where there will be probable impacts from potential sources of contamination.
- **Zone 3** shall consist of remaining recharge area(s) or area of contribution to the well not delineated as Zone 2 and where there may be possible impacts from potential sources of contamination.
- **Two year travel time zone** shall be used to identify a protection area to provide adequate protection from pathogen threats resulting from onsite disposal of sewage.

The following sections describe a number of SPA delineation methods for groundwater sources for use under a variety of circumstances. Most of the information contained in this section is taken directly from the EPA document, "Guidelines for Delineation of Wellhead Protection Areas" (June 1987, EPA 440/6-87-010, pages 4-1 through 4-41), although some modification has occurred. These methods are slanted toward low cost and easy application on the premise that the implementation of a Source Protection Plan is the goal and that this implementation will not take place unless and until a SPA has been delineated. Methods accepted by Vermont to delineate groundwater Source Protection Areas (Wellhead Protection Areas) in order of increasing technical sophistication are:

1. Calculated fixed radius;
2. Simplified variable shapes;
3. Analytical methods;
4. Hydrogeologic mapping; and
5. Flow models.

The arbitrary fixed radius method is no longer an approved method for public community water supply's delineation of SPA. This method was used to establish the "default" SPA of 3000' circles. It is still used to establish Zone 1 and for NTNC systems.

According to the Water Supply Rule (Appendix A Part 11.4.2.1), calculations of travel time must take into account hydraulic gradient, porosity, saturated hydraulic conductivities in the materials with the largest saturated hydraulic conductivity, the cone of influence of production wells or the recharge area of springs being considered, and mounding of the water table due to groundwater recharge by discharge of the sewage effluent. These are reviewed on a case-by-case basis and there is not any specific approved method.

method are also discussed. Many of the methods can be combined in order to appropriately delineate Zone 2 and 3 of the SPA. Examples of delineations are shown in Section 4.3.1.6.

The following sections contain a variety of geologic and hydrogeologic terms. The reader is encouraged to consult other reference sources, such as textbooks, and attend relevant operator training classes, to gain a greater understanding of what these terms mean and how they relate to one another. These sections are designed to familiarize the reader with potential delineation methods. Professional assistance will likely be necessary in order to delineate a SPA.

4.3.1.1 Calculated Fixed Radius

Delineation of a SPA using the calculated fixed radius method involves using an analytical equation to solve for the radius. In general, it involves drawing a circle for a specified Time of Travel (TOT) criterion threshold. The center of the circle is the pumping well. A radius is calculated using an analytical equation that is based on the volume of water that will be drawn to a well in the specified time (Figure 2). Three of the equations that can be used to calculate the fixed radius are shown in Example 1 (Section 4.3.1.6).

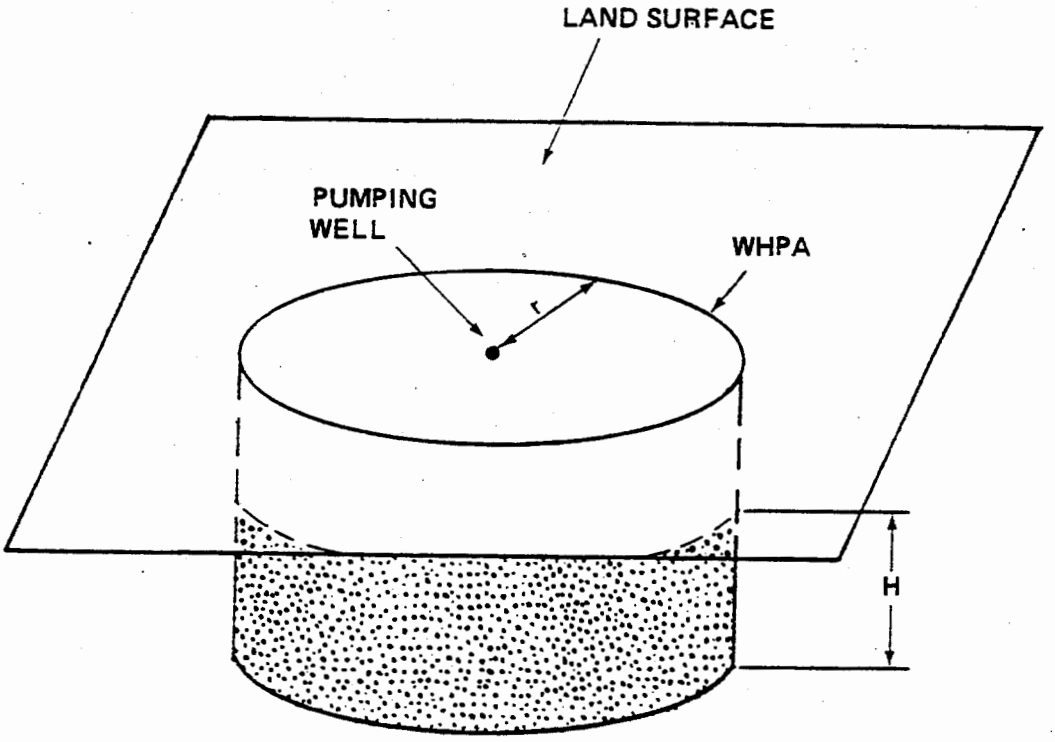
Advantages. The methods are easy to apply and relatively inexpensive; they require a limited amount of technical expertise. In addition, a SPA can be delineated in a short period of time. Conceptually, they offer a significant increase in accuracy over the interim 3000 foot circle which some existing systems have in Vermont.

Disadvantages. The calculated fixed radius method may be inaccurate, since it does not account for many factors that influence contaminant transport and does not account for the basic hydrogeologic characteristics of the aquifer. This can particularly be true in areas of mixed soil types or where significant hydrologic boundaries are present. Combining it with the use of other methods helps to improve the accuracy (see Section 4.3.1.6 Examples).

Costs. Costs of developing a SPA using calculated fixed radius are relatively low. Some initial costs may be encountered in hydrogeologic data collection.

4.3.1.2 Simplified Variable Shapes

In the simplified variable shapes method, "standardized forms" are generated using analytical models, with both flow boundaries and Time of Travel (TOT) used as criteria. These forms are basically circles or cones. This method attempts to simplify implementation by selecting a few representative shapes from the large array of potential possibilities.



-Radius (r) is calculated using a simple equation that incorporates well pumping rate and basic hydrogeologic parameters.

-Radius determines a volume of water that would be pumped from well in a specified time period.

H = Open interval or length of well screen.

Figure 2 Calculated Fixed Radius Method

The appropriate "standardized form" is then selected for hydrogeologic and pumping conditions matching or similar to those found at the wellhead (Figure 3). The standardized form is then oriented around the well according to groundwater flow patterns. The variable shapes are calculated by first computing the distance downgradient and lateral extent of the groundwater flow boundaries around a pumping well, and then using a TOT criterion to calculate the upgradient extent. Standardized forms or boundaries for various criteria are calculated for different set of hydrogeologic conditions. Input data for the standardized shapes include basic hydrogeologic parameters and well pumping rates. See Example 2 (Section 4.3.1.6) for equations and figures that relate to this method.

Advantages. Advantages of the simplified variable shapes method are that it can be easily implemented once the shapes of the standardized forms are calculated, and that it requires a relatively small amount of field data. In addition, relatively little technical expertise is required to do the actual delineations. Generally, the information required to apply to a shape for a particular well or well field, once the standardized forms are delineated, are the well pumping rate, material type and the direction of groundwater flow. This data may be available from the specific well's pump tests or from a textbook. This method offers a more refined analysis than the fixed-radius method, with only a modest increase in cost.

Disadvantages. The simplified variable shapes method may not be accurate in areas with many geologic heterogeneities and hydrogeologic boundaries. There are some conceptual problems if flow directions near a well differ from those inferred from regional or subregional assessments.

Costs. Costs of initially developing the standardized forms for a specific locality may be moderate, although the costs of implementation (i.e., selecting the appropriate standard share for a well site) are relatively low. Significant data collection is required (compared to calculated fixed radii) in order to obtain the set of representative hydrogeologic parameters need to calculate the shapes of the standardized forms and to determine the overall groundwater flow direction in the vicinity of specific wells.

4.3.1.3 Analytical Methods

With analytical methods, SPAs can be delineated through the use of equation(s) to define groundwater flow and contaminant transport. The uniform flow equations (Todd, 1980) shown in Figure 4 are often used to define the area of contribution to a pumping well in a sloping water table situation. Analytical methods do not calculate Zones 2 and 3.

Analytical methods, such as the uniform flow equations, require the use of various hydrogeologic parameters to calculate the distance to the downgradient divide, or stagnation point, and the lateral extent of the SPA. The upgradient extent of the SPA can then be calculated based on either a TOT or flow boundaries criterion. For example, the

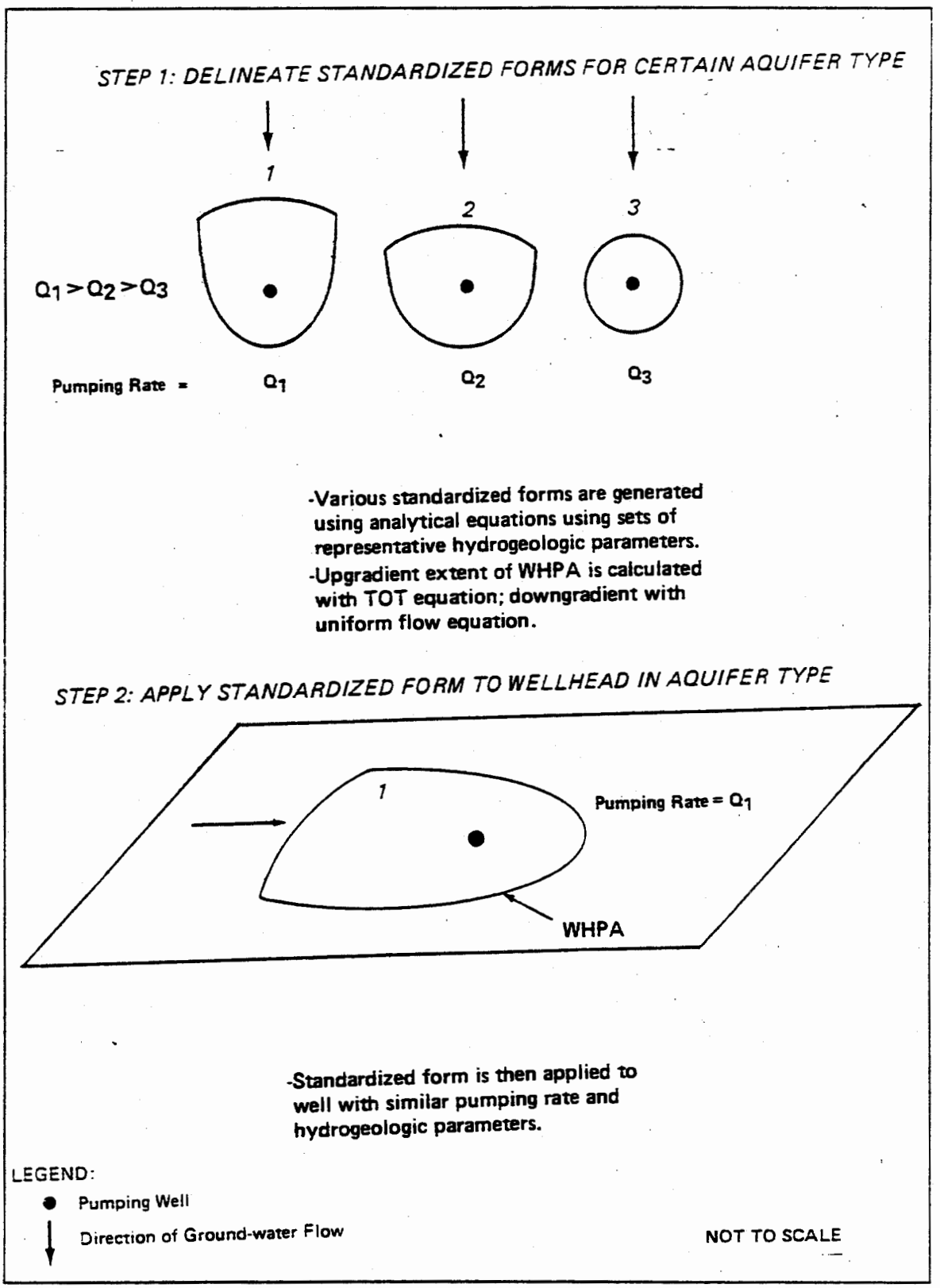
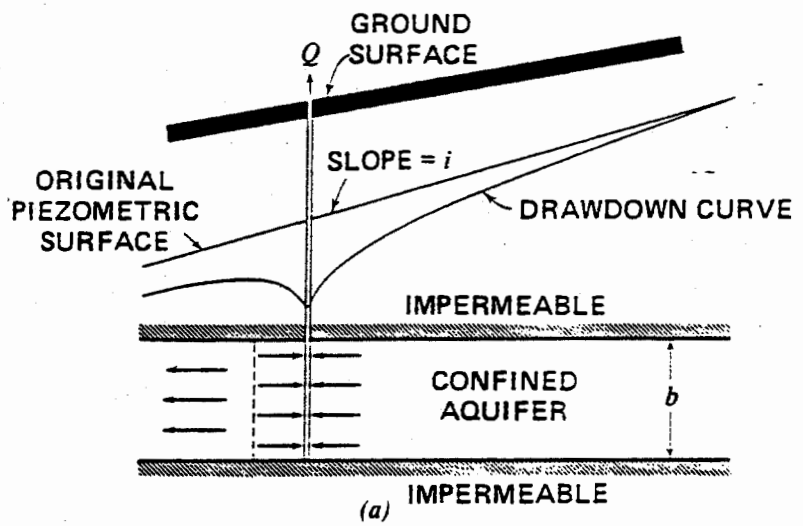
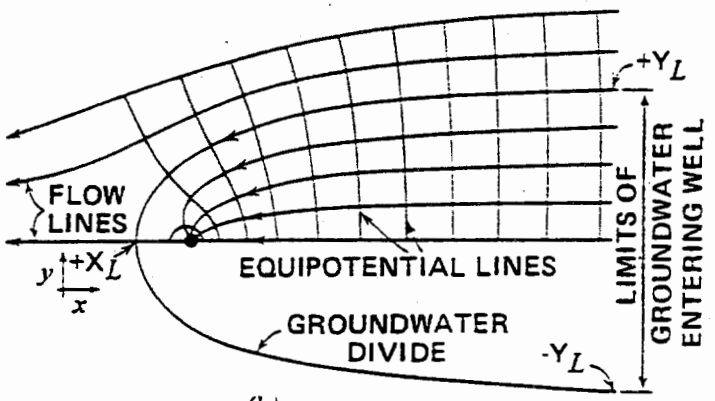


Figure 3 Simplified Variable Shapes Method



(a)



(b)

$$-\frac{Y}{X} = \tan\left(\frac{2\pi Kbi}{Q}Y\right)$$

UNIFORM-FLOW EQUATION

$$X_L = -\frac{Q}{2\pi Kbi}$$

DISTANCE TO DOWN-GRADIENT NULL POINT

$$Y_L = \pm\frac{Q}{2Kbi}$$

BOUNDARY LIMIT

LEGEND:

- Pumping Well

Where:
Q = Well Pumping Rate
K = Hydraulic Conductivity
b = Saturated Thickness
i = Hydraulic Gradient
π = 3.1416

NOT TO SCALE

SOURCE: Todd, 1980

Figure 4 Uniform Flow Analytical Model

location of a hydrogeologic boundary such as a groundwater divide or lithologic contact, can determine the upgradient boundary of the SPA.

Site specific hydrogeologic parameters are required as input data for each well for which the method is applied. These parameters can include the transmissivity, porosity, hydraulic gradient, hydraulic conductivity, and saturate thickness of the aquifer. The uniform flow model can be used to calculate distances that define Zone of Contribution or ZOC (the area that supplies groundwater recharge) of a well pumping in a sloping water table, but generally will not calculate drawdown, which determine the area of Zone of Influence or ZOI (the area within which the water table has been changed due to groundwater withdrawal). For flat water tables, however, analytical models can be used to calculate both the ZOC and ZOI of a well because in these cases the boundaries of the two could closely coincide. These calculations can be performed with the aid of computers.

Advantages. The methods use equations that are generally easily understood and solved by most hydrogeologists and civil engineers. In addition, it takes into account some site specific hydrogeologic parameters. It is, furthermore, the most widely used method, allowing comparisons with other SPA programs.

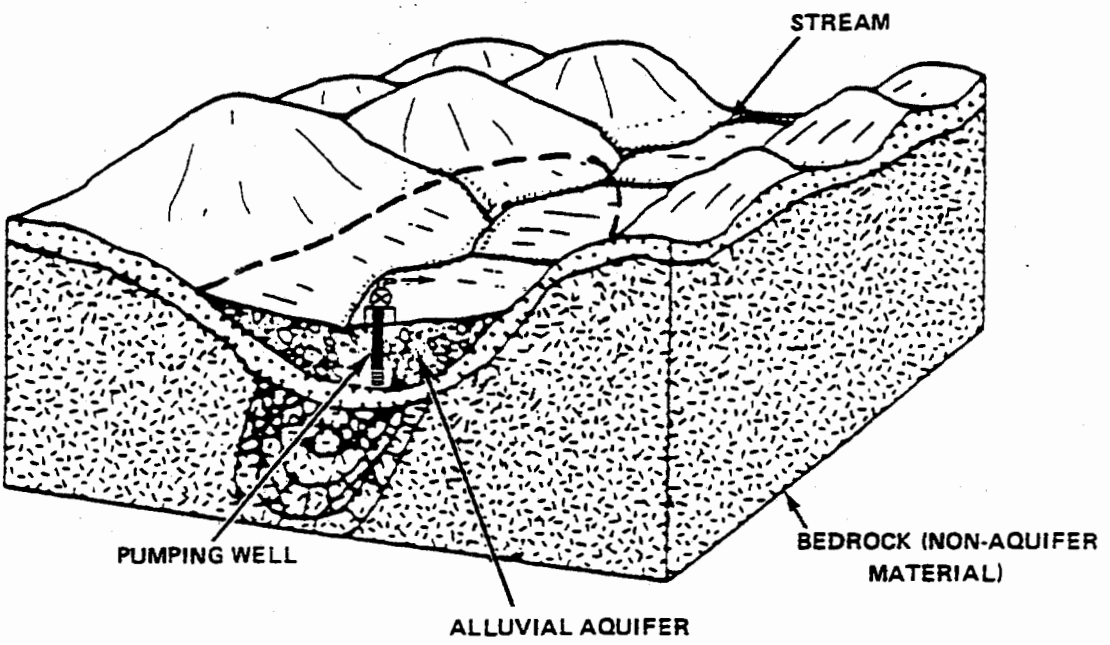
Disadvantages. The methods use models that generally do not take into account hydrologic boundaries (e.g., streams, canals, lakes, etc.), aquifer heterogeneities, and non-uniform rainfall or evapotranspiration. If inappropriate hydrogeologic estimates are used, a very large or very small SPA may result.

Costs. Costs of using analytical methods to delineate SPAs are relatively low, although costs can be high if site-specific hydrogeologic data must be developed for the SPA.

4.3.1.4 Hydrogeologic Mapping

In many hydrogeologic settings, flow boundary and TOT criteria can be mapped by geological and geophysical methods. The flow boundaries are defined by lithologic variation or permeability contrasts within the aquifer. Geological observations may provide surface indications of lithology changes, which will correlate with SPA boundaries (Figure 5). Geologic observations are made by walking the area looking for various geologic outcrops, surficial materials and then locating them on a map. Surface geophysical data can be used to map the spatial extent or thickness of unconfined aquifers. Hydrogeologic mapping may also include mapping of groundwater levels in order to identify groundwater drainage divides, as shown in Figure 6.

Advantages. Hydrogeologic mapping is well suited to hydrogeologic settings dominated by near-surface flow boundaries, as are found in many glacial and alluvial aquifers with high flow velocities, and to highly anisotropic aquifers, such as fractured bedrock and conduit-flow karst.



— — — Zone 2 SPA Boundary Drawn as a Contact Between Aquifer and Non-Aquifer Material

Note: Zone 3 could be delineated based on the larger area of recharge derived from surface runoff, and inferred from topography and basin boundaries.

NOT TO SCALE

Figure 5 Hydrogeologic Mapping

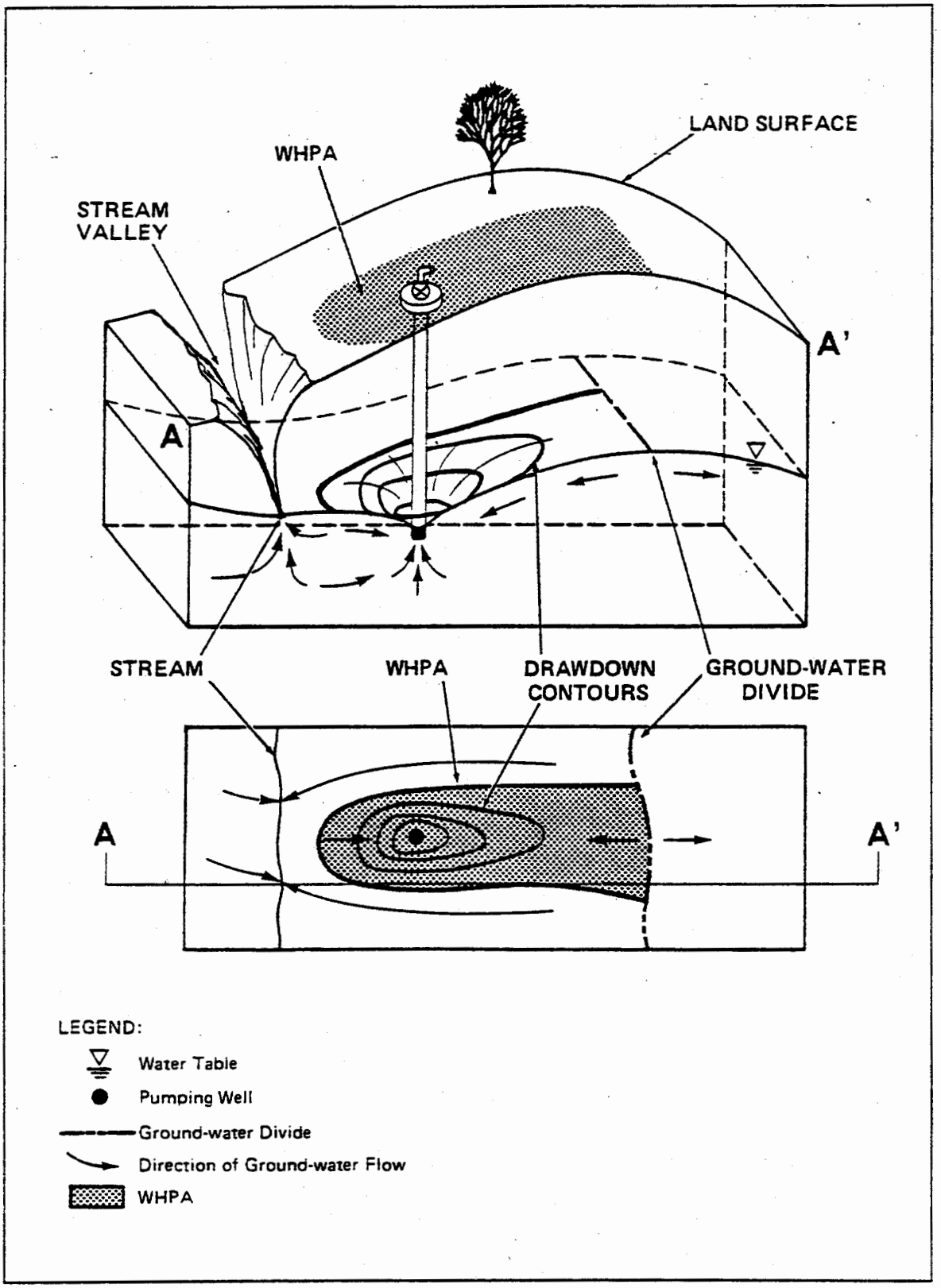


Figure 6 Hydrogeologic Mapping (Groundwater Divide)

Disadvantages. The method requires specialized expertise in geologic and geomorphic mapping and significant judgement on what constitutes likely flow boundaries. This method is also less suited to delineating SPAs in large or deep aquifers.

Costs. Costs of developing and implementing a wellhead protection program using hydrogeologic mapping are variable. Costs may be relatively low if considerable data are already available or if the general hydrogeology of the groundwater system is known. The particular type of hydrogeologic mapping technique used will also determine costs. In general, geophysical techniques are the most costly, followed by mapping geologic contacts, dye tracing, regional water level mapping, and basin delineation using topographic mapping. Costs may be high if little hydrogeologic information is available in an area and if test holes and/or pump tests are necessary to confirm the mapping.

4.3.1.5 Numerical Flow/Transport Models

SPAs can be delineated using computer models that approximate groundwater flow and/or solve transport equations numerically. A wide variety of numerical models are presently available both commercially and through organizations, such as the U.S. Geological Survey, and the National Groundwater Association. They are generally not used in Vermont due to the high cost, level of expertise required to run a model, and the data intensive nature of modeling.

Numerical flow/transport models are particularly useful for delineating SPA where boundary and hydrogeologic conditions are complex. Input data may include such hydrogeologic parameters such as permeability, porosity, specific yield, saturated thickness, recharge rates, aquifer geometries, and the locations of hydrologic boundaries. Solute transport parameters such as dispersivity may also be incorporated in these models.

Criteria such as drawdown, flow boundaries and TOT may be mapped using numerical methods, typically in a two-step procedure. First, a hydraulic head field distribution is generated with a numerical flow model under a prescribed set of hydrogeologic parameters and conditions, and with a selected flow boundaries criterion to determine the extent of the modeling domain. Second, a numerical solute transport model that uses the generated head field is input calculates the SPA based on the preselected criterion. Figure 7 illustrates a flow chart of some typical components of this procedure.

Advantages. This method provides a very high potential degree of accuracy and can be applied to nearly all types of hydrogeologic settings. The models can also be used to predict the dynamic aspects of this SPA such as changes in the size of the SPA resulting from natural or human effects.

Disadvantages. Costs for this method are usually relatively higher than others. Considerable technical expertise in hydrogeology and modeling is required to use this

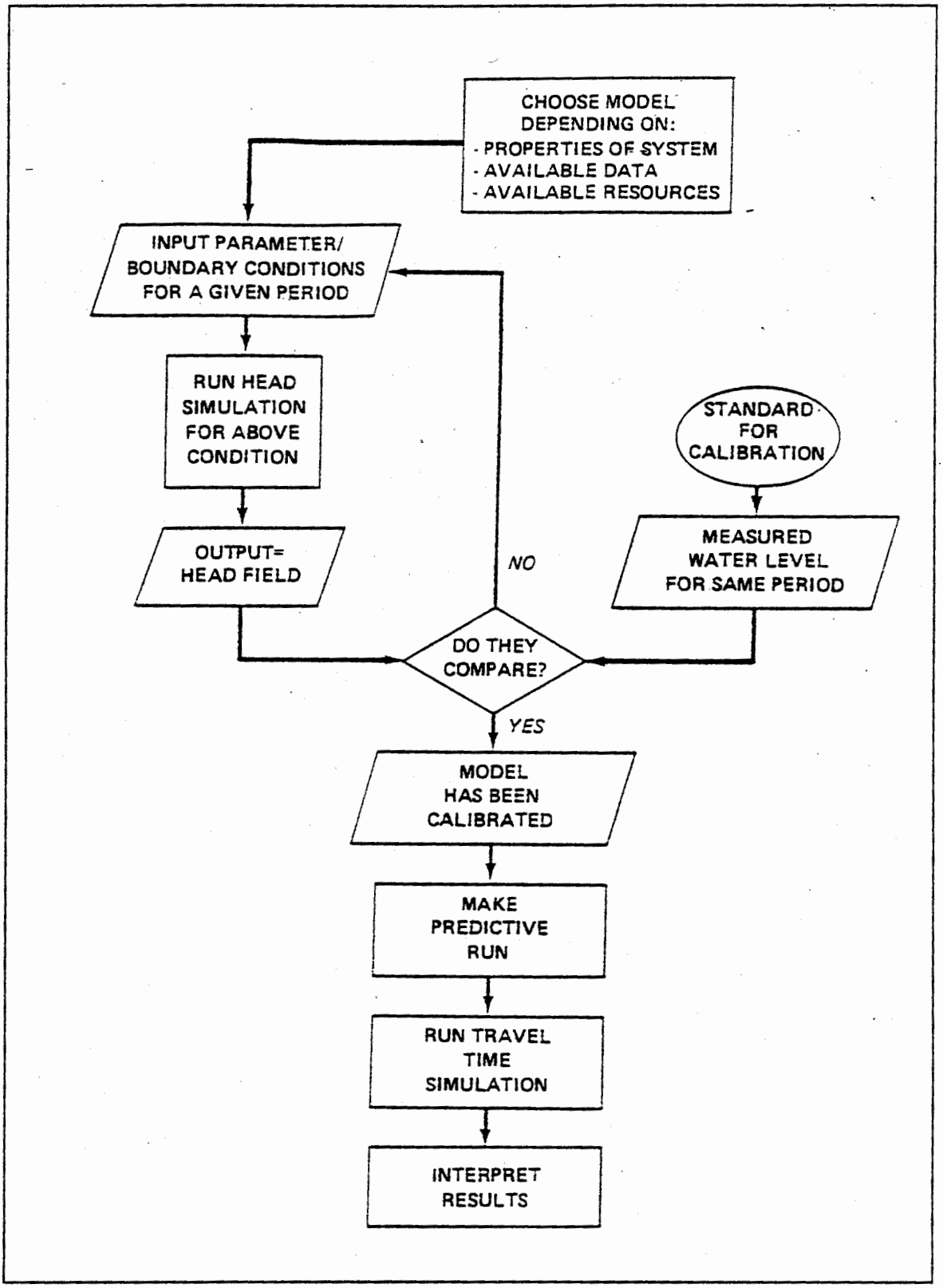


Figure 7 Numerical Modeling Flow Chart

method. However, the cost may be warranted in areas where a high degree of accuracy is desired.

Costs. Costs of developing and implementing a numerical model to delineate SPAs can be relatively high, depending upon the availability and quality of data, the number of wells, and the complexity of the hydrogeology. However, if adequate databases exist and the hydrogeology of the area is known, numerical models can be cost effective. Numerical modeling can also be less expensive if relatively homogeneous hydrogeologic conditions exist and extensive data input is not necessary. In this case, a large number of "default values" for some of the hydrogeologic parameters can be used, while using better known values for the more sensitive parameters.

4.3.1.6 Examples

Example 1 Three Calculated Fixed Radius Equations Examples.

The Infiltration Equation is a method that is suitable when no pump test data are available and as a supporting analysis to a more accurate method. The analysis involves calculating land surface area sufficient to provide the necessary recharge to match the project demand (an annual amount of water), given certain rates of water infiltration into soils. It is a good equation to use for springs and infiltration galleries. It is generally used for unconsolidated, coarse soils, such as sand and gravel.

$$R = \sqrt{\frac{Q}{(InfiltrationRate)(\pi)}}$$ Infiltration Equation

Where R = Radius (ft)

Q = Amount pumped (ft^3/yr) obtained from known pumping rates or maximum demand figure

Infiltration rates (ft/yr) can be obtained from textbook tables based upon soil types. Some suggested rates are:

Till - 0.58 ft/yr

Shallow to bedrock, more permeable tills - 1 ft/yr

Sand and gravel - 1.8 ft/yr.

The data required for the Volumetric Flow Equation includes the pumping rate of the well and porosity. The time period used is one considered adequate to allow cleanup of groundwater contamination before it reaches a well, adequate dilution or dispersion of contaminants, or die off of pathogens. This can be used to calculated the Two Year Time of Travel Zone (t=2 years).

$$r = \sqrt{\frac{Qt}{\pi n H}}$$ Volumetric Flow Equation

Where Q = Pumping Rate of Well (ft^3/yr)
n = Aquifer Porosity
H = Open Interval or Length of Well Screen (ft)
t = Travel Time to Well (yr)

Vermont used a calculated fixed radius equation to delineate SPA based on a drawdown criterion threshold of 0.05 foot. If pump test data are available for an unconfined unconsolidated aquifer, then the radius of Zone 2 is determined using the Theis Nonequilibrium Equation (Theis, 1935).

$$r = \sqrt{\frac{u4Tt}{S}}$$

Where
T = aquifer transmissivity
t = time to reach steady state
S = storativity or specific yield of aquifer
u = a dimensionless parameter related to the Well Function (W(u)).

$$W(u) = \frac{4\pi Ts}{Q}$$

Where
s = drawdown at the maximum radius of influence
Q = pumping rate
To calculate the radius, the well function (W(u)) is calculated and then u is obtained from a table. This value of u is then used to calculate the radius (r) in feet.

In an example case, the input data are:
T = 200 ft^2/day
t = 1 day
S = 0.02
Q = 25 gpm
s = 0.05 feet
This gives a radius of 315 feet for Zone 2. To provide a more accurate SPA, this calculated radius can then be skewed in the direction of groundwater flow patterns.

Example 2 Simplified Variable Shapes & Uniform Flow Equations. The dimensions of the simplified variable shape are developed using uniform flow equations (Todd, 1980) and a TOT equation. Areas are generated for various sets of representative hydrogeologic conditions. The standardized forms are then oriented around the well according to groundwater flow patterns (Southern Water Authority, 1985).

The uniform flow equations (subsection 4.2.4) are used to calculate the zone of contribution to a pumping well. These equations describe the zone of contribution (ZOC) for a confined, porous media aquifer under uniform flow and steady-state conditions. For unconfined aquifers, thickness is replaced by the uniform saturated aquifer thickness, provided that the drawdown at the well is small in relation to the aquifer thickness. These equations do not determine the upgradient limits of the ZOC. Therefore, another technique is necessary to close the upgradient boundary of the ZOC.

The distance (r_x) defining the upgradient extent of the ZOC is determined by substituting a 50-day TOT criterion for t_x and solving by trial and error the equation

$$t_x = \frac{S}{v}\left[\pm(r_x - r_w) + Z\ln\frac{(Z \pm r_w)}{(Z \pm r_x)}\right]$$

where

$$Z = \frac{Q}{2\pi K b i}$$

where

v = groundwater flow velocity
t_x = travel time from point x to pumping well
S = specific yield or storativity
K = hydraulic conductivity
b = saturated thickness
I = gradient
r_w = well radius
r_x = distance from point x to pumping well
± = whether point x is upgradient (+) is downgradient (-) from pumping well

Standardized forms, such as those shown in Figure 8, were developed using data from approximately 75 different possible sets of hydrogeologic parameters with varying pumping rates, hydraulic gradients, storativities and aquifer thicknesses. When a SPA is to be delineated for each well, the standardized form that most closely matches the pumping

rate and parameters at the well is used. The standardized form is drawn over the well in the appropriate direction of groundwater flow.

Example 3 Uniform Flow Equations. The distances to the downgradient stagnation point and the envelope of the area of contribution were calculated using the uniform flow equations, as shown in Figure 9 (Anderson-Nichols & Co., 1985). The distance to the downgradient divide (X), or stagnation point at the well, was calculated using the equation

$$X=\frac{Q}{2\pi Ti}=1,167 feet$$

where
Q = pumping rate of the well = 134, 760 ft^3/day
I = hydraulic gradient of the water table = 0.00125
T = aquifer transmissivity = 14,700 ft^2/day
The maximum width of the influx zone (Y) is calculated using the equation

$$Y=\frac{Q}{Ti}=7,334 feet$$

The distance to the upgradient limit was set as the distance to the upgradient regional groundwater divide, which in this case was equal to 3,800 feet.

Example 4 Hydrogeologic Mapping & Simplified Fixed-ring Calculation. Figure 10 shows a Vermont example in which mapping of geologic contact is combined with a calculated fixed-radius (Section 4.3.1.1). Zone 2 is delineated using hydrogeologic calculations that calculated a 1000 foot radius and then modifying the radius using hydrogeologic mapping based upon field visits and soil maps. Zone 3 is delineated with hydrogeologic mapping of the well's recharge area. Hydrogeologic mapping in this case is based on physical boundaries and the prevailing topography, with the assumption that shallow local groundwater flow mirrors topography. Zone 2 boundaries could be connected with streamline flow boundaries that are drawn perpendicular to groundwater elevation contours up to the groundwater divide to complete the SPA. This process is simple and fast, incorporates local aquifer and topographical heterogeneities and is very inexpensive.

Example 5 Simplified Variable Shape. If data on aquifer parameters are not available, then a flow net analysis (Cedergren, 1967) can be used to determine Zone 2. The flow net

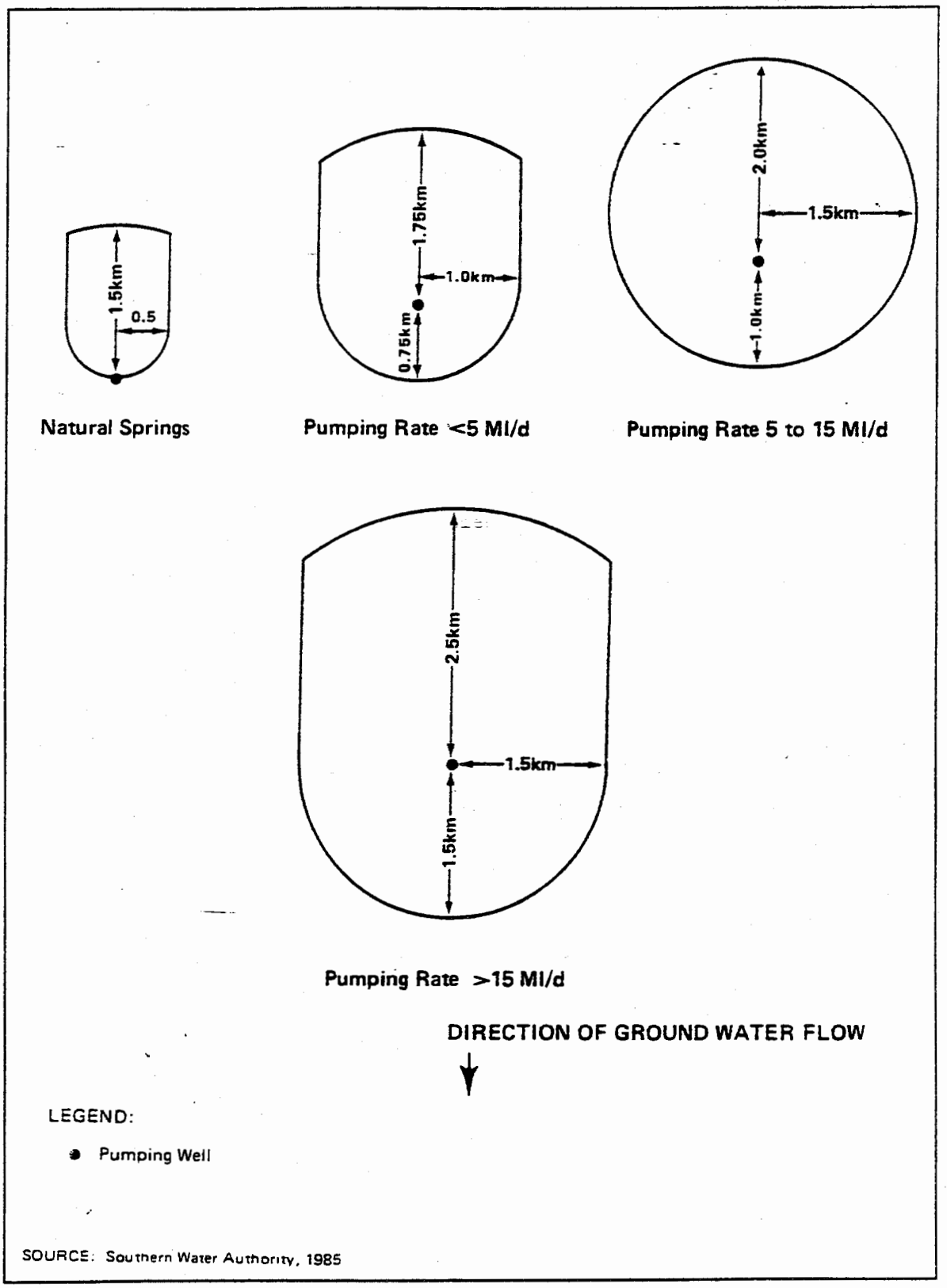


Figure 8 Examples of Simplified Variable Shapes

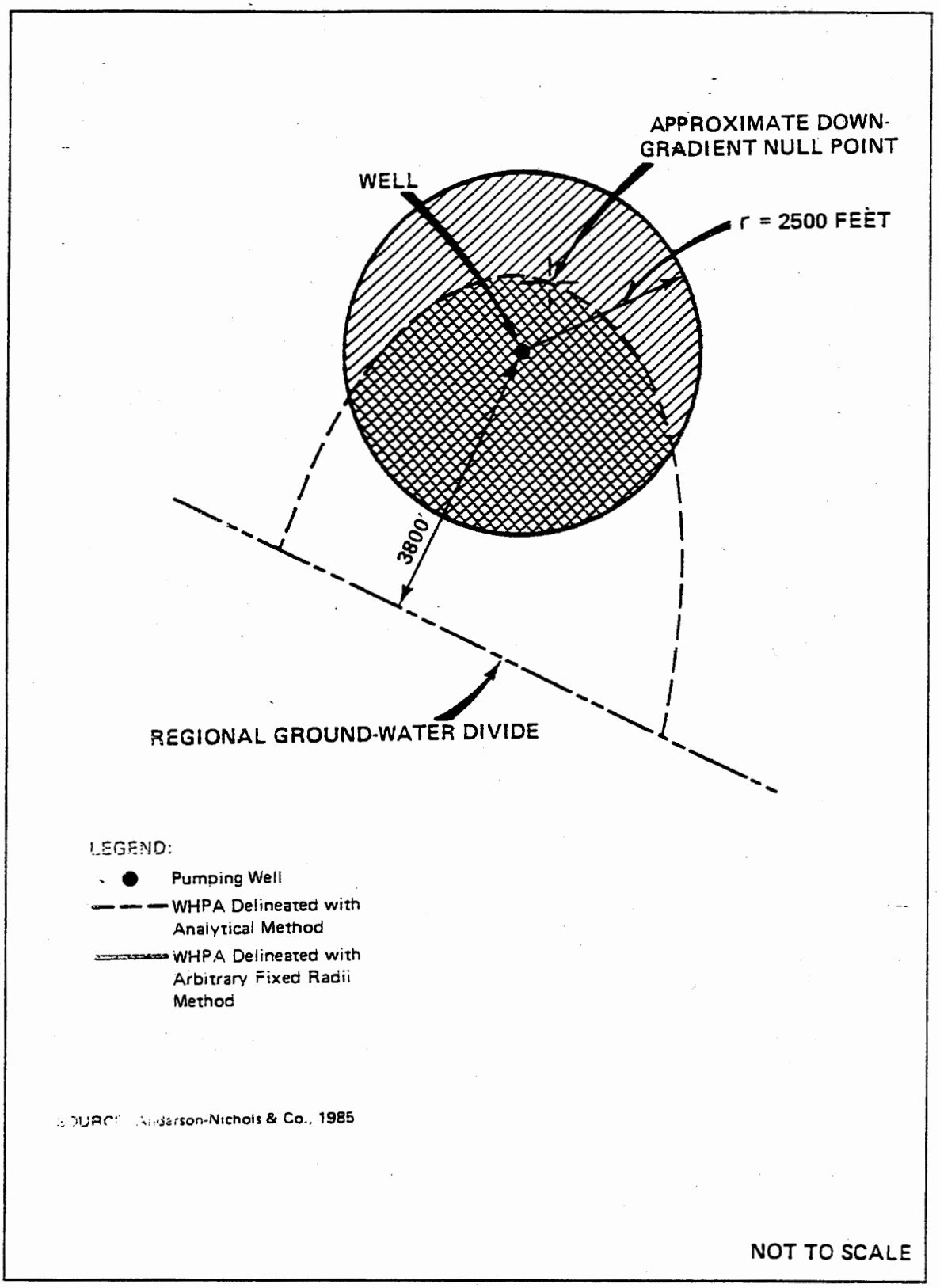
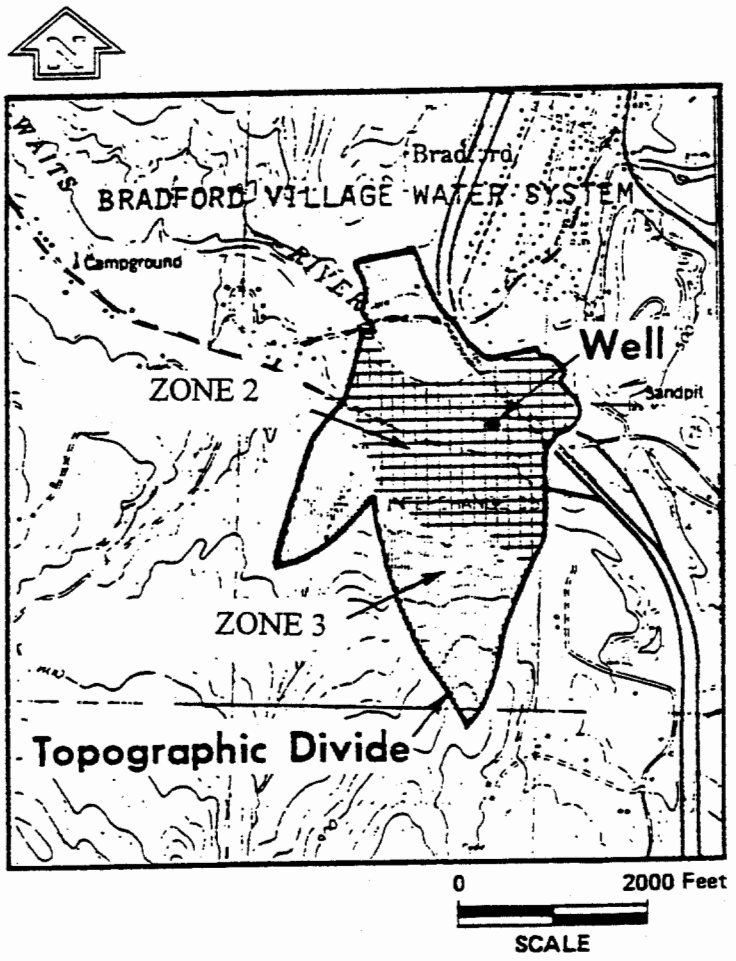


Figure 9 Arbitrary Fixed Radius, Analytical Model and Hydrogeologic Mapping



ZONE 2 (STRATIFIED DRIFT)
ZONE 3 (TILL AND BEDROCK)

Figure 10 Hydrogeologic Mapping

is drawn to represent the flow channels along which water moves toward the pumping well. These flow paths can include induced recharge from other sources such as streams lakes, etc., recharge from the immediate upgradient deposits, recharge reaching the well along the regional flow path, and recharge pulled back by the pumping well against regional gradients (Figure 11). A number of observation wells are necessary in order to appropriately construct the flow net.

The analysis is made by using the discharge of the pumping well and back-calculating in the flow net equation to determine various components of flow. If a pumping rate is not known, then the maximum demand figure for the ground water system, as supplied by the WSD, can be used to estimate the discharge of the pumping well.

$$Q = \frac{Kh}{m}\left(\frac{nf}{nd}\right)$$

Where K = hydraulic Conductivity (ft/day)
h = head (ft)
nf/nd = The Shape Factor. The number of flow channels divided by the number of equipotential drops.
m = saturated thickness (ft)

Reasonable judgements should be made about the recharge sources, flow net shape, and the parameters K, h, nf/nd, and m. These judgements are based on existing information, the field reconnaissance and USGS topographic information, soil conservation service maps, test pit data and soil borings.

Flow net shape adjustments and adjustments in the flow net parameters are made until a reasonable comparison is established between calculated Q and known Q. Zone 2 is then drawn to surround the flow net with an upslope Zone 3 area encompassing materials that drain directly into Zone 2. In some cases, there may be insufficient data to draw the flow net, therefore, the SPA is interpreted from existing surficial, bedrock, hydrologic and field reconnaissance information. SPA delineation is based on ground water divides, flow lines, and flow system boundaries (see Figure 6).

Example 6 Infiltration Equation and Hydrogeologic Mapping. Provided is an example of a SPA that was delineated for a southern Vermont community using the infiltration equation to identify the source's radius of Zone 2 (Figure 12).

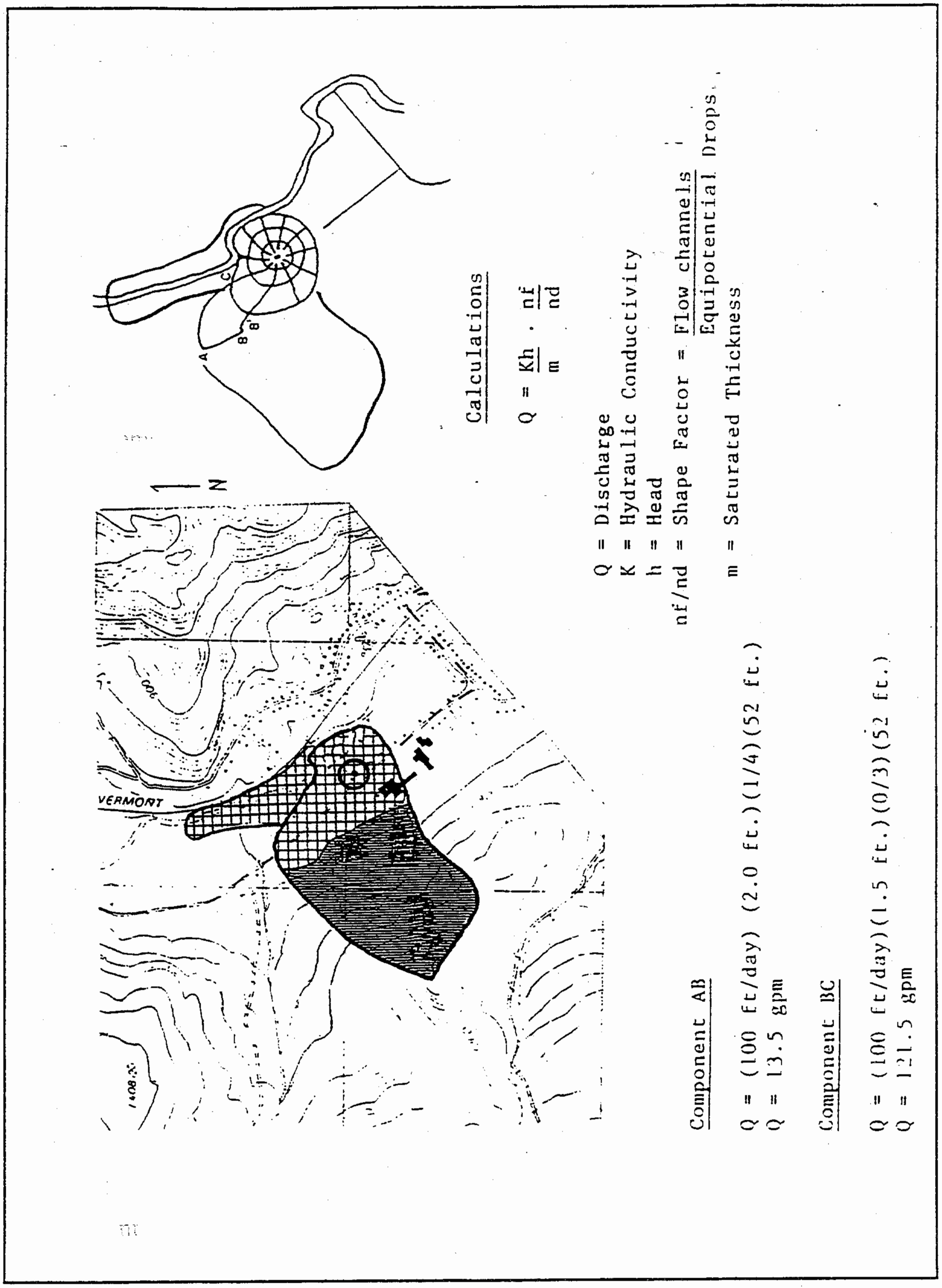


Figure 11 Simplified Variable Shapes

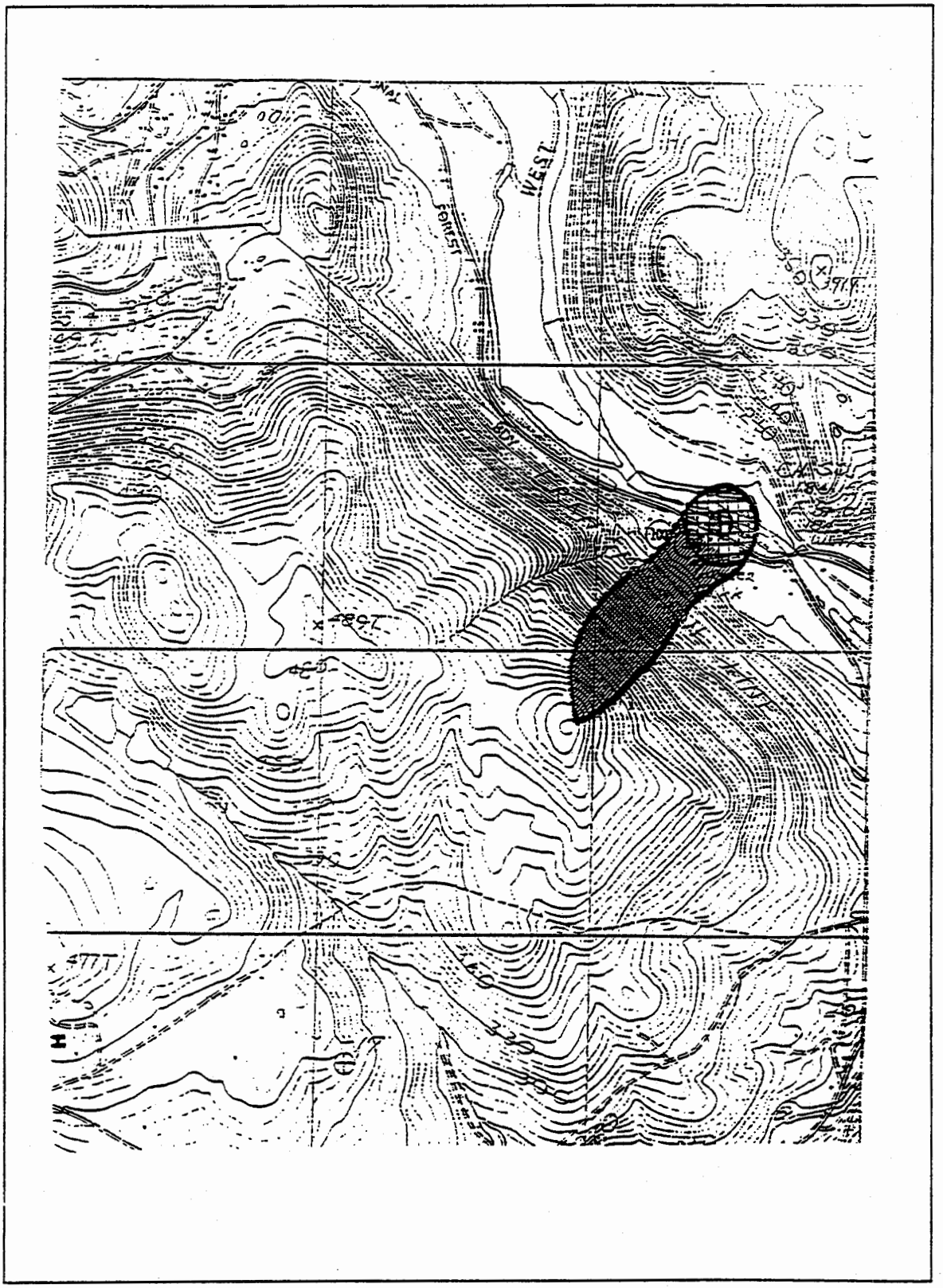


Figure 12 Infiltration Equation Example

Although no driller's log was available for this well, records indicate that the well is completed in bedrock. Considering the available information, the most probable aquifer type is fracture bedrock. Recharge to the well should occur when precipitation infiltrates through unconsolidated materials and into the bedrock where fractures intersect the surficial materials. The records indicate a yield of 6 gpm which is used as the maximum yield for this site (6 gpm = 421,636 ft^3/yr).

Due to the variance in surficial materials and the probable presence of till, an infiltration rate of 0.58 ft/yr is used.

$$R=\sqrt{\frac{421{,}636 ft^3/yr}{(0.58 ft/yr)(\pi)}}=481 ft.$$

Zone 3 includes the land surface which is directly upgradient of Zone 2. This is restricted to the valley wall on the same side of the river as the well.

Example 7 Hydrogeologic Mapping for a Spring. Water falls as precipitation and moves through unconsolidated overburden or at the interface between unconsolidated material and bedrock. In this case, ground water divides are assumed to match surface water divides. To determine this hydraulic geometry, the springs are accurately located on topographic maps with a site description to determine if the source of the spring is bedrock, unconsolidated material or the interface conditions. If this is not clear, other information is consulted, including soils, surficial geology, air photos and topography. When a suspected unconsolidated or interface condition is defined then the SPA is outlined along drainage divides to encompass the upgradient source(s) of recharge. High spring flow monitoring data must be used in the analysis of the SPA delineation.

Low relief in the upgradient direction may indicate that ground water flow passes under obvious surface topographic divides seen on topographic maps and moves toward the discharge point. To encompass the inferred SPA, the recharge area must be outlined beyond the low topographic divide. In practice, the boundary beyond the obvious divide can be a potential losing stream that may be the source of ground water discharging at the spring site.

Losing streams flow out of impermeable upland areas onto more permeable surficial deposits. Surface waters infiltrate into permeable deposits and recharge ground waters. The SPA is outlined to encompass this inferred source of recharge to springs with low divides in the upgradient direction. Boundaries in the vicinity of the potential losing stream are outlined along the stream course, therefore, water quality of the potential losing stream is important. A field reconnaissance greatly aids this effort to define the extent of deposits, hydraulic geometries and the position of constricting bedrock. To finalize the area a 200 foot isolation distance is employed in the downgradient direction from the

spring source. The isolation distance can be reduced to no less than 50 feet in the down slope direction (See Figure 13).

Example 8 Hydrogeologic Mapping for a Spring. Existing information, an accurate field location, and a site description indicate that the spring waters may emanate from bedrock. Air photos and published geologic information are consulted to get an indication of fracture trace and structural trends. The area is then outlined along upslope drainage divides but adjusted to fracture trace and structural trends which indicate that water could be carried under obvious surface topographic divides toward the spring source. In practice, this creates somewhat larger areas as upslope divides are followed, which encompass suspected ground water movement along fracture traces and structural trends. A 200 foot isolation distance is used to outline the SPA in the down gradient direction (Figure 14). The isolation distance for springs can be reduced to no less than 50 feet in the down slope direction provided that the area downslope of the spring is below the bottom elevation of the spring. As in Example 7, high spring flow monitoring data must be used in the analysis of the SPA delineation.

4.3.2 Non-Transient, Non-Community Water Systems (NTNC)

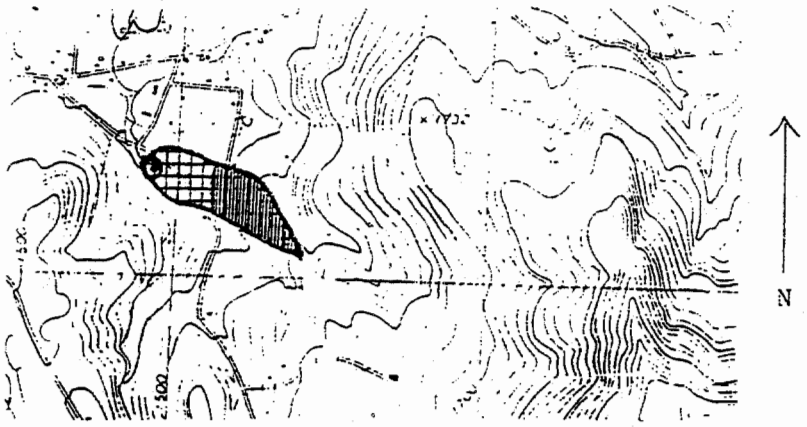
The following method for delineating a proposed SPA is recommended for schools and other NTNC Public Water Systems. If resources allow, a system should use the most accurate delineation methods given the available data. Descriptions and examples of more accurate methods can be found in Section 4.3.1. In particular, the system may want to consider extending the SPA to the groundwater divide in the upgradient direction.

STEP 1: DETERMINE AVERAGE DAILY DEMAND (ADD)
Determine the volume of water used from the source during the average 24 hour period, expressed in gallons per day. This is known as the Average Daily Demand (ADD). Ask your Regional Team member for assistance if this value is not known.

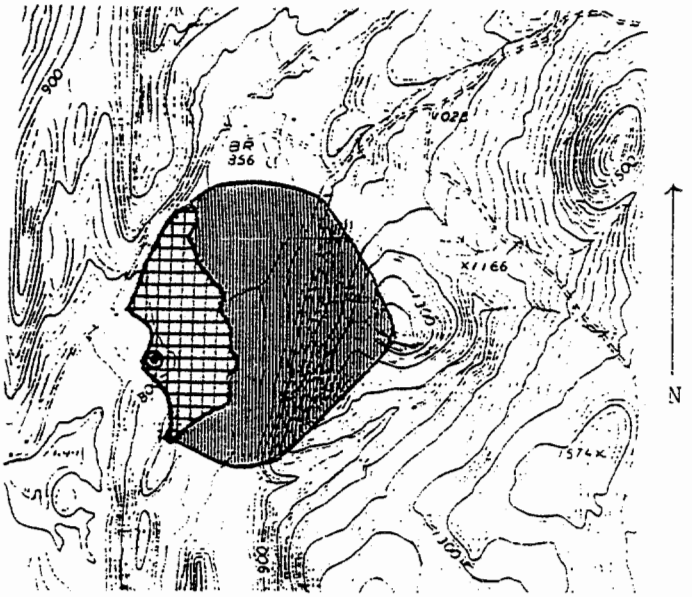
ADD = : _____ gpd

STEP 2: CALCULATE MAXIMUM DAILY DEMAND (MDD)
Calculate the MDD by dividing ADD value (from Step 1) by 720 (minutes in a 12-hour period). The answer will be in gallons per minute.

MDD = : _____ gpm

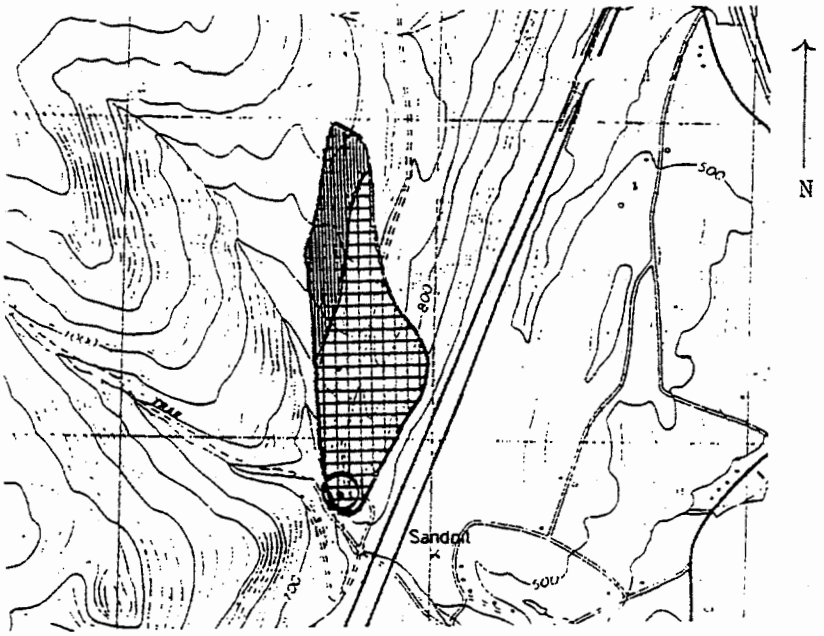


An example of Springs in Unconsolidated Material or at the Interface Between Unconsolidated Material and Bedrock with High Relief in the Upgradient Direction.



An example of Springs in Unconsolidated Material or at the Interface Between Unconsolidated Material and Bedrock with Low Relief in the Upgradient Direction.

Figure 13 Example of a Spring SPA



Example 14 Example of a Spring SPA

STEP 3: CALCULATE RADIUS OF PROPOSED SPA

Compare MDD value from Step 2 to the MDD values in the table below. Select appropriate radius from right side of table.

MDD of Source (gpm)	Radius of Proposed SPA (feet)
0 - 4.9	500
5 - 19.9	1000
20 - 49.9	2000
50 - 99.9	2500
100 or greater	3000

RADIUS = : _____ feet

STEP 4: LOCATE SOURCE ON MAP(S)

There are three acceptable maps for locating your public water source. Listed in order of preference they are:

- A local tax map with a scale of 1:5000 or better;
- A Vermont Mapping Program Orthophoto Map with a scale of 1:5000 (or possibly 1:1250); or
- A U.S. Geological Survey 1:24,000 or 1:25,000 Scale Topographic Map.

Using a clean, unfolded and untrimmed map accurately locate the source (well or spring) with a small dot. If your SPA has already been delineated, mapped and approved by the WSD, a copy of this map is acceptable.

STEP 5: DRAW PROPOSED SPA

With a compass, draw a circle on the map using the radius from Step 3 and the point (well or spring) from Step 4 as the center. Set the compass opening using the scale bar on the map.

The resulting circle represents your proposed Public Water Source Protection Area (SPA) for the source shown. The map will be used as part of the Source Protection Plan submittal.

4.3.3 Transient, Non-Community Water Systems (TNCWS)

Transient, Non-Community Water Systems (TNC) customers are generally perceived to have less long-term exposure to contaminants, and therefore have a lower priority for

implementation of source protection. Due to the typically smaller demand, TNC systems generally have smaller SPA. However, they do need some form of source protection to minimize the risk of contamination especially since they do not have the same level of overview as the NTNC or PCWS. The recommended method for delineating a proposed Public Water Source Protection Area (SPA) for a TNC is the same method used for NTNC systems which is described in Section 4.3.2. Please refer to Vermont's Water Supply Rule, Appendix A Part 11 for regulations regarding the development of TNC Systems.

4.4 Reference List for Section 4

Anderson-Nichols &Co., Inc. 1985. Edgartown Water Resource Protection Program Final Report, Phase 3. Edgartown Board of Health, MA.

Cedergren, H.R. 1967. *Seepage, Drainage, and Flow Nets.* John Wiley & Sons, New York.

Southern Water Authority (England). 1985. Aquifer Protection Policy, 1985. Guildborne House, Worthing, West Sussex, England.

Theis, V.B. 1935. The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage. *Transactions of the American Geophysical Union*, 2, pp.519-524.

Todd, D.K. 1980. *Ground Water Hydrology.* John Wiley and Sons, New York.

Section 5 THE SOURCE PROTECTION PLAN (SPP)

5.1 Introduction

Public water suppliers should protect their sources of water by creating and then following a fairly simple and straight forward plan called a Source Protection Plan or SPP. Such plans are required from all Public Community Water Systems (PCWS) and are recommended for Non-Transient, Non-Community (NTNC) and Transient, Non-Community (TNC) systems. The SPP must also include a Contingency Plan to provide drinking water in the case of source contamination or disruption of service. In developing a SPP, it is important to remember that the goal is to identify and manage the risk of contamination within the SPA, and that the type and level of management must be appropriate for the risk.

Water systems that develop Source Protection Plans may be eligible for waivers from certain chemical monitoring requirements. There is a potential for a full waiver of all Synthetic Organic Compounds (SOC) and a reduction in monitoring for Volatile Organic Compounds (VOC). If you are interested in the waiver program, please contact the Water Supply Division for information and an application packet.

For assistance with SPPs or waivers, water suppliers should contact their Regional Team member by calling 1-800-823-6500 or (802) 241-3400. A map of the Water Supply Regions is on Page 108.

5.2 Elements of a Source Protection Plan (SPP)

Source Protection Plans (SPP) should contain all of the following elements in order to effectively protect the public water supply source and to gain the necessary approval from the Water Supply Division (WSD).

5.2.1 Maps

Most SPP need two maps--one showing the location of the public water source and the Public Water Source Protection Area and the other showing the Potential Sources of Contamination (PSOCs) within the SPA.

5.2.2 Delineated Source Protection Area (SPA)

Every SPP needs a clearly delineated Source Protection Area (SPA) within which the SPP will be implemented. A SPA is the surface and subsurface area from or through which contaminants are reasonably likely to reach a water system source.

Systems with two or more sources should consult with their WSD Regional Team member for guidance as to whether their multiple sources should be protected by one SPP. Some sources will have overlapping SPAs, and not all PSOCs will affect all sources equally.

5.2.3 Inventory and Assessment of Potential Sources of Contamination (PSOC)

Every SPP will need an inventory and an assessment of the Potential Sources of Contamination (PSOCs) that occur within the SPA. Each PSOC will have some level of risk which should be determined in order to select the appropriate management technique.

5.2.4 Management Plan of Risk

The SPP should identify how the water system will manage the risks in conjunction with the PSOC's responsible party.

5.2.5 Contingency Plan

All Source Protection Plans must include Contingency Plans for the location and provision of alternate drinking water supplies for each public water system in the event of source contamination or disruption. Contingency Plans must address short term and long term needs.

5.3 Steps to SPP Development

5.3.1 Creating the Maps (STEP 1)

The ideal SPP will have two maps. One map will be drawn on a USGS Topographic, 1:24,000 or 1:25,000 scale base map showing the location of the source and the boundary of the SPA. The second map will be on a 1:5000 or 1:1250 scale tax map base showing the source, the SPA with its zones and all of the inventoried PSOCs. Town or city tax maps are the preferred bases for PSOC inventory due to the good scale, property lines, parcel numbers and in some cases the owner's names. If no tax map is available, water suppliers should contact the Vermont Mapping Program by calling (802) 241-3507 to purchase an orthophoto map.

Both maps should include the following information:

1. Town;
2. Name of the water system;
3. Water System Identification (WSID) number;
4. Name of person preparing the map;
5. Scale of the map;
6. North arrow; and
7. Any other information requested by the Regional Team.

If the SPA is being redelineated, maps must be kept **unfolded**, either flat or rolled, and untrimmed to allow the WSD to accurately transfer the information to its Geographical Information System (GIS). If the SPA is not being delineated or redelineated, copies of the maps are acceptable provided that they are easy to read.

5.3.2 Mapping the Source (STEP 2)

Once the base maps are ready, the water supplier will need to accurately locate the source(s) on both maps. The Water Supply Division (WSD) has almost all of the Public Community Water Supply SPA and sources located on its Geographical Information System (GIS), please call to see if your system is mapped.

If there is no location available from WSD, or if the WSD location appears to be inaccurate, the water supplier will need to accurately identify the source with a small dot and its unique source number on both maps. (A GPS location is preferred, but not required.) The unique source number consists of the WSID number for the system linked to a three-character source number. The Water Supply Division must be contacted to obtain the source number(s) for your system. For example, source number one for the Wet Water Company would be identified on both maps with 9999-001. If the source is also identified by a name, for example Dutch Hill Spring, the name should also be included on the map. Sources must be precisely located on the maps by persons knowledgeable about maps and familiar with the source. Please consult an expert or the Water Supply Division if you are unsure of your source location.

5.3.3 Mapping the SPA (STEP 3)

After the source is located, the outline of the Public Water Source Protection Area (SPA) must be accurately drawn on both maps. The necessary information may be available from the WSD or the consultant who originally delineated the SPA. This information should be transferred to the base maps.

The SPA will need to be delineated according to one of the methods discussed in Section 4 and then approved by the WSD before proceeding with the Source Protection Plan. A public notice period is required for all changes to an existing SPA or a new SPA. The water supplier should consult with the appropriate regional team in selecting a delineation method.

5.3.4 PSOC Inventory (STEP 4)

Introduction

Identifying Potential Sources of Contamination (PSOCs) within Public Water Source Protection Areas (SPA) is one of the more critical steps towards protecting water quality at

the source. Many human activities and natural processes can contaminate water. However, not all potential sources are of equal concern in determining risk to human health.

Almost any substance can contaminate water. The primary concern for drinking water quality and the potential effects on public health, however, are those biological agents such as protozoa, bacteria, and viruses which can cause human diseases. Typically, such agents are transmitted to drinking water sources by human or animal waste. Fortunately, most of these biological agents cannot live for long periods of time without being able to reproduce inside a human or animal body. They tend to die off in the environment if they cannot reach a host. For this reason, isolation is a critical factor in protecting drinking water sources, and the reason that the Source Protection Area concept works so well.

Isolation also works well with chemical contaminants because they tend to break down into other, perhaps less toxic, compounds, and they may become diluted and dispersed as they travel from disposal site to drinking water source. Therefore, a Public Water Source Protection Area (SPA) works well in most cases to help keep contamination away from the source, or at least focus your protection efforts. To be more effective, however, it is wise to know what contaminants we are dealing with. This is where the concept of identifying and assessing the risks from Potential Sources of Contamination (PSOC) comes in. Most contaminants are themselves not readily visible in the environment. However, we can observe houses, factories, orchards and other human activities or land uses which have the *potential* to be sources of contamination. Most contaminants can be linked to a limited number of activities or land uses. Appendix B of this document is a list of many of the Potential Sources of Contamination (PSOCs) which are of particular concern to drinking water quality in Vermont. The list is not complete. There may be other PSOCs within your Public Water Source Protection Area (SPA) which you should address.

PSOC inventories should be conducted whenever any of the following situations occur:

(a) the PWS is applying for source approval for a proposed new source or increasing the yield from an existing source;
(b) during sanitary surveys;
(c) when applying for monitoring waivers;
(d) when preparing Source Protection Plans;
(e) according to schedules posted in operating permits; and
(f) annually.

The PSOC Inventory

The recommended process for a PSOC inventory is to go, with map and forms in hand, door to door asking to visit and discuss the property and activities, and to inventory those which have "some potential" to be sources of contamination. In many cases, the owner or occupant of the property may not be aware that their residence or activity lies within the

SPA and perhaps has no idea that their activities could result in contamination of the public's drinking water. This opportunity to educate and solicit cooperation should not be overlooked. The pro-active, willing cooperation of persons in control of their activities is the best and lowest cost method of risk management.

The person(s) doing the PSOC inventory should be careful to remember that a PSOC is only a *potential* source of contamination. A few activities may have a high probability to contaminate the source. Many pose only low to moderate risks, and distance between the PSOC and the source is a major inverse factor in calculating risk. A PSOC inventory is not a witch hunt, but an honest effort to identity all the potentially risky activities for subsequent assessment and appropriate management.

To begin the PSOC inventory, we suggest reviewing Appendix B and making a list of PSOCs known to be within your SPA. Also, please review the form for conducting a PSOC Inventory and Risk Assessment (Appendix D). It may be helpful to plan the inventory with the aid of the tax map to determine the route to be taken. A copy of the map could be made to check off those parcels visited to eliminate missing a critical PSOC.

A variety of PSOCs are not visible, so it is important to ask questions about the use and location of septic tanks, leachfields, underground storage tanks for oil and gas, stormwater collection basins, landfill boundaries, etc. In some instances, it may be helpful to take photographs for future reference.

Depending on the size of the SPA, and the inventory person's knowledge of the area, it may be helpful to mail out or distribute a letter with information and suggested schedules for the inventory in advance. This could help speed the process, and increase public acceptance and support.

The following checklist is suggested to help organize and conduct the inventory:

- conduct a pre-inventory mailing;
- an on-site inspection is necessary;
- be polite and courteous;
- always ask permission to enter and inspect;
- always deal with the responsible person (a return trip or two may be necessary);
- always explain your purpose;
- allow time for acceptance and questions;
- take clear notes, ALWAYS PRINT;
- use ball point pens - NOT fibre tips (many run when wet);
- remember the inventory is a step, not the goal - the goal is protection of the public water source;

- remember you will need the cooperation of the property owner in almost all cases; and
- remember the property owner probably does not think of his or her activity as being a threat to the public health.

Mapping PSOCs

The locations of the listed PSOCs must be recorded on the tax or orthophoto map showing the SPA (see 5.3.1). Each PSOC should be shown on the map with a small symbol at the correct location and the unique PSOC number from the PSOC Inventory and Risk Evaluation Form.

5.3.5 Assessing the Risks (STEP 5)

Not all PSOCs are of equal threat to public water supply sources. The risk to your source is assessed by using the PSOC Inventory and Risk Evaluation Form (Appendix D). The purpose of this assessment is to allow for the management of PSOCs in the SPA and to focus first on those high risk activities and last on the lower risk ones.

The risk assessment process may be done by the responsible person for the public water system, an operator, a consultant, or any other appropriate person. The WSD recommends that the risk assessment process not be started until the inventory has been completed. The actual risk to the source and the health of persons from each contaminant at each activity (PSOC) will be made upon considering the following factors:

- Distance from PSOC to source
- Toxicity of contaminant (if chemical)
- The relative elevation of the bottom of source compared to discharge point or potential discharge point at the PSOC
- Level of control exerted over PSOC (Is the PSOC regulated by a state permit? See Appendix C.)
- Volume of contaminant which is, or might be, released at the PSOC
- Is the PSOC one which involves a past, present and ongoing, or a potential discharge?
- The nature of the soils between the PSOC and the source
- The aquifer characteristics, if known
- Type and severity of illness associated with the PSOC if contaminants are disease causing
- Other factors which might help evaluate the level of risk as high, medium or low

5.3.6 Contacting PSOC Managers (STEP 6)

The management of contaminants from Potential Sources of Contamination (PSOCs) is a process which requires at least some level of cooperation from the person or persons responsible for the activity which is the PSOC. The water system owner or operator will have a much easier time if there is wholehearted cooperation. For this reason as well as for good public relations, the water supplier should send a follow-up letter to each PSOC's responsible party. The letter should describe the results of the inventory and the assessment and either recommend an effective management technique or request a meeting to discuss management. Some PSOC managers may not recognize that their activity is a threat to the quality of the drinking water source. In such cases, the water supplier will have a real selling job to do; but, in any case, good communication is the best policy. The tone of the letter should be neighborly and cooperative and open the door for effective management and education.

5.3.7 Selecting the Management Option (STEP 7)

After evaluating the activity which has been designated as a PSOC, the water supplier in cooperation with the responsible person should decide on the appropriate management technique needed to reduce the risk to an acceptable level.

The following is a partial list of suggestions which might be considered as risk reduction techniques:

- Best Management Practices (BMPs) which have been adopted and approved by the State for the particular activity or land use to be managed. BMPs often represent a workable compromise between no management and governmental regulations via permits.
- Land Purchase is the most effective, but most expensive, way to reduce risks. It allows the water supplier to exert maximum control over the SPA. Few PWS will likely be able to afford this technique outside of Zone 1.
- Posting boundaries with signs warning the public of the SPA and drinking water source. Not everyone agrees about the effectiveness of signs. Some think they may invite trouble, but we believe most citizens will react favorably.
- The purchase of development rights by the water supplier may allow the land owner to defer indefinitely the encroachment of human land uses which would increase the risk to drinking water quality.
- Local ordinances or zoning controls may be effective in reducing the risks from high density, commercial or industrial development. Such management works best when the community knows it is entirely dependant on the existing water supply. This technique may also be used to set aside land to expand SPAs or create new ones.

- Frequent and energetic inventories of the SPA by the water supplier with public notices to all affected property owners, may work well to remind the public of the consequences of increasing risks within the SPA.
- Public educational efforts in the community and schools will help assure an informed and supportive public.

5.3.8 Contingency Plan (STEP 8)

Each SPP must contain a Contingency Plan for providing drinking water from alternate sources should the primary source become contaminated or the flow of water becomes disrupted as might occur by pump failure, main rupture or severe drought. Contingency plans are part of the federal SDWA requirements to protect the public health. Providing high quality, safe drinking water is a day-in and day-out necessity to help protect and maintain public health. Contingency plans establish short and long term procedures to replace drinking water sources when contamination or stoppage of flow occurs. A contingency plan allows the WSD to evaluate the PWS ability to provide safe drinking water in response to emergencies and long-term problems with the source.

Appendix D of the Water Supply Rule requires that the Operations and Maintenance Manual for the water system contain a Contingency Plan. It specifically states the Contingency Plan shall contain:

- Required notification of key contact people;
- Alternate water supply made available, both long term and short term solutions;
- Emergency procedure for non-scheduled sequenced system shut down and start-up; and
- Notification or posting of any notice required to the water system customers for use of the emergency source.

The Contingency Plan should also contain a list of people to contact in case of emergencies (i.e., Fire Department, plumber, Water Supply Division, Hazardous Material Spills (1-800-641-5005)).

In cases of declared disasters, the WSD coordinates with the Emergency Management Division to provide water buffaloes and other sources of water (see Duties and Roles).

5.3.9 Writing the SPP (STEP 9)

The final step in developing a SPP is to write the SPP with emphasis on the management techniques decided on for each contaminant at each PSOC. During this process, the water system should evaluate the options for its local government to participate in SPA

protection. In most cases, local governmental support will greatly facilitate source protection.

5.3.10 Submitting the SPP (STEP 10)

Make at least one copy of the complete SPP for your files and submit a copy to the appropriate Water Supply Regional Team for review and approval.

5.4 Plan Approval

Source Protection Plans (SPP) submitted by the Water Supplier or other person to the Water Supply Division will be reviewed by the Regional Team. The reviewer will check the SPP for completeness, accuracy and the feasibility of the management techniques contained in the SPP. Unacceptable plans will be returned with comments and suggestions for improvements. Acceptable plans will be filed at the WSD in the WSID file for the system, and a letter sent to the water supplier notifying her or him of the approval.

5.5 Implementing a SPP

The approval of a SPP is only the beginning of the ongoing work to effectively manage risks within a SPA. The long term goal is to reduce existing risks and to prevent new risks from arising. The system operator should annually review the SPP, including the Contingency Plan, and the system's Operations and Maintenance Manual (O&M) for instructions for risk management in the SPA.

Avoiding new risks not addressed in the SPP requires that the water supplier maintain an ongoing review of all activities within the SPA and of the public notices required for certain local and state permits. "Eternal vigilance" is a good motto since some PSOCs may not require a permit. The risk is to the quality of the public water source and it is the water supplier who bears the ultimate responsibility and loss should the management option fail to protect the source.

Source protection by local government(s) is one of the best assurances of long term risk management. Water systems and the WSD should cooperate with local government to encourage effective bylaws, ordinances, overlay zoning or any other effective option to see that source protection works.

5.6 Updating a SPP

The WSD requires annual updates of the SPP in Permits to Operate, including developments within the SPA which have impacted or may impact the source, any new or

changed PSOCs, and risk management operations. These updates are reviewed at the time of a scheduled sanitary survey.

5.7 Assistance

Regional Team members are available for assistance with SPP development and implementation. Water suppliers and other parties involved in SPA protection should feel free to call 1-800-823-6500 or (802) 241-3400 for assistance. Other organizations can provide assistance in developing Source Protection Plans, please see Section 3 Duties and Roles for a complete listing.

Section 6 PUBLIC PARTICIPATION AND EDUCATION

6.1 Public Participation

Public participation is one of the most important concepts of government in Vermont. Public participation in the regulation of public water supplies and, in particular, the management of public water source protection areas is specified in statute at 10 VSA §1675(c) and 1679(d). Section 1675 requires public notice for each application for a new source for a community or non-transient, non-community system. Section 1679 requires public notice for each proposed public water source protection area. Both notices require opportunity for written comments, public hearings, or both.

The public also has opportunity to participate in groundwater protection at the state level by attending monthly meetings of the Groundwater Coordinating Committee. This committee advises the Secretary concerning the development and implementation of the State's comprehensive groundwater management program. This opportunity is expressed in statute (10 VSA §1392(c)).

At the local and regional levels in Vermont, the public has opportunity to participate on commissions, boards, and committees which address public water supply protection issues, including District Environmental Commissions which implement Vermont's land use law (Act 250); Regional Planning Commissions; Municipal Selectboards; Local Planning and Conservation Commissions; Boards of Adjustment; and Conservation Districts.

6.2 Education

The Water Supply Division continues to encourage and participate in educational programs statewide which deal with drinking water and groundwater issues. Section 3.2.4 further discusses the Water Supply Division's educational roles.

> Persons interested in serving as guardians of safe drinking water or learning about groundwater and public water source protection are encouraged to call the WSD at 1-800-823-6500 or (802) 241-3400.

Section 7 WAIVERS AND FINANCIAL ASSISTANCE

7.1 Waivers

The Vermont Water Supply Division offers waivers from many of the more expensive water quality monitoring requirements under the Federal Safe Drinking Water Act (SDWA). The USEPA authorizes states like Vermont with primary enforcement authority for the SDWA to offer waivers from monitoring for certain chemicals. Some chemical compounds have statewide waivers, and some require demonstrations of non-use within the SPA or that the source is not vulnerable to contamination. If you receive a waiver, then you may either not have to monitor for certain chemicals or have a reduced monitoring schedule. In either case, a waiver can save a water system a significant amount of money.

Application for waivers can be obtained by calling the Water Supply Division. Once received, the completed waiver applications are reviewed by the appropriate Regional Team. If the waiver application includes an approvable Source Protection Plan (SPP) and proves that the source is not vulnerable to that particular contaminant, the waiver is granted and the SPP filed in the system's file for follow-up under Permits to Operate and Sanitary Surveys. Waivers are a means for a PWS to save significant amounts of money and begin an active Public Water Source Protection Area (SPA) protection program.

7.2 Financial Assistance

Any municipally-owned public water system may apply for financial assistance to plan for and construct needed improvements to its system, including the delineation of a Public Water Source Protection Area (SPA), and the development of a Source Protection Plan (SPP). Financial assistance is awarded based on criteria and standards to determine priority for funding as set out in state regulations. The goal of the priority setting system is to correct deficiencies in public water systems which affect public health. (See Chapter 3 of the DEC Rules, Municipal Water Supply Project Priority System for further information.)

A Drinking Water State Revolving Fund is currently being developed based upon the criteria established in the 1996 SDWA Amendments for municipal and private Public Community Water Systems. Specific information about this program, which includes loans, grants and combination of loans and grants, can be obtained by contacting the Water Supply Division.

Section 8 ABANDONMENT OF PUBLIC WATER SOURCES AND SPA

8.1 Introduction

Any public water system (PWS) may petition the WSD to abandon one or more public water sources together with any related Public Water Source Protection Area (SPAs) previously approved by the WSD.

When reviewing a petition to abandon a public water source, the WSD will consider the following criteria:

(a) alternate means of providing water meeting all the requirements of the Federal Safe Drinking Water Act to those persons currently served by the source;
(b) the capacity of the source proposed for abandonment;
(c) potential future demands for water from the system;
(d) the quality of the water from the source to be abandoned; and
(e) the viability of the PWS requesting the abandonment.

8.2 Petitioning to Abandon

A petition to abandon a public water source and any related public water source protection area (SPA) shall contain sufficient information for the Secretary to determine whether the source and SPA meet the criteria for abandonment and can satisfy the conditions for a Petition to Abandon (see 8.3).

8.3 Conditions for a Petition to Abandon

An approved Petition to Abandon a public water source and its source protection area shall contain the following conditions:

(a) A notification of abandonment to all users of the system, all property owners whose lands are adjacent to or within the SPA to be abandoned, the town or towns involved, and the following state agencies: Public Service Board, Public Service Department, Department of Health, Wastewater Management Division of the Department of Environmental Conservation, and the Department of Agriculture, Food and Markets;
(b) provisions for the transfer of ownership of property, if appropriate;
(c) conditions for the physical closure or sealing of the source to be abandoned, which conditions shall comply with the well abandonment conditions of the Water Supply Rule, Appendix A - Subpart 12, and shall protect the public health and safety; and
(d) a map showing the location of the abandoned source and the abandoned Public Water Source Protection Area.

Appendix A
VERMONT'S WATER SUPPLY RULE CHAPTER 21, APPENDIX A, PART 3

Appendix A - Water Supply Rule Appendix A Part 3

Part 3 WATER SUPPLY SOURCE DEVELOPMENT AND PROTECTION

3.0 General

In selecting the source of water to be developed, the consulting engineer, hydrologist, or hydrogeologist shall show, to the satisfaction of the Agency, that an adequate quantity of water will be available, and that the water which is to be delivered to the consumers will meet the current requirements of the Agency with respect to microbiological, physical, chemical and radiological qualities. Each water supply should take its raw water from the best available source which is economically reasonable and technically feasible. Proposed sources are evaluated against six criteria; site, construction, water quality, water quantity, interference and source protection.

Source approval applies to a new **Public Community** water system source and an increase in approved yield of an existing **Public Community** water system source.

General procedural requirements for source approval are outlined in Subpart 3.1. Technical requirements for surface water are outlined in Subpart 3.2 and for ground water in Subpart 3.3.

3.0.1. First-In-Time

For the purpose of determining first-in-time for rights to water supply development or groundwater degradation, and to accommodate compatible land uses, the following shall be recognized as initiating a project:

(a) Submittal of a substantially complete application for approval of a drinking water source;
(b) Submittal of a substantially complete application for a building permit or sewage disposal permit for a non-state regulated project;
(c) Submittal of a substantially complete application for a State Permit to dispose, discharge, or use any substance which may affect water quality;
(d) Existing land and groundwater uses; or
(e) Other state and local planning actions as reviewed on a case by case basis.

3.1 Water Supply Source Approval Process And General Requirements

The Agency uses a step-by-step process culminating in the approval of a **Public** water supply. No source approval or construction permit will be issued until all the Agency's concerns are addressed.

Applicants for source approval shall apply for and receive, if appropriate:

(a) Source Construction Approval;
(b) Source Testing Approval; and
(c) Source Approval.

3.1.1 Step 1. Source Approval Application

The purpose of the Source Approval Application is to record information required to determine whether the site at the proposed location is suitable for source construction.

3.1.1.1 Application Form

Applications for Source Approval shall be submitted on forms provided by the Agency. The application shall be accompanied by a fee indicated on the form. Information requested on this form may include:

(a) Project Municipality, Town, Name, contact information about the owner and consultants, and a project description.
(b) Project proposed source type and site selection method.
(c) Project demand, peaking factor and rationale for selection. The information requested in (d) below may be limited to well yield(s) not to exceed project demand.
(d) Location on a USGS 7.5 minute map of potential sources of contamination (PSOC) which may adversely impact the proposed water supply source. PSOC shall be located within:

    (1) 2000 feet for well yields expected from 0 - 19 gpm; or 3000 feet for well yields expected equal to or above 20 gpm for ground water sources; or
    (2) The drainage area of the surface water source as described in Subpart 3.2.6.

(e) A site plan showing location of the proposed source, name and address of all landowners with property adjacent to or included in a radius of 200 feet of the proposed source.
(f) Plans and specifications of the proposed source or test well, and preliminary site development and explorations or testing.
(g) Information about existing uses or allocations for the future use of the proposed source.
(h) With the prior approval of the Agency in unusual cases the delineation of preliminary source protection area may be substituted for (d) above.
(i) See Vermont Wellhead Protection Plan for additional guidelines.

Note: Information on potential sources of contamination may be available from:

(a) Department of Environmental Conservation:

(1) Water Supply Division;
(2) Permits, Compliance and Protection Division;
(3) Solid Waste Management Division;
(4) Hazardous Materials Management Division; and
(5) Water Quality Division;

(b) Department of Agriculture, Farms & Markets;
(c) Local Government;
(d) Local residents;
(e) Field investigations;
(f) Local farmers (Obtain information on existing and likely future crop and farm chemical uses); and
(g) Federal agencies.

A 1:5000 scale orthophoto or site map of equal or larger scale may be required showing detailed information required.

3.1.2 Step 2. Site Inspection

3.1.2.1 The applicant shall request Site Inspection from the Agency and arrange to meet at agreed upon time and location.

3.1.2.2. The site inspection shall be conducted by the Agency, along with the applicant and/or consultants.

3.1.3 Step 3. Source Construction Public Notice and Hearing

For site(s) approved by the Agency, and prior to construction of source, the applicant shall provide the Agency with certification that all landowners adjoining the source isolation zone (200 feet in radius unless changed as per Subpart 3.3.1.2.) of the proposed source have been notified of the proposed source. Certification shall be provided prior to receiving source construction approval.

The division shall give public notice for each proposed public water source by publication in a newspaper of general circulation for the area containing the proposed system and by causing a notice to be posted in the clerk's office for the municipality containing the proposed source. The division shall provide an opportunity for written comment or a public hearing, or both, on the application before ruling on the application.

3.1.3.1 The Agency will review its findings and write a review letter requesting more information, or one of approval, conditional approval, or denial of approval for the proposed site.

3.1.3.2. The applicant may then construct Source of Supply per Agency's approved plans.

3.1.4 Step 4. Source Testing Application/Source Testing

The purpose of the source testing application is to provide the applicant and Agency with a review of the information needed to determine that the testing and data to be collected will address the concerns of the Agency with respect to source yield, quality, site, interference/allocation, source protection area delineation, ground water under the direct influence of surface water, and/or impact of PSOC.

3.1.4.1. Source Testing Application Form

Applications for Source Testing Approval shall be submitted on a form provided by the Agency. Information requested on this form may include:

(a) Project municipality, town, name, and State identification number;
(b) Well Completion Report on Agency form;
(c) For ground water sources, location of all wells as follows:

Pump Test Rate (gpm)	Monitor Radius
0 - 19	1000 feet
20 - 49	2000 feet
50 - 99	2500 feet
100 +	3000 feet

(d) For ground water sources, information about all ground water sources described in 3.1.4.1.c. including:

(1) Name, address and phone of owner of source.
(2) Source type, depth, yield, pump setting, static water level and log.
(3) Demand on the source and calculations (See Subpart 2.2).

(e) Detailed description of data to be collected; methods of analysis to be used, and scientific references for testing of source yield; site; interference/allocation; source protection area delineation; ground water under the direct influence of surface water; and/or impact of PSOC.
(f) Responses to comments made in the Agency's letter following the site visit and public notice/comment period.

3.1.4.2 The Agency will review a completed application and write letter of approval, conditional approval, or denial.

3.1.5 Step 5. Source Evaluation Report

3.1.5.1. Source evaluation reports must be prepared under the supervision of a hydrogeologist or engineer, knowledgeable in the field of well hydraulics and

contaminant hydrogeology. Each report must consider and comment on the following:

(a) Site isolation zone, ownership and/or easements;
(b) Water Quality;
(c) Water Quantity;
(d) Source construction, as built engineering plans shall be included;
(e) Interference with other water supply withdrawals as appropriate;
(f) Source Protection Area and Protection Plan;
(g) Agricultural lands in source protection area; and
(h) Additional studies as required by the Agency.

3.1.5.2 The report, for wells only, shall include but not be limited to the following:

(a) A summary of the test design, test method, problems encountered, analysis used, and detailed hydrogeologic setting.

When appropriate Graph of Sw/Q vs Q and evaluation of step test data using published methodologies acceptable to the Agency.

(b) Published analytical method or any preapproved proprietary method proposed by the consultant and approved by the Agency for safe yield appropriate to the hydrogeologic setting based on data collected from the constant discharge and recovery tests. Rationale for choice of analytical method.
(c) All calculations used in the determination of source yields, source protection areas, and interference with other source withdrawals.
(d) Plots of time drawdown data on log-log or semi-logarithmic paper for well yield tests.
(e) Plot of discharge vs time on the same semi-log plots of time vs drawdown for proposed production and observation wells. Plot of distance vs drawdown (if 2 or more observation wells are available).
(f) Plots of precipitation and temperature conditions occurring before, during and after the testing, when appropriate.
(g) All raw data including drawdown, discharge, and recovery.
(h) A final source protection area delineated on a USGS topographic map or other base map as approved by the Agency and include rationale, calculations and information specified in Subpart 3.3.6.2.
(i) Geologic cross sections or fence diagram including water levels that illustrate subsurface geologic conditions from available data.
(j) Two ground water contour maps (pumping and non-pumping conditions) from available observation well data.
(k) Hydraulic information as requested on forms provided by the Agency.
(l) Well Completion Report on Agency form.
(m) Calculations and tables of aquifer coefficients.

(n) Information as necessary to evaluate whether ground water is under the direct influence of surface water. See Subpart 3.3.8.

(o) If the secretary finds there are agricultural lands in the area which are likely to affect the proposed source but not likely to constitute a public health hazard, the secretary shall require the applicant to certify in the permit that the proposed source will be abandoned, replaced or tested if it becomes contaminated by agricultural activities conducted on the agricultural lands.

(p) A source protection plan, including a contingency plan, for emergency actions in cases of loss of source use. See §7.6 and Appendix D, §11.

3.1.5.3 Source Protection Area Public Notice and Hearing

The Secretary shall give public notice of each proposed **Public** water source protection area by publication in a newspaper of general circulation for the area containing the proposed protection area and by causing a notice to be posted in the clerk's office for the municipality containing the proposed area. The Secretary shall provide an opportunity for written comment or a public hearing, or both, on the proposed area before designating the area.

3.2 Surface Water Development

A surface water source includes all tributary streams and basins, natural lakes and artificial or natural impoundments above the point of water supply intake.

3.2.1 Source Approval

3.2.1.1 Source Approval Application (See Subpart 3.1 for details)

(a) Source approval will be based on existing threats to the water sources and the ability of the water supplier to effectively manage those threats.

(b) Land within a 200 feet isolation zone of the intake (or as approved by the Agency) shall be owned or legally controlled by the utility as in Subpart 3.3.1.2(f). Land uses not permitted within 200' of the intake are listed in Subpart 3.3.1.2(e).

(c) Fencing of the intake site may be required by the Agency.

3.2.2 Construction

3.2.2.1 Design of intake structures shall provide for:

(a) withdrawal of water from more than one level if quality varies with depth,

(b) separate facilities for release of less desirable water held in storage,

(c) where frazil ice may be a problem, holding the velocity of flow into the intake structure to a minimum, generally not to exceed 0.5 feet per second,
(d) inspection manholes every 1000 feet for pipe sizes large enough to permit visual inspection,
(e) occasional cleaning of the inlet line,
(f) adequate protection against rupture by dragging anchors, ice, etc.,
(g) ports located above the bottom of the stream, lake or impoundment, but at sufficient depth to be kept submerged at low water levels.

3.2.2.2 Natural and Artificial Impoundments

Site preparation shall provide for, where applicable:

(a) removal of brush and trees to high water elevation,
(b) protection from floods during construction, and
(c) closure of all wells which will be inundated, in accordance with requirements of the Agency.
(d) Obtaining necessary approvals and permits from other local, state, or federal agencies.

3.2.2.3 Filtration Requirement

All surface water sources shall be filtered and disinfected, or receive an avoidance of filtration waiver, in accordance with §6.2 of Subchapter 21-6.

3.2.3 Quantity

3.2.3.1 Safe Yield Analysis

The quantity of water at the source shall be shown to supply the design year average day demands given either a 1Q20 low flow condition for intakes without raw water impoundments; or a 20 to 50 year drought condition using a mass diagram for systems with raw water impoundments, and shall consider other withdrawals in the stream, including minimum stream flow requirements of the Agency.

3.2.3.2 Quantity Testing

In the absence of suitable long term gaged flows, existing information from surrounding watersheds may be used. Hydrology models used to predict low flow conditions must include gaged flows from the water shed in question. The proposed watershed shall be gaged on a daily basis during at least 30 days of the year's low flow conditions. Low flow conditions may be late summer and mid

winter depending on the watershed. Method proposed for determination shall be pre-approved by the Agency.

3.2.4 Water Quality

The proposed source shall be tested for the water quality constituents and standards shown in SubChapter 21-6 of these regulations, and additional tests as determined by the Agency.

3.2.5 Source Interference

Interference with existing withdrawals shall be evaluated. The proposed withdrawal rate shall not create a potential health hazard nor interfere with existing uses of the surface water source. These existing uses are to be identified by the applicant. These shall include but not be limited to: deeded or legislated water rights, uses for minimum stream flow, and uses for assimilative capacity.

3.2.6 Source Protection

A source protection area shall be delineated for the surface water source and a source protection plan shall be developed which mitigates risks associated with existing and potential sources of contamination.

3.2.6.1 Delineation

Source protection areas delineation for surface water sources shall include the following zones:

(a) Zone 1 shall consist of an area 200 feet in radius around the intake or as otherwise determined by the Agency.
(b) Zone 2 shall consist of areas within the watershed located within 200 feet of perennial surface water and limited to 17,000 acres.
(c) Zone 3 shall consist of the remaining watershed area beyond zones 1 and 2, except as may be reduced by the Agency on a case-by-case basis giving consideration to the size of the watershed and the likelihood of contamination of the source.

3.2.6.2 Source Protection Plan (SPP)

(a) The source protection plan shall identify all potential sources of contamination within zone 1 and zone 2.

(b) The SPP shall identify all major potential sources of contamination within Zone 3. Major potential sources of contamination shall include but not be limited to:

(1) Direct or indirect discharges as permitted by the State, or other known piped discharge to surface water.
(2) Municipal wastewater or industrial storage lagoons and/or injection wells.
(3) Pulp mills.
(4) Active or closed solid waste landfills.
(5) Mining operations or drainage.
(6) Radioactive waste storage facilities or disposal sites.
(7) Hazardous waste storage or disposal sites.

(c) The SPP shall identify control measures for minimizing risk from each potential source of contamination identified in Subparts 3.2.6.1(a) and 3.2.6.1(b).
(d) The SPP shall identify mechanisms to be used to minimize risk of contamination from future potential sources of contamination.
(e) The SPP shall contain a contingency plan for the location and provision of alternate drinking water supplies in the event of contamination or catastrophic loss of supply.
(f) The SPP inventory shall be submitted with request for waivers from monitoring requirements of Subchapter 21-6 as appropriate.
(g) The SPP inventory shall be updated upon renewal of permit to operate.

3.3 Groundwater Source Development

A groundwater source includes all water obtained from dug, drilled, bored or driven wells, springs, and infiltration lines and galleries. The degree of treatment required for a groundwater source may be similar to that of surface water sources in cases where the groundwater source is under the direct influence of surface waters as determined in Subpart 3.3.8. Three types of groundwater sources are recognized. They include wells, springs, and infiltration galleries and are referred to as wells unless otherwise specified.

(a) Wells are groundwater sources which lower the water table or potentiometric surface in the source and aquifer. Included are free flowing wells; see Part 12.
(b) Springs are groundwater sources which rely solely on gravity to carry the water from the source to distribution.
(c) Infiltration galleries may be considered either sources of groundwater, surface water, or ground water directly influenced by surface water.

3.3.1 Source Site and Isolation Zone

3.3.1.1 General Information on Sites

Proposed well site locations shall be remote from all sources of contamination, hydraulically upgradient of major sources of contamination, and situated so as to minimize the impact from water quality threats. Proposed well sites will not be approved by the Agency in areas which may create a public health hazard or unacceptable risk. Fencing or posting of well sites to restrict access may be required by the Agency on a case-by-case basis. On site sewage disposal systems located within the recharge area shall be located a minimum of a two year travel time in saturated materials from proposed well sites.

3.3.1.2 Well Isolation Zones

The well isolation zone shall be a water system controlled 200' radius around the proposed well unless approved otherwise based on site specific considerations as follows.

(a) The isolation zone may be increased at the discretion of the Agency to insure reasonable protection of water supply sources.

(b) Well isolation zone reductions to a minimum of 125', may be allowed if the following can be shown:

(1) An impeding layer of soil is present and located at least 200' around the well, with no significant hydraulic connection to the proposed aquifer. Hydraulic connection, or lack thereof, between aquifers must be determined by standard pumping test methods including:

i) stressing the production well or proposed aquifer,
ii) monitoring the aquifer's response in multi-level piezometers, and
iii) mapping areas of influence of the well in overlying unconfined aquifers.

or:

(2) Undevelopable land surrounds the well site such as rock cliffs.

(c) Spring isolation zones may be reduced in a down slope direction provided that the area down slope of the spring is below the bottom elevation of the spring. This area must be large enough to include space for maintenance of the spring. In no cases shall a spring isolation zone be reduced to less than 50 feet in the down slope direction.

(d) All proposed wells shall be evaluated for direct influence by surface water as per Subpart 3.3.8.

(e) Permitted and prohibited land uses in the well isolation zone are as follows:

(1) Permitted land uses will be restricted to:

(i) source operation and maintenance;
(ii) playgrounds, ball fields, tennis courts;
(iii) seasonal light duty roads;
(iv) conservation zones;
(v) controlled use of potassium and phosphorous fertilizers; and
(vi) other uses which have the approval of the Agency.

(2) Prohibited land uses include:

(i) application of nitrogen, pesticides and herbicides
(ii) Buildings other than those required for the water system.
(iii) Parking of motor vehicles
(iv) Chemical or fuel storage except natural gas or propane and other chemicals that are required by the water system
(v) swimming pools.
(vi) salted or paved roads passing through the area
(vii) septic tanks, subsurface disposal systems and sewer lines
(viii) any other activity which may contaminate the water supply.

(f) Control of land use activities within the well isolation zone. Documented control of the well site isolation zone must be shown by one of the following documents certified by the applicant's attorney:

(i) ownership of the land; or
(ii) easements with restrictive covenants.

Legal control of land uses within the isolation zone by the water system must be tied to the land deeds for all parcels within the well isolation zone and run with the land regardless of future land ownership so long as the source is used for a **Public** water supply.

3.3.2 Source Construction

Construction of **Public** water system drilled wells shall comply with the well construction standards in Part 12 of this appendix A.

3.3.2.1 Spring and Shallow Well Construction

Construction of springs and shallow wells shall only be permitted when drilled wells are not feasible or upon waiver by the Agency. Specific reasons shall be submitted to the Agency as to why drilled wells are not feasible and may include

results of test wells on the project site, results of existing well yields in the project area, or detailed hydrogeologic analysis.

3.3.2.1.1 Construction Materials

Acceptable materials include:

(a) concrete tiles (grouted together),
(b) poured in place concrete,
(c) well casing, and
(d) other metallic or plastic casing as approved by the Agency.

3.3.2.1.2 Site Work

Spring and shallow well site construction shall include the following:

(a) accessible entrance with lock,
(b) screened openings,
(c) runoff diversion berm located 50 feet upslope where feasible,
(d) back fill material of high clay content sloping away from the structure,
(e) minimum of 4 inches of top soil over the clay, and
(f) a watertight sanitary cover.

3.3.2.2 Water Level Measurement

(a) Provisions shall be made for periodic measurements of water levels in the completed well, e.g. install 0.5 to 1" diameter probe tube.
(b) Where pneumatic water level measuring equipment is used, it shall be made using corrosion resistant materials attached firmly to the drop pipe or pump column and in such a manner as to prevent entrance of foreign materials.

3.3.2.3 Observation Wells shall be:

(a) Constructed in accordance with requirements for production wells and properly protected and maintained if to remain in service.
(b) Protected at the upper terminal to preclude entrance of foreign materials.
(c) Closed in accordance with requirements for permanent wells, if they are taken out of service.

3.3.3 Water Quantity

3.3.3.1 Safe Yield

(a) Drilled wells

(1) The well shall be capable of 180 days of pumping at the average day demand rate followed by a peak of 3 or 7 days of pumping at the maximum day demand rate without dewatering the well. The 7 day duration of maximum day demand pumping shall be applied to water systems serving developments constructed for the purpose of accessing recreational and resort areas. The 3 day duration of maximum day demand pumping is applied to all other water systems. Peaking duration is evaluated by the Agency on a case-by-case basis.

(3) Wells which may be subjected to interference from existing wells shall have that interference evaluated per Subpart 3.3.3.2.2(f).

(3) Proposed wells which may be subject to future interference shall be allowed to use only 90% of the total available head in the safe yield analysis. This requirement may be waived by the Agency for wells belonging to the same **Public** water system.

(b) Springs

Spring yields determined from random measurements throughout summer and fall shall be divided by 4 and compared against maximum day demands to determine the adequacy of the source. Springs issuing from a defined bedrock or sand and gravel aquifer, and having a detailed hydrologic low flow analysis will be compared against maximum day demands, in a 1Q20 drought condition.

(c) Shallow wells

Shallow wells shall have yields determined in a manner similar to drilled wells and take into consideration seasonal low static water level.

All safe yield analyses shall use methodologies appropriate to the hydrogeologic setting and published methodologies, unless previously approved by the Agency.

3.3.3.2 Pumping Test Procedures and Requirements

All well tests shall consist of and be conducted in the following order: a step drawdown test where appropriate, a constant discharge test, and a recovery test. The constant discharge test shall be conducted after full recovery from the step test. The recovery test shall immediately follow the constant discharge test. Tests shall be evaluated using standard published methodologies or any preapproved proprietary method proposed by the consultant and approved by the Agency. All recordings and evaluations (including graphical) appropriate to the testing program shall be provided to the Agency.

3.3.3.2.1 Step drawdown tests shall:

(a) Contain at least 5 steps of at least 60 minutes duration.
(b) Hold discharge constant for the duration of each step. See table below under Constant Discharge Test (in Subpart 3.3.3.2.2) for discharge limits.
(c) Have drawdown measured to the nearest 10th of a foot.
(d) Recommended times for drawdown measurements are as follows:

0 - 10 minutes	every 1 minute
10 - 20 minutes	every 2 minutes
20 - 60 minutes	every 5 minutes
60+ minutes	every 10 minutes

(e) Provide a graph of Sw/Q vs Q and evaluation of the data collected above using published methodologies.

3.3.3.2.2 Constant Discharge Test

The constant discharge test shall be conducted after full recovery from the step test. The following table shall be used to determine the duration of constant discharge tests:

YIELD (GPM)	DURATION	CONSTANT DISCHARGE WITHIN
0 - 49	72 hours	± 5%
50 - 99	96 hours	± 3%
100 +	120 hours	± 3%

The constant discharge test shall include but not be limited to the following:

(a) Discharge shall be held constant within the above limits. Ball-type valves shall be placed after meters to prevent turbulence in the meter. Meters shall be checked by another independent method, i.e., bucket and stopwatch.
(b) Drawdown measurements to the nearest 100th of a foot in observation wells and to the nearest 10th of a foot in production wells.
(c) Recommended times for drawdown and discharge measurements in the production well, including early time readings, are as follows:

TIME INTO TEST, MINS	READING FREQUENCY
0 - 10	every 1 minute
10 - 30	every 2 minutes
30 - 90	every 5 minutes
90 - 180	every 10 minutes
180 - 420	every 30 minutes

420 - 1440	every 60 minutes
1440 - end of test	every 2 to 4 hours

(d) All observation wells within the specified radius (see Subpart 3.1.4.1(c) for the radius) shall be monitored and water level measurements shall be taken as follows:

(1) Water level measurements shall be taken every four (4) hours for two (2) days prior to and one (1) day following the constant discharge test.

(2) Water level measurements during the constant discharge test shall be taken at least every four (4) hours and more frequently based on the hydrogeologic setting and distance from the production well.

(3) Monitoring of observation wells in use shall include measurements taken at a time following the longest recovery period, usually between 3 and 5 A.M.

(e) A graph of drawdown vs time on log-log or semi-log paper and distance vs drawdown, if two (2) or more observation wells are available, and an evaluation of this data using published methodologies.

(f) An evaluation of ground water level trends for the production and monitoring wells prior to pumping to evaluate seasonal or storm related fluctuations in ground water conditions, effects of neighboring wells, and domestic usage patterns.

(g) Precipitation and discharge plotted on each graph of time drawdown for all wells monitored.

(h) The installation and monitoring of observation wells, piezometers or other monitoring devices as needed.

(i) Type and location of all observation wells shall be shown on engineering plan.

3.3.3.2.3 Constant Discharge Test Interruptions

The first 24 hours of the constant discharge test shall be free of interruptions. If an interruption occurs the test shall be terminated, the well allowed to fully recover and the test restarted. After the first twenty four (24) hours, if the constant discharge test is interrupted a total of two (2) hours or longer, the test shall be terminated, the well allowed to fully recover and the test re-started.

3.3.3.2.4 Recovery tests shall be conducted immediately following the constant discharge test and shall include the following:

(a) Drawdown measurements to the nearest 10th of a foot in production wells.

(b) Monitoring for two days or complete recovery, whichever occurs first.

(c) Monitoring of drawdown at timed intervals which will result in evenly spaced plots on logarithmic paper when plotted as s' vs t/t'. Recommended times of recovery measurement beginning when the well is turned off are as follows:

RECOVERY TIME, MINS.	FREQUENCY
0 - 10	every 1 minute
10 - 20	every 2 minutes
20 - 60	every 5 minutes
60 - 120	every 15 minutes
120 - 360	every 60 minutes
360 - 600	every 120 minutes
600 - 2880	every 360 minutes

(d) Calculation of aquifer parameters from recovery data.

3.3.3.2.5 Testing Requirements for Springs

Detailed hydrologic analysis must include at least the following:

(a) Monitoring of spring yield for low flow analysis on a weekly basis from July 1 to October 15 and from December 15 to March 15. The lowest flow during either period shall be used in the analysis.

(b) Monitoring of spring yield for high flow analysis on a weekly basis from March 15 to July 1 and from October 15 to December 15. The highest flow during either period shall be used in the calculation and delineation of the Well Head Protection Area(s).

3.3.3.2.6 Shallow Wells

Shallow wells must be tested in a manner similar to drilled wells. Testing shall occur either during periods of low static water level or the data adjusted to seasonal low levels.

3.3.4 Water Quality

3.3.4.1 The proposed source shall be tested for the water quality constituents as required in Subchapter 21-6 of this rule. The source shall meet all current physical, chemical, microbiological and radiological requirements of the Agency. Initial testing of sources intended for **Public Non-Transient Non-Community** water systems shall consist of all constituents listed in Table 1 of Subchapter 21-6 of this rule.

3.3.4.2 Samples shall be collected at the conclusion of the test pumping procedure.

3.3.4.3 Field determination of physical constituents or special sampling may be required by the Agency.

3.3.4.4 A turbidity in excess of 5 NTU is not acceptable. Treatment may be required.

3.3.5 Source Interference

Source interference monitoring shall be conducted on all sources, when permitted by the source owner, within the monitoring radius defined in this subpart unless a waiver is granted by the Agency. Source interference analyses determine whether a proposed pumping well will result in a source interference problem at a neighboring water supply. See Subpart 3.3.5.4 for the definition of unacceptable source interference.

3.3.5.1 Development of a source interference testing program.

(a) The proposed source interference testing program shall be detailed on the Source Testing Application Form.

(b) All source owners within the radial distances defined in subpart 3.3.5.2(c) shall be identified and notified in writing of the forthcoming test. The notification shall:

(1) Include an informational form letter supplied by the Agency.
(2) Request monitoring permission and a written response;
(3) Define responsibility to prepare source for monitoring;
(4) State the monitoring radius requirement.
(5) Offer to disinfect and re-seal the source when the monitoring ends.
(6) Inform the source user and owner that the applicant will supply potable water or cease the pump test should the their water supply needs not be met.
(7) Identify name and phone number of contact person in the event of a water outage during testing.

(c) If unable to monitor a neighbor's source, estimate source interference based on calculations.

(d) All sources identified per 3.3.5.2(c) shall be monitored, if possible.

(e) All sources monitored shall be disinfected at the end of the testing program when permitted by the source owner. Monitoring tubes and water level probes shall be disinfected prior to installation.

3.3.5.2 Data Collection for Source Interference Testing.

(a) All data specified in Subpart 3.3.3.2.2(d) shall be collected.
(b) Existing sources not in service should be measured to the nearest 0.01 foot. Sources in service should be measured to the nearest 0.10 foot.
(c) The following rates and distances shall be used for determining the study area for source interference monitoring.

PUMP TEST RATE, GPM	MONITOR RADIUS	DURATION
0 - 19	1000 feet	72 hours
20 - 49	2000 feet	72 hours
50 - 99	2500 feet	96 hours
100 - +	3000 feet	120 hours

(d) Water usage and listing of sources in service.

3.3.5.3 Data Submittal

Source interference information shall be submitted in the Source Evaluation Report on forms provided by the Agency.

3.3.5.4 Definition of Unacceptable Source Interference

Public and private water supplies depleted by the testing of proposed sources (and existing permitted sources seeking an increase in approved yield) shall be able to meet their expected demand while the proposed **Public** Water Supply is pump tested for approval. If, as a result of source interference, existing water supplies cannot meet their design demands, then a source interference problem exists. Interference problems may also include water quality problems resulting from public source testing.

3.3.5.5 Resolution of Unacceptable Source Interference

(a) The applicant must resolve all source interference problems prior to source approval for proposed **Public Community** Water supplies. Any agreement between the applicant and the affected party will be reviewed by the Agency. The applicant is responsible for identification of all sources in use within the monitoring radius defined in Subpart 3.3.5.2. The Agency may either reduce the approved yield or require additional testing or analysis to determine the impact upon the unmonitored source.
(b) Solutions may include:

(1) drill affected source deeper and test for water quantity.
(2) test affected source or re-evaluate existing data.
(3) Connect affected water supply onto acceptable **Public** water supply

(4) develop an alternative water source for the affected source.
(5) Present water usage data from the affected water system which documents a reduction in water demand.
(6) For some private water supplies, additional storage may be developed to offset the source interference.
(7) Hydrofracture the well or redevelop by other methods.

3.3.6 Source Protection

A Wellhead Protection Area shall be delineated for the water supply source and a source protection plan shall be developed which minimizes, to the extent practicable, risks from potential sources of contamination.

3.3.6.1 Wellhead Protection Areas (WHPA) - General

(a) The WHPA shall be defined as the surface and subsurface area surrounding a water well or well field, supplying a **Public** water system, through which contaminants are likely to move toward and reach such water well or well field.
(b) The WHPA is a tool applied in the management of groundwater quality and quantity. It is used as a guide in review of proposed activities proximal to a **Public** water supply.

Delineation of Wellhead Protection Areas is required for a new **Public** Water Supply and for altering the permitted production rate. Wellhead protection areas contribute ground water to a pumping well and include recharge areas, transmission zones and ground water storage areas. Well Head Protection identifies areas where land or subsurface activities may affect the well water quality.

(c) If a new **Public** water supply well interferes with an existing **Public** water supply, and increases the wellhead protection area of the existing well(s), then the applicant shall redelineate the wellhead protection area for the affected existing well.
(d) Any increase in the risk of contamination to an existing **Public** water supply caused by the expansion of its WHPA due to pumping of a proposed well must be addressed by the applicant prior to Source Approval of the new **Public** water system.

3.3.6.2 WHPA Delineation

(a) Wellhead protection areas shall be delineated using existing geologic and hydrogeologic data, and pumping test data. The applicant shall give consideration to the following:

(1) Hydrogeologic setting based on published and unpublished reports, well logs, fracture traces, on site observations, and other site specific information available.
(2) Pump testing at design production rate
(3) Ambient non-pumping ground water flow conditions based on topography and observation wells when available.
(4) Topography using U.S.G.S. topographic maps.
(5) Structure (fracture pattern, jointing, lineaments)
(6) Surficial and bedrock geology (rock types, depositional environment, etc.)
(7) Soils (type, thickness, hydraulic properties)
(8) The well's expected maximum use.
(9) Elevation of the well intake.
(10) Appropriate hydrogeologic models.
(11) Seasonal maximum discharges of springs

(b) The delineation of a WHPA is performed in conjunction with the Source Approval process described in Subpart 3.1.

(1) Source Construction Application:
Identification of sources of contamination, development of a conceptual hydrogeologic model, and preliminary WHPA based on existing data collection and assessment;
(2) Source Testing Application; Scope of Work:
The applicant shall propose the method of WHPA delineation, state what data are to be collected from the pumping test and how it will be used in the WHPA delineation. The proposal may include:

(i) Monitoring wells to determine distance drawdown relationship. Production wells in unconsolidated aquifers with intended production rates of 50 gpm or greater require a minimum of three (3) observation wells. A monitoring well plan and rationale shall be submitted for approval.
(ii) Water table or potentiometric surface fluctuations, ground water flow pattern.
(iii) Effect of precipitation

(3) Source Evaluation Report
Each WHPA shall be delineated after careful consideration of all existing information. The WHPA shall be presented on a original unfolded USGS map of scale 1:24000 or as required by the Agency. This map shall include the following:

(i) Name and number of the project and source, and the town name.
(ii) Pumping rate of the source in GPM, maximum day demand.

A narrative which describes the following for each WHPA shall be included in the Source Evaluation Report.

(i) Bedrock and surficial geology (rock types, depositional environment, etc.)
(ii) Structure (fracture pattern, jointing, lineaments)
(iii) Soils (type, thickness, stratification, hydraulic, properties)
(iv) Hydrogeologic setting and aquifer type
(v) Field Reconnaissance observations
(vi) Data Gaps which may be filled through future testing.

Note: As data is gathered during source development, refinement of the understanding of the groundwater flow system should occur. It is therefore expected that the methodologies employed for WHPA delineation be adjusted to the hydrogeologic environment and that all existing data be considered to define a reasonable area to be used to protect the source.

3.3.6.3 WHPA Zones

Wellhead protection areas shall be delineated with the following zones, in a manner that reflects the hydrogeologic setting.

Zone 1 Shall consist of the isolation zone as described in Subpart 3.3.1.2. This is the area where impacts are likely to be immediate and certain.

Zone 2 Shall consist of the contributions from the monitoring radius established in Subpart 3.3.5.2(c), and outside the Zone 1 Isolation Zone. This area is one where there will be probable impacts from potential sources of contamination.

Zone 3 Shall consist of remaining recharge area(s) or area of contribution to the well not delineated as Zone 2 and where there may be possible impacts from potential sources of contamination. Groundwaters under the direct influence of surface water shall include upstream areas in the watershed within 200 feet of any surface water potentially influencing the well.

Two year travel time zone shall be used to identify a protection area to provide adequate protection from pathogen threats resulting from onsite disposal of sewage.

3.3.6.4 Source Protection Plans

Source protection plans shall be developed for groundwater sources and shall meet the requirements of Subparts 3.2.6.2 and 3.3.6.

3.3.7 Infiltration Galleries

(a) Two types of infiltration galleries are recognized by the Agency.

(1) Groundwater induced infiltration galleries located so as to intercept ambient groundwater flow.

(2) Surface water induced infiltration galleries located so as to intercept surface water. Infiltration galleries within 200 feet of surface water are considered surface water induced infiltration galleries, unless detailed analysis of groundwater flow conditions and water quality determine waters to be acceptable groundwater.

(b) Groundwater induced infiltration galleries may be considered only where geological conditions preclude the feasibility of developing an acceptable drilled well.

(c) Infiltration galleries shall be regarded in the same manner as wells as far as sanitary isolation distance and land uses are concerned.

(d) Flow in the galleries shall be by gravity to the collecting well.

(e) Review Process
Infiltration galleries should only be considered when development of alternative sources are shown not to be technically viable.

(1) Groundwater induced infiltration galleries will be reviewed in a similar manner to wells.

(2) Surface water infiltration galleries will be reviewed on a case by case basis and may be considered surface water intakes.

3.3.8 Ground Water Under the Direct Influence of Surface Water

3.3.8.1 General

All **Public** water systems using a ground water source and any new proposed groundwater sources must obtain a determination by the Secretary as to whether the ground water source is under the direct influence of surface water by the following dates:

a)	**Public Community** Water Systems	June 29, 1994
b)	**Public Non-Community** Water System	June 29, 1999

3.3.8.2 Authority

The Secretary, when making the determination under 3.3.8.1, will use the criteria established under the provisions of 40 CFR, §142.16 (b)(2)(i)(B) as set out in 3.3.8.4.

3.3.8.3 Application

All water systems using groundwater sources shall apply on forms provided by the Agency for a determination by the Secretary of groundwater under the direct influence of surface water.

3.3.8.4 Criteria

All systems not otherwise exempted under 3.3.8.6, and using groundwater sources, shall use the (MPA) test when the source meets any one or more of the following criteria:

(a) The source has a history of water-borne disease;
(b) The source, within the most recent 3 year period, has had one or more violations of total coliform MCL or has failed to meet any total coliform monitoring requirements;
(c) The source is subject to annual flooding;
(d) There are construction defects or deficiencies which could allow surface water to directly enter the source;
(e) The source is a spring or infiltration gallery;
(f) The source has a tested capability to yield more than 500 gallons per minute;
(g) The source is less than 150 feet from a surface water body and:

    (1) has less than 50 feet of soil over the screen, end of casing, or bedrock surface;
    (2) has no confining layer; or
    (3) has a direct hydraulic connection;

(h) The source is a bedrock well farther than 150 feet from the nearest surface water but has:

    (1) less than 50 feet of watertight casing; or
    (2) no confining layer.

(i) The source exhibits other convincing evidence of being under the direct influence of surface water.

3.3.8.5 Procedures, Form

The Secretary will develop procedures and a form for applying for the Groundwater under the direct influence of surface water determination.

3.3.8.6 Exemptions

(a) Systems are exempt from further testing when all available sources:

(1) are ground water sources, but not springs or infiltration galleries; and

(2) are farther than 150 feet from the nearest surface water body; and for rock wells

(3) have more than 50 feet of watertight casing or a confining layer.

(b) Systems which pass the Microscopic Particulate analysis tests are exempt from further testing.

3.3.8.7 Required Treatment

Systems with groundwater sources determined by the Secretary to be under the direct influence of surface water as a result of failing the Microscopic Particulate Analysis must provide treatment as required by 40 CFR, Part 141, Subpart H. (See Appendix F).

3.4 Standards for Public Non-Community Water Supply Sources

3.4.1 Water supply sources for **Public Non-Community** water systems shall comply with the **Small Scale** Water Supply requirements found in Part 11 of this Appendix A.

Appendix B
PARTIAL LIST OF POTENTIAL SOURCES OF CONTAMINATION (PSOC) IN VERMONT

A Partial List of Potential Sources of Contamination in Vermont.

The following list is not inclusive, but is provided as a guide for Public Water Systems in developing Source Protection Plans. It is not intended to be adopted as a list of prohibitions in a wellhead protection area, but if a listed land use exists or is proposed in a PWS, the activity should be reviewed for any potential impact. By using best management practices and conservative design standards, the risk of contamination can be reduced. There is some overlap among the categories. Some activities are regulated by the State (Appendix C); others are not.

I. Commercial Activities

1) Laundromats
2) Drycleaners
3) Carpet and Upholstery Cleaners
4) Printing and Publishing
5) Photography and X-ray Labs
6) Furniture Stripping/Painting
7) Beauty Salons
8) Funeral Homes
9) Pest Control
10) Boat Building & Repairing
11) Automotive Service Industry
    a) gasoline stations
    b) car wash
    c) service station
    d) service (full repair)
    e) service (minor repair)
    f) body work
    g) junk yards
    h) auto/truck sales
12) Cemeteries
13) Taxidermists
14) Oil Distributors
15) Wood Preserving
16) Machine Shops/Metal Working

II. Manufacturing

1) Soft drink bottlers
2) Textiles (dying & finishing of fiber, yarn, or fabric)

3) Paper and allied products
   a) pulp mills
   b) paper coating & glazing
4) Tanneries
5) Paving and Roofing (asphalt plants)
6) Rubber and Miscellaneous Plastic Products
7) Stone, Glass, Clay & Concrete Products
8) Canneries
9) Meat Packing, Rendering & Poultry Plants
10) Electrical Component Industry
11) Industrial Lagoon and Pits
12) Chemicals and Allied Products
   a) fertilizers
   b) pesticides and agricultural chemicals
   c) industrial organic chemicals
   d) synthetic organic fibers, except cellulosic
   e) biological products
   f) medicinal chemicals & botanical products
   g) pharmaceutical preparations
   h) soap and other detergents
   i) specialty cleaning, polishing and sanitation preparations
   j) perfumes, cosmetics, and other toilet preparations
   k) paints, varnishes, lacquers, enamels and allied products
   l) gum and wood chemicals
   m) adhesives and sealants
   n) warehouses retail/wholesale
13) Furniture Manufacturers

III. Agricultural

1) Animal Feedlots, Barns, Stables, and Kennels
2) Manure Pits
   a) lined pits
   b) unlined pits
3) Fertilizers and Pesticides (usage and storage)
4) Animal Burial
5) Dairy Waste
6) Poultry and Egg Processing
7) Creameries and Dairies

IV. Municipal

1) Dust Inhibitors
2) Landfills
   a) with or without leachate collection system
   b) lined or unlined
   c) solid waste, hazardous waste, demolition
3) Storm Water Drains and Retention Basins
4) Sludge and Septage Land Application or Landfilling
5) Wastewater and Sewer Lines
6) Railroad Tracks and Yards Maintenance Stations
7) Highway de-icing salts
   a) application
   b) storage
8) Airports
   a) maintenance/repair aircrafts
   b) runway maintenance
   c) storage areas
9) Electric Power Generation Plants and Powerline Corridors
10) Rights of Way and Highway Maintenance
11) Solid waste storage facilities and transfer stations

V. Residential

1) Septic Systems, Cesspools & Privies
   a) septic tank cleaners
   b) septage
2) Household Hazardous Waste
   a) cleaning supplies
   b) paint products
   c) automotive products
   d) lawn care (pesticide spraying and storage)

VI. Other Land Uses

1) Mining and Mine Drainage
2) Development (ski resorts, hotels, etc.)
   a) community size septic systems
   b) community size fuel storage tanks
3) Landscape Work
   a) turfgrass care - athletic fields

b) commercial landscape work - grounds keeping
c) tree service
d) forestry

4) Radioactive Wastes
   a) medical
   b) energy related
5) Class V Underground Injection Wells
   a) automobile service station floor drains
   b) industrial process water and waste disposal wells
   c) agricultural drainage wells
   d) storm water and industrial drainage wells
   e) cesspools
   f) aquifer remediation related wells
   g) abandoned drinking wells
   h) groundwater heat pump return wells
6) Underground storage tanks
7) Above Ground Storage Tanks
   a) manure tanks
   b) chemical tanks
   c) fuel tank (farms)
8) Clandestine Dumping
9) Stump Dumps
10) Hazardous Waste Disposal, Storage and Transfer
11) Stockpiles
   a) chemicals
   b) salt
12) Open burning and Detonation Sites
13) Parking Lot Runoff
14) Construction
15) Waste oil storage facilities, above and below ground

Appendix C
STATE PERMITTING PROGRAMS AND REGULATED LAND USES

Appendix C - State Permitting Programs and Regulated Land Uses

Explanation of State Permit Programs

The following is a brief summary of some of the Vermont permit programs which relate to public water source protection. This appendix is intended to assist the system in identifying which government agency may have jurisdiction over land uses in the system's SPA.

Any person seeking a permit from the State for environmental issues is advised to first contact a Permit Specialist at one of the Regional Offices. See Listing on Page 109.

ACT 250

Act 250 provides a public, quasi-judicial process for reviewing and managing the environmental, social, and fiscal consequences of major subdivisions and development in Vermont through the issuance of land use permits. Act 250 projects are reviewed, approved and/or disapproved by District Environmental Commissions (see page 109). State agencies which are responsible for related, applicable permits make recommendations to the District Environmental Commission on those proposals regarding issues under their jurisdiction. Act 250 permits are required for the following:

- the construction of improvements for commercial or industrial purposes and any substantial change to a commercial or industrial project in existence prior to June 1, 1970 (excluding farming, forestry or logging activities; or electric generation or transmission facilities requiring a certificate of public good from the Public Service Board) on ten or more acres in a municipality with permanent zone and subdivision regulations **or** on more than one acre of land in a municipality without permanent zoning or subdivision regulations;
- construction for any purpose above the elevation of 2500 feet;
- construction of ten or more housing units, a commercial dwelling on ten or more acres in a municipality with permanent zone and subdivision regulations **or** on more than one acre of land in a municipality without permanent zoning or subdivision regulations (one commercial dwelling may be enough to trigger jurisdiction);
- construction involving more than ten acres for state, county or, municipal purposes'
- construction of a road incidental to the sale or lease of land in excess of 800 feet or serving more than five lots;
- any substantial or material change to a project already subject to an Act 250 permit;
- exploration for fissionable source materials;
- drilling oil or gas wells;

- the creation of or offer to sell a subdivision of land consisting of ten or more lots of any size created within a five mile radius or within a District in a continuous period of five years; and
- the sale by public auction of subdivided lots may require a permit.

PRIVATE WATER WELLS

Drilled water wells for private residences are regulated through the licensing of water well drillers who are required to follow the provisions for well isolation and construction standards in Part 12 of Appendix A, of The Water Supply Rule. These wells may also be regulated through the Water Supply/Wastewater Permit (WS/WW).

PUBLIC COMMUNITY WATER SUPPLY SYSTEMS

The Water Supply Division (WSD) of the DEC regulates all aspects of public water supply including bottled water. Small scale water systems are regulated by the Wastewater Management Division using the appropriate criteria from the Water Supply Rule, Chapter 21 of the Vermont DEC Rules.

WATER SUPPLY/WASTEWATER PERMIT (WS/WW)

For subdivision permits involving single family homes, the isolation distance between the septic system and the water supply well is the primary factor of concern in reviewing the permit application. For subdivisions involving a public community water system the WSD has jurisdiction and will do the permit review. WWMD will not issue the WS/WW permit until the WSD has approved the water supply. For non-community water supplies the WWMD issues its WS/WW permits under Part 11 of Appendix A of the Water Supply Rule.

The WW regulations apply to new activities as well as changes in use at existing facilities. If there is an increase in water use as a result of a change in activity, a new permit is required. Generally, flow calculations are utilized to determine the estimated water use of the new activity. If a new permit is required then the entire system must be upgraded to meet current regulations.

If the change of activity introduces the discharge of hazardous materials at the site, the WWMD will request a review of the waste discharge permit application by the Hazardous Waste Management of the waste management division (WMD). If it is found that hazardous materials are truly to be discharged, the WMD will take the lead on the permit application and establish all technical waste disposal criteria. The WWMD Division will continue to assess the engineering aspects of the permit relative to water supply.

If an Act 250 permit was issued for the existing activity, an amendment to the permit will be required for any change of use. The WWMD issues separate permits for mobile home parks (including two or more mobile homes), campgrounds, subdivisions and schools. Each of these permits are reviewed based on the same criteria as the WS/WW permit.

SMALL SCALE WATER SUPPLY AND WASTE WATER DISPOSAL PERMITS (Including those for mobile home parks (more than two mobile homes), campgrounds, subdivision, and schools which are by rule Non-Transient or Transient, Non-Community Public Water Supply Systems)

These small scale water supply and wastewater discharge permits (WS/WW) are issued by the Wastewater Management Division (WWMD) of the Department, which has purview over developments with sanitary waste discharges of less than 6500 gallons per day (gpd) and water supplies for the same. This includes most commercial, residential, and industrial disposal systems. Projects are evaluated on the basis of public health concerns, primarily the threat of pathogens reaching drinking water supplies.

SEPTIC SYSTEMS (On-Site Wastewater Treatment/Discharge systems)

The development's engineer cannot proceed with site work until this permit is issued. Consequently, the general approach is for the engineer, using his or her professional judgement, to assess the general suitability of the site for septic disposal and then have DEC inspect the site prior to submittal of an application. The inspection consists of test pits to determine percolation capability of the soils, depth to groundwater and bedrock, and general site suitability.

If there is an actual failure of a septic system and an upgrade is required, a permit is needed to undertake the work. DEC will require the applicant to come as close as possible to meeting the regulatory standards on the particular site.

INDIRECT DISCHARGE PERMIT (Land-based Sewage Disposal Systems Equal to or Greater Than 6500 Gallons Per Day)

This permit program is administered by the WWMD of the DEC from the Waterbury Office. Systems under jurisdiction include both larger subsurface disposal systems (e.g. leachfields), as well as, sewage treatment - spray disposal systems. The purpose of the program is to ensure that discharges from these systems, which are conveyed to surface water by groundwater flow, do not cause water quality violations in the receiving surface waters.

Construction of the sewage collection, treatment, and disposal system must be certified by a Vermont registered professional engineer under the conditions of the Indirect Discharge Permit. Afterwards an inspection is required annually by a Vermont registered professional engineer to ensure that the system is operating properly. Engineering reports are forwarded to the WWMD. If there are complaints the WWMD staff may do additional site visits.

STORMWATER DISCHARGE

This permit program is administered by the WWMD of DEC. Its purpose is to ensure that surface waters are being protected from large quantities of concentrated stormwater runoff. If runoff is diffuse and flows into the ground, a WWMD permit is not required. However, an underground injection control (UIC) permit may be required. Generally, WWMD staff will review proposed plans in order to assess the magnitude of the runoff, but no inspection of the site is required. Many of the projects of concern are large enough that they will require an Act 250 permit.

UNDERGROUND INJECTION CONTROL

The Water Supply Division (WSD) of the DEC is responsible for this program. Through an inventory and inspection process it attempts to identify all UIC wells, i.e., all wells defined as holes in the ground which are deeper than they are wide and which may receive waste which could enter an underground source of drinking water. Common UIC wells in Vermont are floor drains at automotive facilities, large septic systems, and industrial/ commercial floor drains which discharge to on-site systems. When these wells are located and inspected the facility will be registered for ultimate regulations or closed. Closure is the preferred option. Underground injection wells receiving hazardous waste are prohibited. Stormwater discharges to the groundwater also require UIC permits.

SOLID WASTE TREATMENT, TRANSFER, OR DISPOSAL FACILITIES

The Solid Waste Management Program of the Waste Management Division (WMD) of DEC issues permits authorizing the construction and operation of solid waste management facilities. However, primary responsibility for planning and siting solid waste facilities is delegated to local solid waste districts. The districts must include groundwater considerations in their planning and siting process, including depth to water table, distance from wells and wetlands, soil types and geology. This information is presented at public hearings. Only then will the proposal be submitted to the state. The state will undertake a cursory inspection of the site; however, a more detailed assessment should have been done already. Groundwater classification is one criterion for siting new solid waste facilities.

Special wastes are solid wastes of specific types, including demolition debris, and wood wastes including stumps etc.

A certificate is required by DEC for the disposal of sludge produced by wastewater treatment plants and the septage pumped from septic systems. Guidelines to protect surface and groundwater are used in the certification process.

HAZARDOUS WASTE MANAGEMENT

Notification

All handlers of hazardous waste are subject to the notification requirements specified in § 7-104 of Vermont's Hazardous Waste Management Regulations, (Chapter 7 of Environmental Protection Rules). All questions regarding hazardous waste in Vermont should be directed to Hazardous Waste Management Program at (802) 241-3888.

Transporters

All transporters of hazardous waste in Vermont are subject to regulation and certification under Vermont's Hazardous Waste Management Regulations.

Treatment, Storage, and Disposal (TSD) Facilities

Facilities for the treatment, storage, or disposal of hazardous waste (TSD) must be certified according to Vermont's Hazardous Waste Management Regulations, Subchapter 5 criteria prior to construction or operation. The certification review process considers the location of wells and public water source protection areas. However, hydrogeologic studies are not required for certification since all waste must be securely contained. Unannounced facility inspections are performed annually to evaluate compliance with the Rule.

UNDERGROUND STORAGE TANKS (UST)

All USTs in Vermont must receive a permit from DEC, except for: tanks less than 1,100 gallons in capacity. Permit conditions include monitoring to reduce the potential for groundwater contamination. Home heating oil tanks are not regulated by the state. In order to protect locally important groundwater resources, local governments can fill in the regulatory gap.

New Permits

All new UST, except those noted above, must receive a permit from DEC. Each new UST must be double-walled, no matter where it is located within the state. Some method of leak detection, preferably electronic or interstitial monitoring, must also be included on all new tanks. Although DEC does not do a site inspection for each new UST, a site analysis is done as part of the permit review process. The local community is notified of each

proposed permit, and if there appears to be public concern a public hearing is held. At the present time, Public Water Source Protection Areas are not considered in the siting of new UST, because regulators feel that the double-walled and monitoring requirements afford adequate protection to groundwater. SPAs are considered when reviewing existing UST which have chosen to do precision tank testing as a means of leak detection. These tanks will receive closer scrutiny to minimize the potential for leaks.

Leaking USTs (LUST)

DEC has funds available to help in the clean up of LUST. A priority ranking scheme has been devised in order to identify those Leaking USTs (LUSTs) which pose the most threat so that they may receive the cleanup funds first. This ranking takes into consideration the health impacts of the substance released, proximity of water supplies, quantity released, and sensitivity of receptors among other factors.

UNDERGROUND STORAGE TANKS - DEPARTMENT OF LABOR AND INDUSTRY (DOLI)

DOLI is concerned with the explosion hazard posed by UST containing flammable or combustible liquids or gas. This permit consists primarily of setback requirements from public buildings as well as cathodic protection to minimize leaking. An inspection may be performed during installation. DOLI jurisdiction includes any UST at a public building.

STORAGE OF FLAMMABLE LIQUIDS/EXPLOSIVES

DOLI regulates the above ground storage of flammable liquids and explosives in order to ensure public safety. A site inspection will be performed before the permit is issued. For tanks placed in the basement of a building, 660 gallons is the maximum size allowed.

PUBLIC BUILDING PERMIT, DEPARTMENT OF LABOR AND INDUSTRY

This permitting program is designed to protect the public, employees and property by preventing and removing fire hazards. It is not designed to protect ground water per se. A permit is required for any new construction of a public building (essentially anything other than single family homes), renovation, enlargement or change of use of an existing building. Review of the permit focuses on the structural integrity and the plumbing. While DEC focuses on the outside facilities (water and wastewater), DOLI concentrates on the inside of the building. A site inspection is performed before the permit is issued.

PESTICIDE APPLICATION

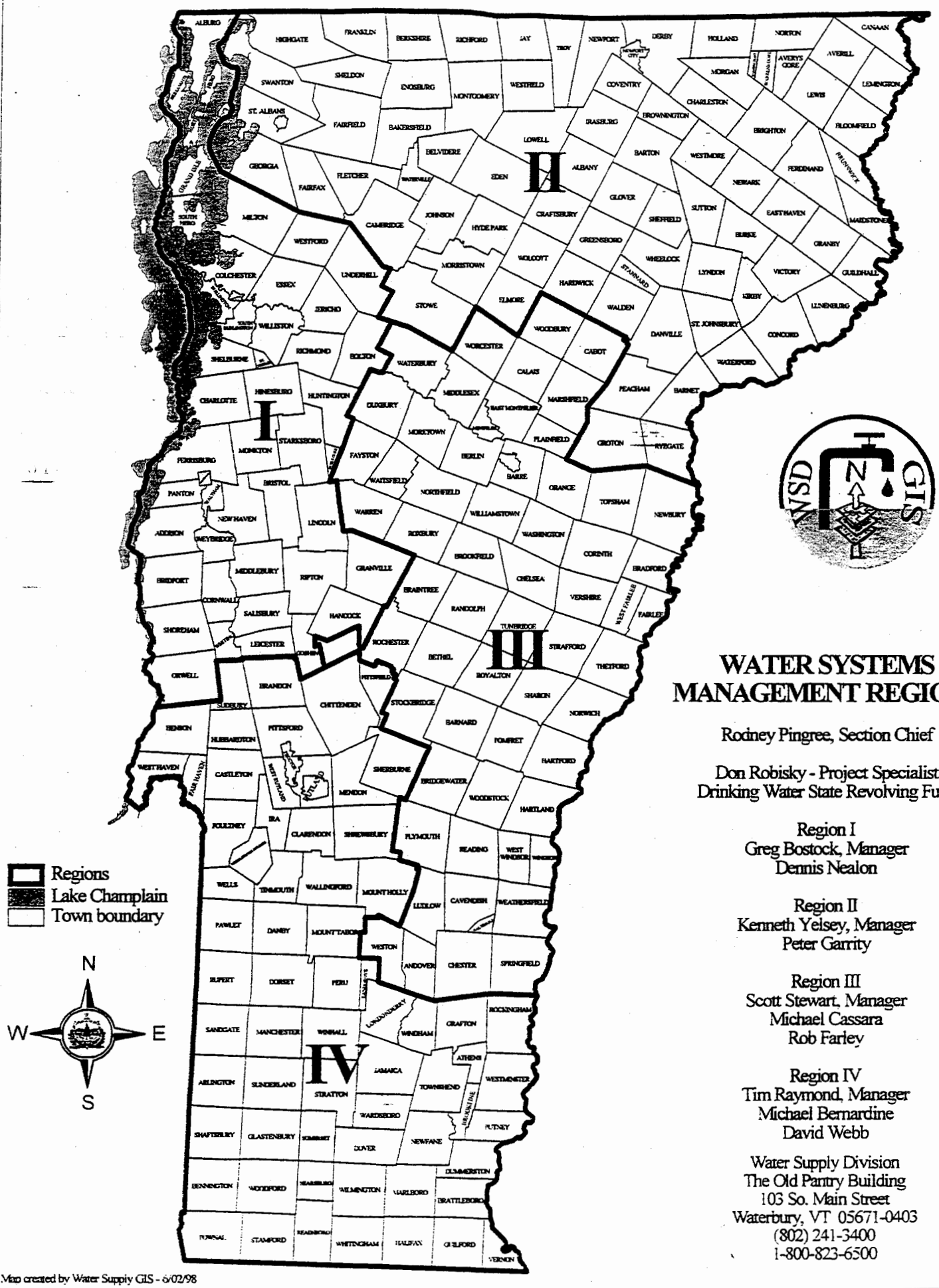
The Department of Agriculture, Food, and Markets (DAFM) regulates the sale and application of pesticides through registration of pesticides and the licensing of applicators. Each applicator must go through training in order to maintain his or her license. DAFM implements the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements in Vermont.

AIRPORTS

The Agency of Transportation issues permits to airports in order to ensure public safety. This permit process reviews the storage of fuel and the testing of USTs in order to ensure their integrity.

JUNKYARDS

The Agency of Transportation permits junkyards. Criteria for the permit focus primarily on aesthetic consideration, although they do specify that junkyards may not be placed in wetlands.



WATER SYSTEMS MANAGEMENT REGIONS

Rodney Pingree, Section Chief

Don Robisky - Project Specialist
Drinking Water State Revolving Fund

Region I
Greg Bostock, Manager
Dennis Nealon

Region II
Kenneth Yelsey, Manager
Peter Garrity

Region III
Scott Stewart, Manager
Michael Cassara
Rob Farley

Region IV
Tim Raymond, Manager
Michael Bernardine
David Webb

Water Supply Division
The Old Pantry Building
103 So. Main Street
Waterbury, VT 05671-0403
(802) 241-3400
1-800-823-6500

Map created by Water Supply GIS - 6/02/98

Agency of Natural Resources and Department of Environmental Conservation District Offices

I. Rutland Office
440 Asa Bloomer State Office Bldg.
88 Merchants Row
Rutland, Vermont 05701-5915
Telephone: (802) 786-5900
Fax: (802) 786-5915

II. North Springfield Office
RD, Box 33, 363 River Street
North Springfield, Vermont 05150
Telephone: (802) 886-2215
Fax: (802) 886-2206

III. St. Johnsbury Office
184 Portland Street
St. Johnsbury, Vermont 05819
Telephone: (802) 748-8787
Fax: (802) 748-6687

IV. Essex Office
111 West Street
Essex Jct. Vermont 05452
Telephone: (802) 879-6563
Fax: (802) 879-3871

V. Barre Office
324 North Main Street
Barre Vermont 05641
Telephone: (802) 479-3621
Fax: (802) 479-4272

Regional Planning and Development Commissions

Addison County Regional Planning Commission
RD 1 Box 275, Colonial Drive
Middlebury, VT 05753

Central Vermont Regional Planning Commission
26 State Street
Montpelier, VT 05602

Franklin-Grand Isle Regional Planning Commission
140 South Main Street
St. Albans, VT 05478

Northeastern Vermont Dev. Association
P.O. Box 640
St. Johnsbury, VT 05819

Southern Windsor Planning and Development Commission
P.O. Box 320
Ascutney, VT 05089-0088

Upper Valley-Lake Sunapee Council
RR 1 Box 123
Lebanon, NH 03766

Bennington County Planning Commission
P.O. Box 342
Arlington, VT 05250

Chittenden County Planning Commission
P.O. Box 108
Essex Jct., VT 05452

Lamoille County Planning Commission
RR 1 Box 2265
Morrisville, VT 05661

Rutland Regional Planning Commission
P.O. Box 965
Rutland, VT 05701

Two Rivers - Ottauquechee Regional Planning Commission
King Farm
Woodstock, VT 05091

Windham Planning & Development Commission
139 Main Street, Suite 505
Brattleboro, VT 05301

Appendix C - State Permitting Programs and Regulated Land Uses

Table of Activities and State Contacts

Land Use/Activity/Potential Source of Contamination	**Program**	**Telephone Number (Area Code 802)**
Agriculture	VT Department of Agriculture, Food and Markets (DAFM)	828-2431
Airports	Agency of Transportation (AOT)	828-2833
Aquifers	Water Supply Division	241-3400 or (800) 823-6500
Asbestos (In Drinking Water)	WSD	241-3400
Barrels (Hazardous Materials/Waste)	Hazardous Materials Management (Haz Mat)	241-3888
Automotive Servicing	Haz Mat Underground Injection Control (UIC) Wastewater Management (WW)	241-3888 241-3400 DEC District Office
Batteries (Disposal)	Solid Waste Management	241-3444
Beauty Salons	Public Buildings, Water Supply & Waste Water (WW)	DEC District Office
Campgrounds	WW	DEC District Office
Chemical Storage Tanks - Elevated Underground	 DOLI Haz Mat	 828-2106 241-3888
Christmas Trees (Pesticide Application)	DAFM	828-2431
Corn Field (Pesticide Application)	DAFM	828-2431
Chloride (Road Salt)	AOT	828-2593
Chloride (In Drinking Water)	WSD	241-3400

Appendix C - State Permitting Programs and Regulated Land Uses

Land Use/Activity/Potential Source of Contamination	**Program**	**Telephone Number (Area Code 802)**
Drums (Hazardous Material)	Haz Mat	241-3888
Dry Cleaners	Haz Mat	241-3888
Dry Wells	WW UIC	DEC District Office 241-3400
Dumps	Solid Waste	241-3444
Farm/Farming	DAFM	828-2431
Feed Lots	DAFM	828-2431
Fertilizer	DAFM	828-2431
Floor Drains	UIC WW	241-3400 DEC District Office
Fuel Oil Spills	Haz Mat	241-3888
Fuel Oil Storage - Elevated	DOLI	828-2106
Fuel Oil Storage - Underground	Haz Mat	241-3888
Funeral Home	WW	DEC District Office
Garbage Disposal	Solid Waste	241-3444
Gasoline Spills	Haz Mat	241-3888
Gasoline Storage - Elevated	DOLI	828-2106
Gasoline Storage - Underground	Haz Mat	241-3888
Golf Course (Pesticides)	DAFM	828-2431
Gravel Pits (Permit)	Act 250	DEC District Office
Groundwater Contamination	WSD	241-3400
Groundwater Protection	WSD	241-3400
Groundwater & Pesticides	DAFM	828-2431
Hazardous Spills	Haz Mat	241-3888
Hazardous Waste	Haz Mat	241-3888

Appendix C - State Permitting Programs and Regulated Land Uses

Land Use/Activity/Potential Source of Contamination	**Program**	**Telephone Number (Area Code 802)**
Heating Oil - Storage	Haz Mat	241-3888
Heating Oil - Boilers	DOLI	828-2106
Herbicides	DAFM	828-2431
Highway Salting	AOT	828-2593
Illegal Disposal on Land	DEC Enforcement	241-3820
Indirect Discharge	WW	DEC District Office
Industrial Discharge	WW UIC	DEC District Office 241-3400
Industrial Discharge (Hazardous)	Haz Mat	241-3888
Injection Wells	UIC	241-3400
Junk Yards (Permits)	AOT	828-2049
Laboratories	Public Buildings, WW	DEC District Office
Landfills	Solid Waste	241-3444
Laundromats	WW	DEC District Office
Leachate	Solid Waste	241-3444
Leaking UST	Haz Mat	241-3888
Local Road Salting	(No State Jurisdiction)	Town Offices
Manure	DAFM	828-2431
Midnight Dumping	Solid Waste Haz Mat State Police	241-3444 241-3888 See Telephone Directory
Mines, Quarries	Act 250	DEC District Office
Nitrate	WSD	241-3400
Oil Spills	Haz Mat	241-3888
Oil Tanks (UST)	Haz Mat	241-3888

Appendix C - State Permitting Programs and Regulated Land Uses

Land Use/Activity/Potential Source of Contamination	**Program**	**Telephone Number (Area Code 802)**
Oil Tanks (Elevated)	DOLI	828-2106
On-Site-Sewage	WW	DEC District Office
Parking Lots (Stormwater to Surface Water)	WW	DEC District Office
Parking Lots (Stormwater to Groundwater)	UIC	241-3400
Pesticides	DAFM	828-2431
Photo Processing	WW	DEC District Office
Power Line Right of Ways Pesticide	DAFM	828-2431
Printing Shops	WW	DEC District Office
Public Buildings	WW	DEC District Office
Railroads	AOT	828-2833
Residential Development	Act 250, WW	DEC District Office
Residuals	WW	DEC District Office
Road Salt	AOT	828-2593
Road Salt (Drinking Water)	WSD	241-3400
ROW (Pesticide Application)	DAFM	828-2431
Salt Piles (State)	AOT	828-2593
Salt Piles (Town)	(No State Jurisdiction)	Town Office
Schools (Drinking Water)	WSD	241-3400
Schools (Public Buildings)	WW	DEC District Office
Seep (of Leachate)	Solid Waste	241-3444
Septage (Land Application)	WW/Residuals	241-3822
Septic Systems	WW	DEC District Office

Appendix C - State Permitting Programs and Regulated Land Uses

Land Use/Activity/Potential Source of Contamination	**Program**	**Telephone Number (Area Code 802)**
Septic Tanks	WW	DEC District Office
Sewers (Municipal)	Public Facilities	241-3737
Sludge Disposal	WW/Residuals	241-3822
Solid Waste	Solid Waste	241-3444
Spills (Haz Mat)	Haz Mat	241-3888
Spray Irrigation (Disposal)	WW	241-3822
Stormwater (to Surface Water)	WW	DEC District Office
Stormwater (to Ground Water)	UIC/WSD	241-3400
Stump Dumps	Solid Waste	241-3444
Sulfur (Taste, Odor in Drinking Water)	WSD	241-3400
Tanks, Storage (Elevated)	DOLI	828-2106
Tanks, Storage (Underground) (UST)	Haz Mat	241-3888
Toxic Waste	Haz Mat	241-3888
Trailer Parks (Drinking Water)	WSD	241-3400
Trailer Parks (Permits)	WW	DEC District Office
Wastewater Disposal	WW	DEC District Office
Wastewater Treatment Plants	Public Facilities	241-3737
Water Testing (Drinking Water)	Health Laboratory	863-7336 800-660-9997
Water Testing (Lakes, Ponds & Streams)	Water Quality Laboratory	241-4520

Appendix D
PSOC INVENTORY AND RISK EVALUATION FORM