WARREN, VERMONT CASE STUDY: A DIFFERENT APPROACH FOR SMALL RURAL VILLAGES

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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.
- Developing and implementing 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 detailed needs assessment, including onsite inspections and soil augering. It included the first municipal alternative system permitted in Vermont, and used remote monitoring for management. The design won a state engineering 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.

This case study includes information about what happened, what worked, what lessons were learned, and suggestions for other communities.

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BACKGROUND

The Town of Warren is located at the state's center in Washington County. It is surrounded by the Green Mountains and is close to the popular ski resort of Sugarbush. 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 rivers are popular spots for bathing and trout fishing. Bedrock outcrops are common throughout the Village area and are an aesthetic feature in the rivers, with rounded surfaces forming pools and swimming holes.

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 didn't know 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 kept occurring, and the environmental and public health concerns remained. A 100-year flood event in 1996 exposed some systems along the river's banks. 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.

An opportunity arose to benefit from an EPA special demonstration grant, and 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 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 Town of Warren's Administrative Assistant became the authorized representative in 2000, and Ms. Kimberly Crosby has filled this position for the town since the summer of 2001.

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 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 is currently leading the effort in 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 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 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.

The remainder of the case study is described in the following sections:

- Public Education and Outreach
- Needs Assessment and Water Quality Testing
- Cluster System Options and Recommended Plan
- Final Design and Construction
- Project Financing
- Management Program
- Summary/Conclusions

PUBLIC EDUCATION AND OUTREACH

This demonstration project included, and still includes, 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.

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. Hoover of MRVPD, met with project team representatives from Stone and FA&A, and Vermont Department of Environmental Conservation (DEC) representatives throughout the needs assessment and decision-making process. A Management Plan committee is still finalizing the onsite program elements.

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 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.

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

Efforts will 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 guarantee the loan program funds.

Handouts have been developed to describe the Warren management program for properties throughout the town, to give information to new connections and owners, to describe the loan program, and to provide a brief total project description.

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 for planning, constructing and funding municipal wastewater treatment facilities. These divisions were accustomed to working independently of each other, and were not even very familiar with each other's programs. A decentralized wastewater management project would need 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.

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 would be exempt. Buildings with other uses would 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, which restricts the potential for growth. This also put system replacements in a "best fix" category, where the design, while not meeting all of the standards, meets as many as possible while not causing surfacing or public health problems. The rules as administered 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. However, this permit program was not 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 programs or other 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 middle of the project where no DEC staff was assigned to the project. Now that the project is being funded and constructed using various state and federal grant and loan sources, Mr. Thomas Joslin with the Facilities Engineering Division has been assigned to the project. He is working closely with FA&A in developing the cost accounting and in working through design and construction details. Mr. Robisky has recently been promoted into a new position with the Facilities Engineering Division and will be involved in finalizing the loan program.

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 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 the exemptions so that all systems would come under the same set of standards throughout the state.

Along with the elimination of exemptions might come reductions in site conditions, particularly when 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 passed a new Septic Law that will eventually bring all small-scale septic systems in the state under the same set of standards. The DEC revised the rules to include a process for approving alternative technologies. Besides the sand filter systems identified in the rules, they have now approved textile filters, peat filters, trickling filters and various dispersal technologies.

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 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 Water 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.

NEEDS ASSESSMENT AND WATER QUALITY TESTING

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

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

The results of this assessment determined which existing systems could be managed; which systems could 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, 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.

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 Geographic Information System (GIS) datalayers 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 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 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.

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 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 that system and install a new alternative 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 pretreatment technologies, needed to be only half the traditional size of a standard system.

Manufacturers or 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, and availability of operators and equipment.

Water Quality Testing

Warren Village is constructed along two rivers: Freeman Brook and the Mad River. 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. 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 analytes (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. This weekend is when many 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.

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 as a baseline for determining any potential biological changes from the large cluster system.

Groundwater Monitoring – Drinking Water Supply Wells/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, 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 hope to 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.

Groundwater monitoring is planned for the large Brooks Field cluster 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. Stone will prepare a Quality Assurance Project Plan (QAPP) for the future groundwater monitoring to start in 2005 or 2006. A QAPP covering both surface water and groundwater sampling programs required by DEC for the permitting of increased flows at Brooks Field will be finalized by the fall of 2004, and a preliminary site visit with DEC representatives will be held to confirm the sampling program in the fall/winter of 2004.

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 for 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. 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 resulted in the inclusion of several of the sites in the recommended plan.

The engineering consultant 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 by the consultant.

The recommended plan was as follows:

1) Five properties – add septic tank risers and effluent filters and manage the existing 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 – construct separate alternative treatment and dispersal field apart from large system

The collection system for the Brooks Field system is a combination of gravity services to the existing gravity sewer, and septic tank effluent pump (STEP) systems onsite connected to low pressure sewer force mains. The Luce Pierce Road cluster is designed with STEG tanks and low pressure sewers only.

The total project costs for the construction of the preferred alternative were far beyond 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 state and federal sources was sought to complete the project. Additional information on the financing is included later in this case study.

Steering Committee and Peer Review

Three Steering Committee members conducted a visit to Warren on October 17 and 18, 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, and FA&A prepared an alternatives analysis and 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 the STEP system effluent out of the gravity sewers.

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 90 percent.

FINAL DESIGN AND CONSTRUCTION

A lot can, and did, happen between the recommended project plan and construction. The project is moving forward in two design and construction phases. Phase 1, constructed in 2003, includes the Brooks Field dispersal field enlargement, including piping and tanks, and part of the collection system within town road rights-of-ways. Phase 2, which is under construction in 2004, 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 components 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) for the construction of the Brooks Field indirect discharge system. In January 2003, the U.S. EPA Region 1 office issued a Finding of No Significant Impact (FNSI) for the environmental aspects of Phase 1 activities.
February 2003	A revised EA was issued in February 2003 that incorporated recommendations received from Vermont DEC during the comment period.
March 2003	The Brooks Field cluster system 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 was approved on March 3, 2003.
May 2003	Amendment No. 2 to the Act 250 permit was applied for because of the expansion of the Brooks Field system to a design flow of 30,000 gpd. The second permit amendment was approved on May 7, 2003.
Fall 2003	A Phase 1a and Phase 2 Archaeological Site Assessment was also conducted 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.

Most of the permits and approvals described in this paragraph 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.

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 poorer soil conditions than expected on a couple of sites, including the town gravel pit site. This site did appear 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 has 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 is designed for this site as part of Phase 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 will be constructed to serve individual properties.

Phase 1 includes 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 conveys the STEP effluent to the existing force main to Brooks Field. Contract No. 1 also includes an extension of the existing gravity sewer collection system on Main Street. The Phase 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 is expected to be completed by the end of August 2004.

Contract No. 2 will include 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. Contract No. 2 also includes extensions of the Brooks Field collection system to serve areas that were previously planned for service by the Town Gravel Pit and Newcomb cluster systems. Construction began in June 2004, and is scheduled to be completed by November 2004.

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 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.

Elementary School Alternative System

The Warren Elementary School alternative treatment and dispersal system chosen for design and construction was the ORENCO recirculating Advantex^{TM} textile filters and shallow gravel-less dispersal system. This system included a new septic tank to follow the existing septic tank, a recirculation/blend tank, a pumping station, a force main to a flow splitter, and a gravel-less shallow half-pipe dispersal 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.

PROJECT FINANCING

The estimated total construction costs are $2.5 million, and the total project costs are $4,623,800, including $290,000 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 grant portion of the funding.

TABLE 1. WARREN TOTAL PROJECT COSTS

Project Element	Estimated Cost	EPA Demo Grant Portion
Needs Assessment-Facilities Plan	$501,500	$326,000
Final Design	$389,300	$271,400
Construction	$2,495,700	$310,700
Construction Engineering Services	$501,000	$176,000
Existing System Capital Payback	$305,300	$198,400
Other Services	$141,000	$0
EPA Demo Only	$290,000	$217,500
	$4,623,800	$1,500,000

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 the 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 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, which, typically for many municipal projects, 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 municipality 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 construction 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, it needs to identify the failed systems to qualify for the funding. Typically, additional failure points may be found during the final design and even construction phases that could increase the total of the grant award.

TABLE 2. WARREN TOTAL PROJECT FUNDING SUMMARY

SOURCE	AMOUNT
EPA Demonstration Grant	$1,500,000
EPA State & Tribal Assistance Grant (STAG)	$1,301,000
Vermont State Pollution Abatement Grant / Match	$880,000
Local Share - SRF Loan	$830,000
Local Share - Town Meeting Allocations/Match	$140,000
	$4,651,000

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.

TABLE 3. VERMONT DECENTRALIZED PROJECT COMPARISON

Description/Year Constructed/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

Estimated Operation and Maintenance (O&M) for the first year of operation is $55,000. The town will hire 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 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 are being installed in all connected users' incoming water supply lines. The bond cost is a part of the Town-wide property tax. For the properties connected to the Brooks Field cluster, reducing water consumption may allow for additional flows in the future, once enough data is collected to analyze actual flows. A typical 3-bedroom residence will pay approximately $500 per year in user fees.

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.

TABLE 4. EPA DEMONSTRATION PROJECT BUDGET BREAKDOWN

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 I/A system)	$5,000
	$1,500,000

MANAGEMENT PROGRAM

The WAC and the project team have worked on the wastewater management program as an integral part of the project. 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. As discussed in the Needs Assessment Report, the Town will construct, own, and maintain the infrastructure that is built during the current project, including upgrades and replacements of individual systems. The cost of future replacements, upgrades, and connections will be the owners' responsibility, although a low-interest loan program should be available to help defray construction costs for system repairs. A means of joining the rural wastewater management program will also be extended to all property owners within the Town of Warren. 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.

Construction Project Management

For systems upgraded, repaired, or connected to an offsite system during the current construction projects (Contracts No. 1 and 2), the Town will own and maintain all the system components including septic tanks. Property easements were secured for construction, and for access and maintenance once construction is complete.

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

1. *Operation & Maintenance Manual*: 90 % complete.
2. *Sewer Ordinance, Municipal Wastewater System*: The first training session was conducted with Kim Crosby on November 24, 2003. A workshop with the Selectboard was conducted in February 2004. The Selectboard has formally selected Ms. Crosby to manage the Sewer Ordinance and the budget/billing process. The Town has hired an operation and maintenance provider, SOS Contract Operations, to provide the operations and maintenance services for the system. Three operator-training sessions have been conducted with SOS Services.
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 stage. The Town, through contracts with a service provider, is currently managing the elementary school system and the cluster system at Brooks Field. This service provider will also maintain the newly constructed Luce Pierce Road cluster system, and the individual system upgrades.

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.

A remote monitoring system for the Brooks Field existing 5,000 gpd cluster system was considered. Informal bids were solicited and received on equipment to install on the system. The cost ranges were considerable, as well as the range of quality of equipment. It was decided not to proceed with equipment purchasing until the expansion project was designed.

The project includes installing remote telephone-based telemetry units (ORENCO's Vericomm™ System) on all of the Septic Tank Effluent Pump (STEP) systems. The village pumping stations and the Brooks Field and Luce Pierce Road cluster system tanks will utilize remote radio telemetry to save the monthly charges of telephone leased 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" will be utilized on each individual residential and non-residential water meter for recording metered water usage. An auto read handheld device will be 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.

Onsite and Other Management Plan Components

A management plan to include systems outside the current central service area is now being finalized. 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 have 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, Colchester, has now also been approved for administering individual loans, and is also looking for assistance from a financial partner 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. Finalizing the onsite management program will be a part of this loan program effort.

SUMMARY/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 the collection of better information regarding onsite conditions, and increased understanding 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 a handful of properties where the existing system was suitable (minor upgrades for maintenance access), a half-dozen 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, the legal agreements were not secured early enough in the project 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 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 offsite systems will be using septic tank effluent pump (STEP) systems with low pressure sewers. The elementary school system tanks, the cluster STEP tanks, and tanks at Brooks Field all utilize remote monitoring technology through telephone connections. The village pump stations will use radio telemetry to reduce monthly service fees. The user fees are a combination of base rates depending on the number of bedrooms, and a water use calculation rate intended as an incentive to conserve water. The water meters will also use remote sensing telemetry for ease of reading.

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

There is an additional onsite management program for properties not part of the construction project. The town wishes to offer services to inspect onsite systems outside of the service area. This program is in the final stages of development. One important part of that program is a low interest loan program through the town for individual property owners. The loan program would be funded through the Clean Water State Revolving Fund (SRF) funds, and Warren will be one of the first communities in Vermont to take advantage of this funding.