Warren, Vermont: A Different Approach For Managing Wastewater in Rural Villages

A DEMONSTRATION PROJECT CASE STUDY FOR THE U.S. EPA / MARCH 11, 2005

The demonstration project was designed to protect valuable water resources like Warren's Mad River, pictured above.

Prepared for the Town of Warren by:

STONE ENVIRONMENTAL INC

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A Case Study for the U.S. Environmental Protection Agency

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Brooks Field in Warren, the site of a new cluster wastewater disposal system serving the Historic Village.

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Executive Summary

Warren, Vermont, is a traditional New England rural town, with an 18th century historic mill village at its core. Two scenic, recreational rivers flow through the village's 95 properties, and its citizens care about maintaining their superior water quality. Warren's path to decentralized wastewater management provides a model for other small communities. Their process, funded in part by a United States Environmental Protection Agency (EPA) demonstration grant, included:

- Assessing the condition and suitability of existing septic systems and their impacts on local water resources.
- Determining and constructing the most cost-effective combination of options, including managing onsite systems, using innovative treatment technologies, and constructing or expanding on offsite cluster systems.
- Developing and implementing a comprehensive decentralized wastewater management program, including remote monitoring technologies on key components, a publicly acceptable user fee structure, and onsite system management.
- Initiating a low-interest property owner loan program for onsite system repairs and upgrades in support of the management program.

The Warren project achieved many firsts in changing the traditional sewer paradigm. The project was among the first to implement a detailed needs assessment, including onsite inspections and soil augering. It included the first municipal alternative system

An aerial picture of Warren Village, looking north. The Mad River runs along the left-hand side of the photograph.

permitted in Vermont, and used remote monitoring for management. The design won a state engineering excellence award and helped convince regulators to include alternative technologies in the state's onsite wastewater rules. The construction project financing for Warren combined demonstration grant and traditional grant/loan funds. The project included public education and outreach to Warren residents, to project consultants, to state and local regulators, and for national dissemination. Finally, Warren spearheaded using Clean Water State Revolving Fund (SRF) monies in Vermont for low-interest loans to property owners.

Many of the lessons learned in the Warren Decentralized Wastewater Management Project can be applied to rural communities throughout the country. Communities facing pollution challenges where traditional sewers and point discharges are unfeasible for their developed village centers need a new way to evaluate the environmental and public health impacts from onsite septic systems. When science-based needs are identified, a range of possible solutions emerges, from onsite replacements to large and small cluster systems where an offsite solution is more appropriate.

Active public involvement in the needs assessment planning process was essential for collection of better information regarding onsite conditions and increased understanding of potential impacts to drinking water supplies and surface waters. The Town's Wastewater Advisory Committee was an instrumental part of the involvement process, leading to high voluntary levels of participation in the construction project and the development of a user fee structure that kept fees manageable for low-income residents and encouraged water conservation. In the long run, this involvement led to town-wide support for the proposed solutions, including a positive local bond vote.

The needs assessment indicated a high level of need for offsite solutions. The range of solutions for Warren included a handful of properties where the existing system was suitable (minor upgrades for maintenance access), a half-dozen properties that could replace their systems onsite, and the remainder of the study area (95 properties total) was best served by connection to one of two offsite cluster systems. Additional cluster system sites were evaluated in the preliminary planning. However, some property owners were not willing to allow a cluster system on their properties. With several properties using onsite solutions, the two town-owned cluster systems provided adequate capacity for existing properties, with a small amount of growth built into the systems. The Warren Elementary School system was constructed as a demonstration for the village in the use of innovative and alternative system technologies.

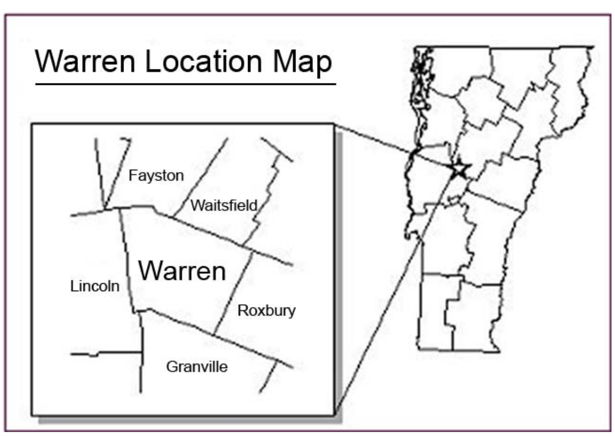
The town owns and manages the onsite and cluster systems through their administrative staff, with service provider tasks performed by contractors. Operation and maintenance manuals, database development, and staff training are included in the management program. One important part of the program is the initiation of a low interest loan program through the town for individual property owners. When finalized, the loan program will be funded through the Clean Water State Revolving Fund (SRF) funds.

2

Background

The Town of Warren is located near the state's center in Washington County. It is surrounded by the Green Mountains and is close to the popular Sugarbush ski resort. It has a population of approximately 4,500. The Warren village area contains 95 properties, including residences and small apartments; small commercial stores; public buildings such as the town offices and hall; the fire station; the post office; the elementary school; and a church. The buildings are typical of 1800's New England mill village architecture with large houses and outbuildings on small lots close to the rivers. Most properties include their own water supply well and septic system. Prior to the decentralization project, there was no existing municipal wastewater infrastructure other than a small cluster wastewater treatment system serving seven properties.

The Mad River flows through town and is met by the smaller Freeman's Brook in the center of the village. Both streams are popular spots for bathing and trout fishing. Bedrock outcrops are common throughout the Village area and are an aesthetic feature in the river and brook, with rounded surfaces forming pools and swimming holes.



A GIS (Geographic Information System) map showing the study area (in yellow).

The Town of Warren conducted a traditional sewer feasibility study in the early 1990s. It included a very limited review of existing environmental conditions. This study proposed connecting all properties to one large system and required everyone to connect to the system, although the treatment and dispersal field could not handle all of the wastewater flows for the village. The project also conducted limited education and outreach efforts. The citizens and Selectboard rejected the recommendations of the study. This process left many residents upset with results that did not prove a need or show that septic systems were impacting the river. Some residents were concerned about neighbors' abilities to pay an annual fee; some were concerned about property rights and being forced to connect to a system; and some were concerned that having a sewer would change the character of the village, perhaps increasing property values and forcing some residents from the village.

While concerns remained about the possible impact of septic systems on the rivers, the town was unsure how to proceed. A local volunteer organization, Friends of the Mad River, has conducted water quality monitoring in several swimming holes along the Mad River for approximately 20 years. The results of the weekly summer monitoring were posted at the swimming holes, and consistently showed bacteriological contamination in some areas, with increasing amounts and frequencies proceeding downstream. Scattered reports of septic odors from failing systems continued to occur, and the environmental and public health concerns remained.

The local inn was also in dire need of an offsite solution, to the point that they offered to fund the construction with an option for the town to pay back the inn once a larger project moved forward. In 1997, the Town decided to construct a portion of a traditional sewer collection system in the center of the village, and a small community cluster system of 5,000 gallons per day (gpd) at the elementary school's recreational field, Brooks Field. The field is the site of the originally proposed large cluster system. This cluster system served seven properties, including the Warren Store, the Pitcher Inn, the fire station, the post office, town offices, and two residences.

A 100-year flood event in 1998 exposed some existing septic systems along the river's banks. An opportunity arose in 1998 to benefit from an EPA special

One example of an onsite system in the Village damaged by the 1998 flood event.

demonstration grant. The Mad River Valley Planning District (MRVPD) assisted the Town in obtaining and administering the grant. A workplan was submitted and approved with a $2,000,000 project budget, including a $1,500,000 EPA grant and a 25% local match requirement. MRVPD managed budgets and work tasks, assisted with outreach, and organized public presentations and local committee meetings.

Ms. Juli Beth Hinds (formerly Hoover), Executive Director of MRVPD in the planning phase, also envisioned a regional approach to onsite wastewater management through sharing resources such as staffing and databases. The neighboring town of Waitsfield, which wants to promote growth in its village center, is currently involved with a similar project, and the opportunity for sharing resources remains a viable option.

The project team includes Stone Environmental, Inc. (Stone) of Montpelier, Vermont, and Forcier Aldrich & Associates, Inc. (FA&A) of Essex Junction, Vermont, as the two primary consultants. Stone led the project during the needs assessment phase, provided hydrogeological services, and offered local and national outreach and technical support, including development of the onsite management program. Forcier Aldrich & Associates Inc. provided engineering consulting services throughout the project, including the design and construction phases. FA&A also provided construction oversight and management program services including sewer use ordinance, cost accounting, and setting up the operation and maintenance plan for the systems.

Pioneer Environmental Inc. of Middlebury, Vermont, provided technical services to the town for the surface water sampling and preliminary hydrogeological testing of the Brooks Field cluster treatment and dispersal site. Endyne Laboratories, Inc. of Williston, Vermont, provided laboratory services to the project, and Hartgen Archaeological Associates of Putney, Vermont conducted the historic and archaeological studies and reports.

The Town Selectboard began the project by creating a local Wastewater Advisory Committee (WAC) that included a Selectboard representative and several village residents. Some of the selected committee members were vocally opposed to the previous project and were wary of this one. They asked the consultants to keep information regarding individual properties confidential, and to only summarize it in reports. They wanted the survey information to also remain confidential, so that even the town officials did not know individual responses. Any project that was to go forward was to be based on voluntary, individual decisions.

3

Public Education and Outreach

This demonstration project included public participation and education as key elements to its continued success. When the demonstration grant was first awarded to the Town, the residents had decided not to go forward with a traditional sewer approach, and the project team had to work hard to overcome a negative public attitude. Following is a description of the local and national outreach efforts that have been completed, and the ongoing efforts.

3.1 Local Wastewater Advisory Committee (WAC)

The local education and outreach effort began with the formation of a Wastewater Advisory Committee (WAC) early in 1999, including representatives of the town Selectboard, the town Administrative Assistant, and citizens from the Village and Town areas. This committee, led by Ms. Hinds of MRVPD, met with project team representatives from Stone, FA&A, and Vermont Department of Environmental Conservation (DEC) representatives throughout the needs assessment and decision-making process.

Town representatives, WAC members, project team members, and Vermont DEC staff traveled and attended outreach events in two demonstration grant sister projects in LaPine, Oregon (1999), and in Rhode Island (2000). The Oregon trip included tours of Washington State's wastewater training center and another demonstration project in Burnett, Washington; and attendance at EPA's Short Course in Seattle, Washington. The Rhode Island trip included attending a presentation and training at the University of Rhode Island's onsite wastewater training facility and touring

Dr. Karen Mancl of the Ohio State University speaks to the WAC and state regulators during a visit to Warren.

the Block Island demonstration project sites where alternative systems were installed on existing properties.

National experts were also brought to Warren to assist with the local outreach effort. Site visits were made and presentations and meetings held with Dr. Robert Rubin, EPA consultant, Dr. Karen Mancl of Ohio State University, Dr. Mark Gross, P.E. of the University of Arkansas, and project steering committee members including Dr. Valerie Nelson, James Kreissel, P.E., and Jerry Stonebridge. One steering committee visit during the draft Needs Assessment Report period in the fall of 2001 resulted in an engineering peer review of the proposed solution.

The WAC was crucial in helping to guide the assessment process and evaluate the proposed solutions, and in building public support for the project. The committee gathered agreements for allowing onsite testing during the needs assessment, held neighborhood potluck dinners to explain the information being presented to the Town, and obtained the first round of voluntary agreements to join the project.

Local education and outreach efforts during the construction project included regular newsletters produced by the Town's construction phase Project Coordinator, Michael Cunningham, and posted on MRVPD's website for Warren. Michael provided assistance during the construction process, particularly as a go-between for the town and contractor and in obtaining easements for the onsite work.

Efforts beyond the demonstration project continue to support the finalizing of the individual onsite system loan program and management plan. Committee and public meetings will be convened to support the ordinance changes for the management plan and to implement the loan program.

Handouts were developed to describe the management program for properties outside the current service area, to give information to new connections and owners, to describe the loan program, and to provide a brief total project description.

3.2
Regulator Education And Outreach

The regulator education and outreach included two state divisions, three state programs, and the local sewage officer. The DEC administers the state rules under two programs for onsite systems and another program for planning, constructing, and funding municipal wastewater treatment facilities. These divisions were accustomed to working independently of each other, and were not very familiar with each other's programs. A decentralized wastewater management project needs the participation of all three divisions. The DEC also did not have any evidence of direct discharges into the surface waters, which could have triggered enforcement orders requiring individuals or the municipality to act.

Warren Village
Wastewater Planning Project

Update February 2000 — Town of Warren, Vermont

Project mission:

The Warren Village Decentralized Wastewater Management Project is intended to find the best, most cost-effective solution to the long-term wastewater treatment and water quality protection needs of Warren Village. Our goals are to ensure the health of the Village community, respect the needs of individual property owners, protect the Village's historic resources, and maintain the Village's unique role as Warren's center.

What's Going on in Warren Village?

For over a year now, a Village Wastewater Advisory Committee has been working on the Village wastewater project, funded through a $1.5 million Environmental Protection Agency (EPA) grant to the Town. The Town is working on a decentralized wastewater management program that will fund a combination of on-site and off-site wastewater treatment systems to solve the Village's long-term wastewater needs. This project is very different from the old proposal for a conventional, centralized sewer system, which was scrapped because of high projected costs and a lack of support.

An example of the newsletters distributed to study area residents.

The Vermont Environmental Protection Rules govern small-scale onsite systems for properties and systems in the state. There have historically been many exemptions in the rules, resulting in frequent instances where systems might not come under any regulation unless the town has its own Sewage Ordinance. The state exemptions include older single-family residences (pre-1970), which means that most of the town properties were exempt. Buildings with other uses trigger the state permit program for system replacements and upgrades, changes in use, or increases in wastewater flows. The ability of each property to meet current minimum standards is limited in many cases, restricting the potential for growth. This also put system replacements in a "best fix" category, where design, while not meeting all of the standards, meets as many as possible while not causing surfacing or public health problems. The rules did not allow the use of innovative/alternative systems other than sand filters, which were first allowed in 1996.

Warren did have a sewage ordinance; so all properties were required to obtain a town permit when onsite systems were constructed or upgraded. However, this permit program was not always administered by trained personnel and consisted of administrative issuing of permits and limited inspections during system construction.

The Vermont DEC was not involved with administering the EPA demonstration grant, and generally was not anxious to be involved with the project unless it triggered their permit or funding programs. The project team made early efforts to request meetings with DEC staff from several divisions in order to keep lines of communication open. Mr. Donald Robisky of the Vermont DEC was actively involved with the project from the beginning, and volunteered to help the WAC work through the needs assessment process. There was a period in the beginning of the project where no DEC staff was involved in the project. Since the project was funded and constructed using various state and federal grant and loan sources, Mr. Thomas Joslin with the Facilities Engineering Division was involved in the final design phase, and Mr. Bruce Epstein was involved in the construction phase of the project. They worked closely with FA&A to develop the cost accounting and in working through design and construction details. Mr. Robisky, in a new position with the Facilities Engineering Division, is involved in administering the SRF loan and State grant programs.

One of the goals of the EPA workplan was to encourage the use of alternative systems where site conditions were unsuitable for conventional technologies. Mr. Robisky attended the trips to Oregon / Washington and Rhode Island. Other regulators later also visited Rhode Island's demonstration project and wastewater training facility. The Warren Elementary School's pilot alternative system was the first of its kind in the state and required several meetings to convince the state regulators to

State regulators, the WAC, and project consultants visited the Northwest Onsite Wastewater Training Center to learn about alternative technologies.

allow the use of advanced treatment technologies and alternative dispersal system technologies other than those specifically approved under their rules. The DEC staff was concerned that alternative technologies might allow the passage of viruses through the system, and also were concerned that homeowners would not maintain the systems, leading to premature (and expensive) failures.

Vermont legislators were also struggling with onsite system issues. They were being asked to eliminate exemptions so that all decentralized systems would come under the same set of standards throughout the state.

Along with the elimination of exemptions came reductions in site conditions for designing alternative treatment systems. The sponsoring House and Senate committees were encouraged to visit the Rhode Island training center and demonstration site. In 2002, Vermont enacted new rules that will eventually bring all small-scale septic systems in the state under the same set of standards. The new rules include a process for approving alternative technologies. Besides the sand filter systems identified in the earlier rules, textile filters, peat filters, trickling filters and various dispersal technologies are also approved.

3.3
National Project Dissemination

Applying the concept of decentralized wastewater management to rural communities is a new approach not just in Vermont or New England, but also across the country. The days of clear problem definitions like direct discharges, and readily available state and federal grant funding for municipal sewer projects, are past. The high percentage of small towns and villages with onsite systems that have problems meeting standards, particularly in areas designated as "growth centers", is a national issue. In 1998, EPA's Response to Congress acknowledged that onsite wastewater treatment and dispersal is a viable long-term solution when appropriately operated and managed.

Extensive national education and outreach efforts were made throughout this project. Papers and presentations were given at four National Onsite Wastewater Recycling Association (NOWRA) conferences (November 2004 being the final presentation), at an American Society of Agricultural Engineers (ASAE) conference, and at an American Planners Association (APA) conference. A presentation was also given at a New England Interstate Pollution Control Commission (NEIWPCC) conference.

The national outreach effort also brought opinions of some of the country's top leaders in onsite systems into the planning process. A steering committee was established as part of the grant program to provide technical expertise on the EPA workplan. The steering committee members include Dr. Valerie Nelson of the Coalition for Alternative Wastewater Treatment; Jerry Stonebridge, who was one of the leaders of the Burnett, Washington, demonstration project; Dr. James Kreissl (formerly with the EPA); Thomas A. Weiss, Civil Engineer with United States Department of Agriculture, Rural Development; Rod Frederick, Environmental Engineer with EPA; and Tom Yeager, P.E., of Kennedy Jenks Consultants. The committee reviewed the draft workplan and submitted comments that were addressed in the final approved workplan.

Mary Clark presents a paper about Warren at the ASAE conference in 2001 as part of the national dissemination effort for the project.

4

Needs Assessment and Water Quality Testing

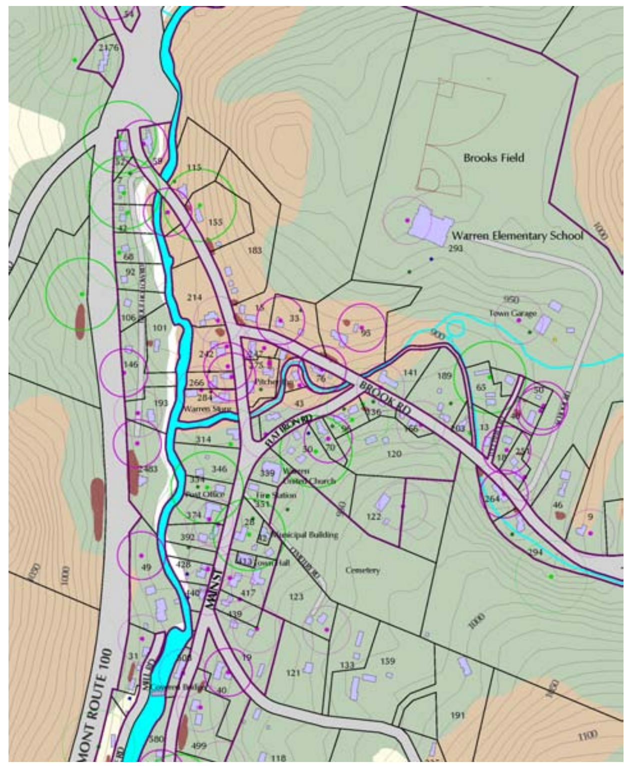
The lot-by-lot needs assessment involved four key elements:

- Collecting and evaluating existing information regarding water resources, water supplies, and septic systems.
- Working with the WAC to collect information, particularly from the surveys.
- Adding a pilot project for the Warren Elementary School alternative system.
- Testing surface water and drinking water supplies.

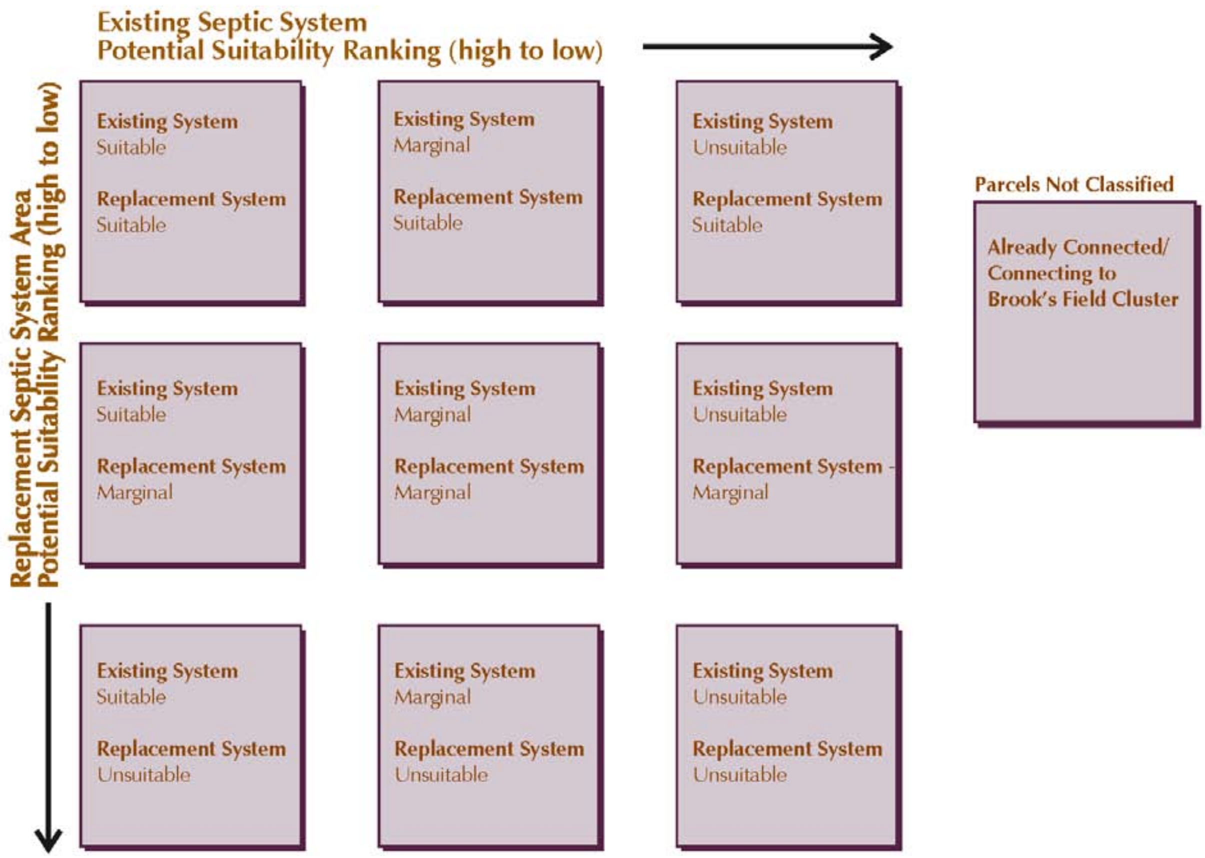
The results of this needs assessment identified which existing systems might be managed; which systems might be replaced onsite; and which properties would benefit from connection to an offsite system.

The evaluation of existing onsite systems entailed distributing a property owner survey questionnaire, requesting permission to walk onsite to view site conditions, and using existing permit file data, Geographic Information System (GIS) data, and previous reports to determine the level of need for alternative onsite systems or for offsite solutions.

Permit file information at both the town and state level was very limited due to the age and exempt status of most properties. Older permit files contained limited information on soils and groundwater tables. In addition, state permits are filed under the owner's name at the time of the permit, so it can be difficult to even locate and match a permit with a particular property. Town staff experience was critical in remembering previous owner names in order to locate permit information.



A GIS figure showing environmental sensitivities in the central Village area, including bedrock outcrops (dark brown), drinking water supplies (red and green circles), and soil suitability for onsite systems (light brown areas are limited).



The ranking matrix used during the Needs Assessment phase of the demonstration project.

The survey questionnaire (response rate of 55%) indicated that most systems included a concrete septic tank and leach field or drywells. Most owners pumped their tanks regularly, and switched drywells each year. Unfortunately, as also seen in the permit review, most systems do not have design plans available. The survey requested that the owners sketch the well and septic system in relation to their house and the road. Since 80% of the responses indicated they did not have any written records of their system, this sketch became the only record.

The GIS data layers available in 1999/2000 were limited in information and of planning-level quality, and as such, could not be used for analysis. The flood plain, road coverages, and rivers all intersected randomly. The information, however, was accurate enough for presentation purposes, and clearly showed soil boundaries, bedrock outcrops, water supply wells and their protective zones. Since many of the protective zones overlapped with septic systems, this was a powerful presentation tool.

An assessment matrix was developed and used to evaluate each property. The consultants attempted to answer two questions for each property:

1. Does the existing system meet current minimum design standards?

2. Is there an area available to install a replacement system that meets current minimum design standards?

The properties were then categorized according to the matrix, as to whether the property was suitable, marginal, or unsuitable for onsite systems. The first round of assessment left many properties in a "marginal" category, with no clear determination of whether they needed offsite connection or not. The DEC representative was concerned that if a site was considered suitable in this planning phase, and was later found unsuitable, there could be a problem connecting them to offsite systems in the future. Having gained a greater understanding of onsite systems, the WAC and Selectboard decided to have more site-specific inspections conducted before identifying which properties needed offsite options.

A second round of inspections was added to the project scope to return onsite (where property owners granted permission), open septic tanks and pump stations, measure setbacks to wells and surface waters, dig hand auger soil holes near the existing system and in a potential replacement area, and conduct drinking water quality sampling where agreed upon by the owner. This second site-specific environmental analysis led to results showing fewer properties in the marginal category, but also indicating a clearer need for offsite connections for most properties.

4.1
Warren Elementary School System

During the needs assessment phase, it was found that the elementary school's system was failing and potentially impacting the school's water supply, a drilled well. The Selectboard requested that additional evaluation be conducted on the existing system, and a potential replacement system area be identified on the property, hopefully not in the area decided on for the large cluster system. They decided to use the opportunity to create a pilot project using alternative technologies for this system, to highlight how such technologies can save on dispersal area size and vertical separation requirements to groundwater and bedrock.

The existing system was found to be hydraulically ponded and within inches of surfacing and causing a public health hazard. Constructed in early 1960 of concrete ameration chambers, it is gravity fed and provides little to no dispersal. The chambers had settled

The Warren Elementary School, with a replacement system using alternative technology under construction in the foreground.

out of level, and the soils testing indicated they were too close to bedrock. The horizontal separation to the drilled well was also closer than the minimum required. The well had been experiencing high nitrate concentrations from unknown sources. As a result of this information, it was decided to abandon the existing system and install a new alternative wastewater treatment and dispersal system. Soil testing was conducted in a wooded area behind the tennis courts and was found to be suitable for a dispersal field, which, due to the use of alternative technology, needed to be only half the traditional size of a standard system.

Manufacturers and distributors of potential treatment and dispersal technologies were contacted and asked to provide performance information and informal construction and operation costs. Several responded and were evaluated not only for cost, but also for performance, reliability, warranties, ease of maintenance, availability of operators and equipment, and acceptability by the State.

4.2
Water Quality Testing

Warren Village is constructed along two rivers: Freeman Brook and the Mad River. Both rivers are used for recreational trout fishing and swimming. Historical sampling by a volunteer organization, Friends of the Mad River, has been occurring in both rivers for approximately 20 years. Their information indicates some bacteriological contamination in the rivers that increases as they flow downstream through the Village area. Some citizens were concerned that the contamination was connected to onsite systems while others blamed agricultural and stormwater runoff.

This project conducted quarterly sampling of certain characteristics (including phosphorus, surfactants, E. coli) in both rivers upstream and downstream of the village. Pioneer Environmental conducted the surface water monitoring from August 1999 through July 2000. In summary, the sampling program did not determine the source of the water quality problems.

In the spring of 2000, the project team discussed changing the sampling methods to see if other means of testing might be more appropriate. Stone Environmental, Inc. conducted a literature search on using microbial tracking indicators to obtain better data. Discussions were held with Vermont regulators, EPA, and Rhode Island sister project representatives from the University of Rhode Island to evaluate whether teaming on a tracking project might be beneficial, since there would be data collection, testing, and reporting efforts that might benefit more than one project. The decision was made to publish the literature review in the Needs Assessment report, but not to proceed due to the high costs of developing and conducting a study and the newness of the testing processes.

The project team also decided to conduct a series of sampling events around the Fourth of July weekend in 2000. This weekend is when up to 20,000 residents and non-residents are in town and the rivers are heavily used. Pioneer conducted three sampling events just before and after this weekend. Results continued to show excellent water quality results. It was decided at that point to terminate the surface water sampling for this project. One lesson learned here was that a monitoring program needs to be frequent enough to have statistical significance or it can be inconclusive, as in this case.

One of the swimming holes in the Village monitored by the Friends of the Mad River.

Surface water evaluations were also conducted on an unnamed stream that flows into the Mad River. This stream was identified as the potential receptor of groundwater under the Brooks Field cluster system site. Pioneer conducted a biomonitoring study of this stream. The results will be used in 2005 as a baseline for determining any potential biological changes from the large cluster system.

4.3
Groundwater Monitoring—Drinking Water Supply Wells and Large Cluster Site

Groundwater monitoring was initially proposed where alternative treatment systems were constructed and for the large cluster system sites. One alternative treatment system was constructed for the Elementary School. This system was approved without a state requirement for groundwater monitoring, based upon the site's location and in the belief that there was no groundwater to capture in monitoring wells. Although there are onsite systems being replaced during this project, no other alternative treatment systems are included in the final design.

Testing of groundwater used for drinking water supplies was added to the project as an incentive for allowing the onsite inspections, during the second round of onsite inspections. Fifty-five tests were completed on a mixture of shallow and drilled wells, and approximately one-third of the samples indicated bacteriological contamination, although none exceeded the nitrogen limits. This testing resulted in more concern and recognition by village residents of the need to implement a solution, particularly since some drilled wells tested as poorly as some shallow wells.

Since the permit requirements allow for fewer analyses for clusters serving pre-existing uses, the Town is not required to conduct groundwater sampling for the Brooks Field expansion. However, they will conduct sampling in the future to obtain information on the performance of the system that could allow for future flows above the pre-existing levels that they are currently required to maintain. In other words, there can be no growth in the village beyond "pre-existing" use status for properties connecting to this cluster system until sampling and analysis is completed and is accepted by DEC. If the water quality sampling shows that the current wastewater flows to the Brooks Field system are not impacting nearby groundwater or receiving waters, the Town will be allowed to add new connections to the system.

Deep monitoring wells (near 100 feet in some cases) were drilled and installed around the proposed cluster system. The soils were logged and hydraulic conductivity tests were conducted on the wells that contained water. A hydrogeological evaluation report building on Pioneer's previous results was prepared by Stone for approval by the Vermont DEC Indirect Discharge Permit Section.

Installation of deep monitoring wells at Brooks Field.

5

Cluster System Options and Recommended Plan

Cluster system sites on town-owned properties and on private properties near areas of need were identified throughout the village. The idea was to find cluster sites as close to the problem areas as possible, reducing the collection system costs and costly state highway and surface water crossings. Areas from very small to very large systems were reviewed, and several of the most favorable alternatives were further evaluated. Permissions were sought and given on seven properties, including private properties, the town-owned gravel pit, and other areas on the elementary school property to conduct onsite soil testing. Another town-owned site at the end of a small side road in the village was identified and tested later.

The testing results for the cluster sites provided the basis for the recommended solutions. The information gathered in the Needs Assessment survey resulted in the inclusion of several of the sites in the recommended plan.

The engineering consultant (FA&A) considered a combination of different types of collection systems and connections to different offsite options. Preliminary cost estimates for construction and total project costs were developed. A present worth analysis and an alternatives analysis was completed on the options, and a recommended option was developed.

The recommended plan was as follows:

1. Five properties – add septic tank risers and effluent filters and manage the existing onsite system
2. Seven properties – design and construct a replacement system on site
3. Twenty-four properties – connect to a cluster system at the town owned gravel pit
4. Four properties – connect to a small privately-owned cluster system for neighbors' properties with high groundwater tables or bedrock outcrops
5. Two properties – connect to a small privately-owned cluster system site, including alternative treatment, for two properties along the river with no land.
6. Forty-six properties – connect to an expanded cluster system at Brooks Field
7. Elementary School – construct separate alternative treatment and dispersal field apart from large system

The collection system for the Brooks Field system is a combination of new gravity services to the existing gravity sewer system and septic tank effluent pump (STEP) systems onsite connected to low pressure sewer force mains that then connect to the existing forcemain. No STEP system effluent is discharged to gravity sewers. The Luce Pierce Road cluster is designed with septic tank effluent gravity (STEG) tanks and gravity sewers to a dosing pump station.

The total project costs for the preferred alternative significantly exceeded the amounts of the original EPA grant and local match. This resulted, in part, from the local WAC's decision to include all construction costs up to the building foundation and installation of water meters as part of the user fee charge, so that the project costs included all of the real costs of the construction. Additional funding from local, state and federal sources was sought to complete the project. Additional information on the financing is included later in this case study.

5.1
Steering Committee and Peer Review

Three EPA Steering Committee members conducted a visit to Warren in October 2001. Dr. Valerie Nelson, Jerry Stonebridge, and Dr. James Kreissl of the steering committee, along with Dr. Mark Gross, engineering professor at the University of Arkansas, met with the WAC, Selectboard members, and the project consultants to review project status and the recommended project plan.

After the publication of the Draft Needs Assessment Report in December 2001, the steering committee requested an engineering peer review of the recommended solution. In particular, there were concerns about the potential problems of mixing raw sewage from some buildings with septic tank effluent from others. The committee also questioned the estimated construction costs. Committee members, Stone staff, and the EPA's project coordinator considered several candidates from around the country. Mr. William Bowne, P.E. from Eugene, Oregon, was selected to conduct the review.

On June 27, 2002, Mr. Bowne visited Warren, toured the study area, and met with the project consultants and state regulators. Several State of Vermont representatives and Town staff were also present during the visit. Mr. Bowne presented his results in late July 2002, and FA&A prepared a response to the engineering peer review's comments and recommendations. The most significant change to the final design based on the peer review was keeping STEP system effluent separate from the gravity sewers.

The Project Steering Committee, Town Selectboard and WAC representatives, and project consultants during a visit to Warren in 2001.

A final Needs Assessment Report was issued in April 2003. The report also included information on the water quality monitoring conducted during the project, the Warren Elementary School pilot project, and development of the management program.

During this phase of the project, formal agreements for each property to participate in the proposed solutions were obtained. The WAC was instrumental in meeting with most owners individually to discuss and obtain agreement to participate. The percentage agreeing to participate has increased steadily since the original effort. The first effort found approximately 80% of the owners willing to participate. Participation in the project is currently at over 90 percent.

6

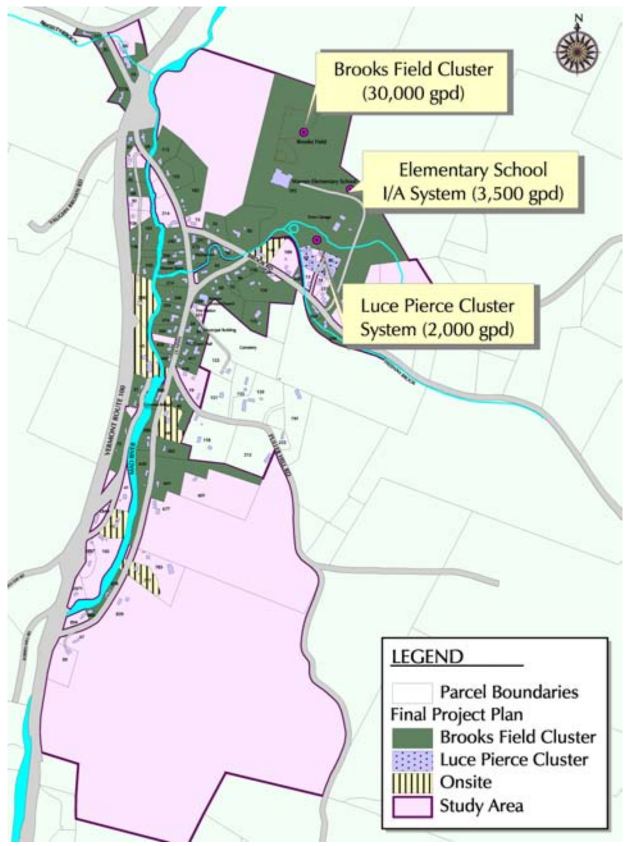
Final Design and Construction

A lot can, and did, happen between the Needs Assessment's recommended project plan and final design completion. The project moved forward in two design and construction contracts. Contract 1, constructed in 2003 and 2004, includes the Brooks Field treatment and dispersal field enlargement, including a 50,000 gallon septic tank, dispersal pumping system, and distribution system. Contract 2 was constructed in 2004, and includes two managed onsite systems with upgrades to the tanks; six individual onsite replacement systems, three systems connected to the 2,000 gpd cluster system on Luce Pierce Road, water meter installations, and STEP systems on private properties connecting to Brooks Field (now enlarged from 5,000 gpd to 30,000 gpd capacity). How the project team reached this point is explained below.

January 2003
The Warren Village Decentralized Wastewater Management Project required an Environmental Assessment (EA) pursuant to National Environmental Protection Act (NEPA). In January 2003, the U.S. EPA Region 1 office issued a Finding of No Significant Impact (FNSI) for the project.

February 2003
A revised EA was issued in February 2003 that incorporated recommendations received from Vermont DEC during the comment period.

March 2003
The project also required a Vermont Land Use Permit amendment under Act 250. The original Act 250 permit was for the pre-existing 5,000 gpd Brooks Field system. The permit amendment for expansion of the system to 25,000 gpd was approved on March 3, 2003.



A GIS image showing the final project plan for Warren Village.

May 2003
Amendment No. 2 to the Act 250 permit, for the expansion of the Brooks Field system to a design flow of 30,000 gpd, was approved on May 7, 2003.

Fall 2003
An Archaeological Site Assessment was also completed for the project. The literature reviews and site visits were conducted in 2002. Additional research was conducted in 2003, and the final report was published

in the fall of 2003. A final update to the archaeological project was completed in the spring of 2004. Since this village contains some properties of historic significance, the additional review was required.

In addition to the Act 250 permit, other state permits were required, including:

- An Indirect Discharge Permit was required for the Brooks Field system.
- Water and Wastewater Disposal Permits were required for the Elementary School and Luce Pierce Road cluster systems.
- Eight individual Water and Wastewater Disposal Permits for individual system replacements.
- State Stream Alteration Permits and State Highway Permits for construction of collection systems.
- State Stormwater Construction Permit.
- Town Septic System Permits were also required for most of the systems.

Most of the permits and approvals described above were triggered by the larger municipal project as opposed to an individual making their own system replacement. The increased level of review, level of detail in design specifications, construction bidding and oversight, the operation and maintenance manuals and management plan are key differences for such a project from an individual system replacement. However, these levels of effort are in line with those expected during a municipal wastewater project.

The Town moved cautiously in approaching the owners of some of the potential cluster system sites. One owner decided not to participate, while another wanted to maintain the ability to cut off service to other properties as they saw fit. Backhoe testing indicated less suitable soil conditions than expected on a couple of sites, including the town gravel pit site. Based on preliminary testing, this site appeared to have the needed capacity to serve the properties of need on the west side of the state highway and the Mad River. However, there are several drinking water supply wells with insufficient setbacks located downslope of this site. Early contacts with the owners during the planning phase showed verbal agreements to consider having the town replace their current shallow well water supply with a drilled well in a location meeting the required setbacks. One property changed hands in the design stage of the project, before written agreements were secured, and the new owner decided not to give up their shallow well. This choice eliminated this site from further consideration.

During the excavation of backhoe test pits and preliminary hydrogeologic characterization performed on properties designated for individual onsite system management, testing was also performed at a site on town property at the end of Luce Pierce Road. This property had adequate capacity to serve all homes on Luce Pierce Road and the Town Garage. A conventional treatment and dispersal system with a design flow of 2,000 gpd was designed for this site as part of Contract 2.

FA&A and Stone performed site visits on participating properties designated for onsite management, onsite system replacement, or connection to a small cluster disposal site. These investigations generally found either that adequate area and soils existed for the design of a conventional replacement system, or that conditions were unsuitable for any onsite system and the structure should be connected to a cluster system. Thus, no additional alternative onsite systems were constructed to serve individual properties.

Contract 1 included the expansion of the existing system at Brooks Field to a capacity of 30,000 gpd, the installation of water meters, and the installation of some of the septic tank effluent pump (STEP) systems and services. A low-pressure sewer collector system conveyed the STEP effluent to the existing force main to Brooks Field. Contract 1 also included an extension of the existing gravity sewer collection system on Main Street. The Contract 1 contract was awarded to N.L.

Chagnon Inc. of Burlington, Vermont in early May 2003. Construction began at the end of May 2003, shut down for the winter, and was completed in October 2004.

Contract 2 included construction of the 2,000 gpd Luce Pierce Road cluster system; additional installation of STEP systems and services, and mainline low-pressure sewers; upgrades to two managed onsite systems; and construction of six individual onsite systems. Construction began in June 2004, and should be completed by June 2005.

6.1 Quality Assurance

Quality Assurance and Quality Control standards were established and followed in several stages of the project. The purpose of the procedures is to provide field, lab and analysis efforts with a process for collecting and analyzing data. Standard Operating Procedures (SOPs) for installation, sampling, testing, equipment calibration, and reporting were included in the original workplan.

Quality Assurance/Quality Control procedures were developed for surface water, groundwater and effluent sampling during the project. Data collection for the needs assessment included available GIS data on parcels, roads, water and wetlands, soils, flood elevations, and water supplies; GPS data on water supplies and wastewater treatment systems; survey data collected from property owners; surface water analytical data gathered during the surface water sampling program; data on treatment systems and water supplies collected during site inspections; laboratory analysis of drinking water samples collected during site inspections; and soil and groundwater level data collected during site investigations.

Laboratory analysis conducted by Endyne, Inc., a state-approved facility with its own quality assurance program, followed the Quality Assurance Project Plans (QAPP) developed for certain activities. Effluent sampling at the Warren School system and at the

The dispersal field for the Warren Elementary School I/A system, three years after the system was installed.

existing 5,000 gpd Brooks Field system was conducted by the Town's Sewage Officer through the fall of 2002. Effluent sampling in accordance with state permits is currently conducted by Simon Operating Services.

Quality Assurance Project Plans were also developed for the surface water monitoring, effluent sampling of the alternative system, and for sampling groundwater monitoring wells for the Brooks Field cluster system.

Health and Safety Plans were developed before each field effort during the Needs Assessment process (for site inspections, cluster site investigations, and testing at Brooks Field and the Town Gravel Pit). All project staff received any necessary additional training before going into the field.

FA&A developed detailed construction plans and specifications and bid documents for permitting and construction. Engineering representatives were onsite during construction for oversight and project management.

6.2 Elementary School Alternative System

The Warren Elementary School alternative treatment and dispersal system chosen for design and construction was the ORENCO Systems Inc. recirculating Avantex™ textile filters and shallow gravel-less dispersal system. This system included a new additional septic tank with effluent filter to follow the existing septic tank, twelve Advantex™ filters, a recirculation / blend tank, a pumping station, a force main to a flow splitter, and an alternating gravel-less shallow half-pipe dispersal trench system. The dispersal system is time-dosed, which is another new feature for dispersal technologies in Vermont. After an arduous permit process, the system was approved for construction. Bids were requested and the system was installed and on-line by January 2001. The system contains remote monitoring technology, and currently undergoes regular operation and maintenance, annual engineering inspections, and effluent sampling after the treatment system. There have been no major problems with this system since installation.

Effluent sampling was initially intended to be completed on alternative treatment systems and large cluster systems where required by permit. The Warren Elementary School system was sampled at the septic tank outlet and treatment system outlet for the EPA demonstration project for two years after it came on-line. A QAPP was prepared for this sampling. This system continues to be sampled at intervals specified in the DEC permit. The results of the sampling indicate this system has remained well within its permitted standards.

The Elementary School system was highlighted during the local Groundwater Festival, and several tours have been given to groups from various Vermont communities, as well as regional and international visitors. In June 2001, the Town, FA&A, and Stone received the Grand Award for Engineering Excellence for the Warren Elementary School innovative wastewater treatment and dispersal system from the Vermont Section of the American Consulting Engineers Council.

7

Project Financing

The estimated total construction costs are $2.9 million, and the total project costs are $4,662,000, including $334,700 in tasks specifically related to complying with the EPA demonstration project. Table 1 shows the major work tasks and estimated costs, along with the EPA demonstration grant portion of the funding.

Project Element	Estimated Cost	EPA Demo Grant
Needs Assessment-Facilities Plan	$462,000	$300,300
Final Design	$386,200	$267,400
Construction	$2,585,070	$293,900
Construction Engineering Services	$448,630	$189,000
Existing System Capital Payback	$305,300	$198,400
Other Services	$140,100	$0
EPA Demo Only	$334,700	$251,000
Total	$4,662,000	$1,500,000

Table 1: Warren Total Project Costs

Once the peer review was completed, the final plan for design was established. The WAC again proved crucial to the process in rallying support for the project. A bond vote for $830,000 for the State Revolving Fund (SRF) loan repayment required approval by the town, which, after a series of public meetings, voted at Town Meeting in March 2002 to approve their portion of the financing on a town-wide basis. The total local share for this project is approximately $970,000 as seen in the table below.

Table 2 below shows all of the funding sources for the project. As is typical for most municipal wastewater projects, this one has multiple sources, each with its own eligibility requirements and matches. The EPA State and Tribal Assistance Grant (STAG) is a special appropriation grant that Vermont's Congressional delegation helped the state and the Town receive. For each of the past several years, Vermont has received one grant earmarked for a centralized project, and one grant for a decentralized or innovative project. Warren originally received $1,500,000, which was subsequently reduced after Congress cut budgets across the board. The Vermont state pollution abatement grant, also called the dry weather grant, is a 35% grant on all project costs from a "point of eligibility". This grant was very important to making the financial plan work. Once a municipality is committed to going forward with a project, the state often visits the project site to declare "points of pollution" that qualify for the funding.

Source	Amount
EPA Demonstration Grant	$1,500,000
EPA State & Tribal Assistance Grant (STAG)	$1,301,000
Vermont State Pollution Abatement Grant / Match	$930,000
Local Share - SRF Loan	$791,000
Local Share - Town Meeting Allocations/Match	$140,000
Total	$4,662,000

Table 2: Warren Total Project Funding Summary

We compared this project with other recent, similar projects in Vermont, and the following table indicates that the cost per equivalent user (EU) is comparable to Warren's. Where there is compact development or the potential for additional growth, there are more EUs to share the costs, thus allowing the cost per user to be reduced from the typical municipal project. In Warren's case, where all costs are included and the need for offsite solutions was extensive, the project could not demonstrate a reduction in costs. However, it is a complete project that includes several decentralized options under one management entity.

Description, Year Constructed, and Equivalent Users	Total Project Costs	Cost per EU
Cabot 2001; 139 EUs	$4,678,000	$33,655
Warren Village 2003; 140 EUs	$4,623,800	$32,027
East St. Johnsbury Village 2004; 11 EUs	$423,600	$38,509

Table 3: Vermont Decentralized Project Comparison

Estimated Operation and Maintenance (O&M) for the first year of operation is $55,000. The town has hired a service provider to handle most of the O&M. Annual engineering inspections and monitoring will also be performed.

The Town and WAC worked with FA&A to develop the user rate structure to cover the costs of the O&M, capital replacement, and loan repayment. The bond cost is a part of the Town-wide property tax. The WAC wanted to develop a rate structure that helped the fixed-income, one-and-two-person residences, and also wanted to promote water conservation. Since much of the O&M costs are fixed, 70% is covered under the base fee. There is then a per-bedroom fee. Water meters were installed in all connected users' incoming water supply lines, and 30% of the user rate structure is based on the metered water use. A typical 3-bedroom residence will pay approximately $540 per year in user fees.

7.1 EPA Demonstration Project Budget

The EPA portion of the total project costs was presented above. Following is a breakdown of the demonstration project budget costs.

Project Element	Budget Amount
1. Public Participation and Education	
Local meetings/travel	$65,000
Regulator meetings/travel	$6,000
National project meetings & dissemination	$56,000
2. Needs Assessment, Facilities Plan, Prelim. Design	$234,000
3. Water Quality Monitoring	
Surface Water Monitoring	$33,000
Groundwater Monitoring - Brooks Field	$55,000
Drinking Water Monitoring	$45,000
4. Final Design	
Elementary School	$15,000
Brooks Field Expansion (Contract #1)	$156,000
Other cluster, onsites (Contract #2)	$133,000
5. Construction	
Elementary School	$117,000
Brooks Field (portion) / System Capital Costs	$510,000
Other cluster, onsites	$0
6. Management Plan	$70,000
7. Effluent Sampling (Elementary School system)	$5,000
Total	$1,500,000

Table 4: EPA Demonstration Project Budget Breakdown

8

Management Programs

The Town now has two wastewater management programs. The first program is for the Warren Village municipal wastewater system constructed in 2003-2005. The second is a proposed Town-wide program for individual onsite wastewater systems.

The WAC and the project team worked on the Village wastewater management program as an integral part of the project. The final management program for the Village most closely resembles the EPA's voluntary management Level 5 model (US EPA, 2003), with the Town acting as the responsible management entity (RME). The Town constructs, owns, and maintains the infrastructure that is built during the current project, including septic tanks and all systems upgraded, repaired, or connected to an offsite system. Property easements were secured for construction, and for access and maintenance once construction is complete. Owners within the village study area will be able to join the program after the current project is complete if they are not already participating. The cost of future replacements, upgrades, and connections will be the owners' responsibility, although a low-interest loan program may be available in the future to help defray construction costs for system repairs. Table 5 on the next page describes how Warren's management program corresponds to the functional categories and major program elements recommended by EPA.

The following documents describe the management program for systems within the Village municipal system area.

1. Operation & Maintenance Manual
2. Sewer Ordinance, Municipal Wastewater System
3. User Charge System Description
4. Schedule of Rates and Fees
5. Estimated First Year O&M Budget
6. Sewer Connection application and permit forms
7. Master List of Users
8. A computer software management program and associated training is also a part of the project.

Operation and maintenance of decentralized systems is important to the performance and longevity of the systems. An overall operations and maintenance manual for the Warren municipal collection, treatment, and dispersal system was developed during the construction phase. The Town, through contracts with a service provider, is currently managing the cluster system at Brooks Field, the Luce Pierce Road cluster system, and the individual system upgrades. The Elementary School manages its own wastewater system separate from the Village program.

Category	Management Program Elements	Warren's Management Approach
Program planning and administration	Public education and participation	• Extensive public outreach program ▪ Annual newsletters and other materials ▪ Public presentations and meetings ▪ Neighborhood meetings ▪ Property owner survey
	Planning	• Collaborative approach including Selectboard, WAC, residents, consultants, and regulators
	Establishment of performance requirements	• Project complied with requirements and standards defined by the VT IDRs and EPRs
	Record keeping, inventories, and reporting	• System inventory initiated in Needs Assessment phase and maintained throughout project • Remote monitoring and metering aid in easy, accurate data collection for reporting • Town and private operator responsible for ongoing recordkeeping and reporting
	Financial assistance and funding	• Construction supported by combination of grants and loans ▪ EPA Demonstration Grant ▪ STAG Grant ▪ State Pollution Abatement Grant ▪ Local Funding (SRF loan,Town Meeting allocation, matching funds)
System installation and operation oversight	Site evaluation	• Initial site assessments performed during Needs Assessment phase • Detailed system assessments performed during final design phase
	System design	• Final design completed by FA&A under contract with the Town
	Construction or installation	• Construction performed by private contractor under contract with the Town • Town owns participating systems in current service area • Future construction/ connection costs paid by individual owners; owners maintain future systems
	Operation and maintenance	• Performed by a private licensed operator contracted by Town
	Residuals management	• Performed by a private licensed operator contracted by Town
Compliance assistance and assurance	Training and certification/ licensing of service providers	• Operators, engineers, and site technicians must have appropriate certification and training as required by State rules
	Inspections and monitoring	• Annual inspections and monitoring performed by engineers and/or consultants contracted by Town
	Corrective actions and enforcement	• State regulators enforce permit conditions

Table 5: Warren's approach to the major elements of its decentralized wastewater management program as presented in the US EPA's Management Guidelines (US EPA, 2003).

8.1 Remote Monitoring

Using remote monitoring systems on decentralized systems was another goal of this project. The elementary school system contains a remote telemetry system that is monitored by the service provider with a telephone beeper and a computer modem connection. Alarm systems are designed to contact the service provider first, so the school is not the first responder for alarm conditions.

Remote telephone-based telemetry units (ORENCO's VericommTM System) were installed on all of the Septic Tank Effluent Pump (STEP) systems. The two village pumping stations and the Brooks Field and Luce Pierce Road cluster system pumping systems utilize remote radio telemetry to save monthly expenses for telephone lines. The size of the radio antennas was questioned during the Act 250 process, but residents saw that the antennae were less than two feet long and that once installed on existing structures, they were aesthetically acceptable.

"Remote touch pads" are utilized on each individual residential and non-residential water meter for recording metered water usage. An auto read handheld device is used to quickly read the remote touch pads at each property. The auto reader is then attached to a computer and the sewer bills are created.

8.2
Town-Wide Management and Other Management Plan Components

A management plan to include systems outside the current central service area is now being developed. For a property owner outside of the village area, this will entail an inspection of the existing septic system and construction of any needed upgrades (for which low-interest loans should be available), followed by routine municipal management. This means annual inspections, maintaining septic tank pumpout records, and scheduling pumpouts—an approach closer to EPA's Level 1 or 2 management models. Several meetings have now been held with Vermont DEC personnel regarding the use of Clean Water State Revolving Fund (SRF) monies to fund a municipal loan program to help individuals repair their onsite systems.

This program will include a priority system so that those with the highest need or the greatest environmental or health impacts are served first. This program, as one of the first of its kind in Vermont, may become the model for other Vermont communities.

The Town faces several challenges to implementing the loan program at this time, chief among which are the lack of a financial partner/institution to administer the loans, and the fact that the SRF funding will not revolve at the Town level. However, DEC representatives committed significant funds over the next three years towards this effort. The financial partner and lack of a state loan application and approval process has slowed the process. However, a second Vermont town has also been approved for administering individual loans, and is also looking for assistance and developing the legal documents for processing the SRF municipal loan. DEC is assisting the towns in developing a process and helping them work out the other steps to the loan program.

9

Summary and Conclusions

Many of the lessons learned in the Warren Decentralized Wastewater Management Project can be applied to rural communities throughout the country. Communities facing pollution challenges where traditional sewers and point discharges are unfeasible for their developed village centers need a new way to evaluate the environmental and public health impacts from onsite septic systems. When science-based needs are identified, a range of possible solutions can emerge for consideration, from onsite replacements to large and small cluster systems where an offsite solution is more appropriate.

Active public involvement in the needs assessment planning process led to collection of better information regarding onsite conditions and increased knowledge of potential impacts to drinking water supplies and surface waters. In the long run, this involvement led to support for the proposed solutions, including obtaining a positive local bond vote. Warren's public involvement included an active local Wastewater Advisory Committee, a property owner survey questionnaire, newsletters and mailings, public presentations, and assistance from the steering committee and other EPA demonstration project members.

The needs assessment conclusions indicated a high level of need for offsite solutions. The range of solutions for Warren included three properties where the existing system was suitable (minor upgrades for maintenance access), six properties that could upgrade their systems onsite, and the remainder of the study area (95 properties total) to be connected to one of two offsite cluster systems. Additional cluster system sites were included in the preliminary planning. However, legal agreements were not secured to allow them to be considered further. With several properties using onsite solutions, the two town-owned cluster systems provided adequate capacity for existing properties, with a small amount of growth built in. The Elementary School system was constructed as a demonstration for the town and state in the use of innovative and alternative system technologies.

The Brooks Field offsite cluster system uses septic tank effluent pump (STEP) systems with low pressure sewers and conventional gravity sewers for wastewater collection; gravity sewers were utilized where feasible. The second offsite cluster system uses a septic tank effluent gravity (STEG) system with gravity sewers to the dispersal field pressure distribution pump system. The elementary school treatment and pumping systems and the cluster STEP systems all utilize remote monitoring technology through telephone connections. The two village pump stations and the pumping system at Brooks Field use radio telemetry. User fees are a combination of base rates depending on the number of bedrooms or living units, and a water use calculation rate intended as an incentive to conserve water. The water meters also use remote sensing for ease of reading.

The town manages the onsite and cluster systems through their administrative staff, with service provider tasks performed by contractors. Operation and maintenance manuals, database development, and staff training are included in the management program.

An additional onsite management program is being developed for properties not part of the construction project, through which the Town will offer services to inspect onsite systems outside of the service area.

Appendix A

Papers, Reports, and Project Documents Produced

Papers

Clark, M.K., Heigis, W. S., Douglas, B. F., and J. B. Hoover. 2001. Decentralized Wastewater Management Needs Assessment: A Small Community's Approach, Warren, Vermont. In On-Site Wastewater Treatment: Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems, pp. 427-434. Abstract available online at http://asae.frymulti.com/request.asp?JID=1&AID=6082&Abstract=427-434.htm&CID=w2001&T=3.

Clark, M.K. 2002. Case Study—Warren, Vermont: How One Community Tackled its Wastewater Challenges Using A Decentralized Wastewater Management Approach. Presented at Granite State Designers & Installers Association 15th Annual Septic System Conference, March 4, 2002.

Clark, M.K., Douglas, B.F., and M.F. Pottinger. 2002. Design-Phase Considerations For A Decentralized Wastewater Management Project In Warren, Vermont. Presented at NOWRA 2002 Conference, November 2002.

Clark, M.K. 2003. The Art of Negotiating with Private Landowners for Municipal Cluster Systems. Presented at NOWRA 2003 Conference (no paper), November 2003.

Clark, M.K., Macrellis, A., Phillips, D., Camara, K., and K. Crosby. 2004. Warren, Vermont Case Study: A Different Approach For Small Rural Villages. Presented at NOWRA 2004 Conference, November 2004.

Douglas, B.F., Clark, M.K, and K.F. Camara. 2001. Decentralized Wastewater Management Project, Town of Warren, Vermont: A Case Study. Presented at NOWRA 2001 Conference (no paper), November 2001.

Hoover, J.B. and B.F. Douglas. 1999. Warren Village, Vermont: "Stopping the Steamroller". Presented at the New England Interstate Water Pollution Control Council Annual Conference, June 1999.

Hoover, J.B., Clark, M.K., and B.F. Douglas. 2000. Building Community Support for Decentralized Wastewater Management through an Elementary School Pilot Project in Warren, VT. In NOWRA 2000 Conference Proceedings, November 2000.

Hoover, J.B. 2001. Decentralized Wastewater Management: Linking Land Use, Planning & Environmental Protection. American Planning Association 2001 National Planning Conference, March 13, 2001. Accessed online at http://www.asu.edu/caed/proceedings01/HOOVER/hoover.htm on December 20, 2004.

Reports

Forcier Aldrich & Associates, Inc. (Donald E. Phillips, P.E., and Kevin Camara, P.E.). April 2002. *Town of Warren, Vermont, Wastewater Improvements Project, Environmental Assessment.*

Forcier Aldrich & Associates Inc. May 2002. Amendment No. 1, December 2002; Amendment No. 2, July 2003. *Town of Warren Decentralized Wastewater Improvement Project, Contract No. 1 and No. 2, Basis for Final Design*.

Forcier Aldrich & Associates Inc. (Donald E. Phillips, P.E., and Kevin Camara, P.E.). May 2002. *Final Design Plans and Contract Specifications, Contract No. 1*.

Forcier Aldrich & Associates Inc. March 2003. *Final Design Plans and Contract Specifications, Contract No. 2*.

Forcier Aldrich & Associates Inc. March 2003. *Town of Warren Decentralized Wastewater Improvement Project, Contract No. 1, Erosion Prevention and Sediment Control Plan*.

Forcier Aldrich & Associates Inc. January 2004. *Town of Warren Decentralized Wastewater Improvement Project, Contract No. 2, Erosion Prevention and Sediment Control Plan*.

Forcier Aldrich & Associates Inc. 2004. *Town of Warren Decentralized Wastewater Improvement Project, Operation and Maintenance Manual.*

Forcier Aldrich & Associates Inc. (Donald E. Phillips, P.E.) April 2004. *Town of Warren, Sewer Ordinance, Municipal Wastewater System*.

Forcier Aldrich & Associates Inc. 2005. *Town of Warren Decentralized Wastewater Improvement Project, Design and Record Drawings, Contract No. 1 and No. 2*.

Hartgen Archaeological Associates, Inc. August 2003. *Phase I Archaeological Investigations for the Proposed Village of Warren Decentralized Wastewater Management Project*.

Hartgen Archaeological Associates Inc. May 2004. *Supplemental Phase IB Archaeological Reconnaissance Survey*.

Stone Environmental, Inc. 2003. *Decentralized Wastewater Management Project, Final Needs Assessment Report*.

Appendix B

Relevant Laws, Rules, and References

State of Vermont, Agency of Natural Resources, Department of Environmental Conservation, Wastewater Management Division, Effective August 16, 2002, Environmental Protection Rules – Chapter 1, Small Scale Wastewater Treatment and Disposal Rules, Waterbury, Vermont.

State of Vermont, Agency of Natural Resources, Department of Environmental Conservation, Wastewater Management Division, Effective April 30, 2003, Environmental Protection Rules – Chapter 14, Indirect Discharge Rules, Waterbury, Vermont.

State of Vermont, State Land Use and Development Plans (Act 250), 10 V.S.A. §6001-6108.

State of Vermont, Special Environmental Revolving Fund, Municipal Loans for Privately-Owned Wastewater Systems, 24 V.S.A. § 4763, eff. May 24, 2000.

Town of Warren, Vermont. Sewer Ordinance. Accessed online at http://www.warrenvt.org/general/documents/SewerOrdinance.pdf on December 20, 2004.

US Environmental Protection Agency, Office of Water. 2003a. Draft Handbook for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems. Cincinnati, Ohio: EPA 832-D-03-00, February 2003.

US Environmental Protection Agency, Office of Water. 2003b. Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems. Cincinnati, Ohio: EPA 832-B-03-001, March 2003.