Lawler, Matusky & Skelly Engineers

Environmental Science & Engineering Consultants

ONE BLUE HILL PLAZA, PEARL RIVER, NEW YORK 10965
(914) 735-8300
TWX: LMSE PERL 710-577-2782

JOHN P. LAWLER, P. E.
FELIX E. MATUSKY, P. E.
MICHAEL J. SKELLY, P. E.
KARIM A. ABOOD, P. E.
PATRICK J. LAWLER, P. E.
FRANCIS M. McGOWAN, P. E.
THOMAS L. ENGLERT, P. E.

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24 December 1985
File No. 455-103

Mr. Edgar Kaup
NJ Department of Environmental Protection
Division of Waste Management
Hazardous Site Mitigation Administration
428 East State Street
Trenton, New Jersey 08608

Re: Combe Fill South Landfill RI/FS
Screening of Technologies - Task 3

Dear Mr. Kaup:

Enclosed for your use is our memorandum on the screening of remedial action technologies for the Combe Fill South landfill. Please review at your earliest convenience and call me with your comments by 31 December 1985. The next step in our Task 3 work is to combine the successfully screened technologies into alternatives and to screen these alternatives prior to the selection of final alternatives for analysis in Task 5. If I do not hear from you by 31 December 1985, I will assume that you have no further comments on this technology screening.

Please forward the enclosed additional copies of this screening to Len Romino, Bob Myers and Janice Haveson in your office.

Very truly yours,

Ruth M. Maikish /kpw

Ruth M. Maikish
Senior Project Manager

Enclosures

cc: K. Stoddard, EPA (2)
C. Boyer, REWAI

303071

DATE: 24 December 1985

TO: File No. 455-103

FROM: R.M. Maikish

SUBJECT: DEFINITION OF GOALS AND OBJECTIVES AND SCREENING OF TECHNOLOGIES FOR DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

1 OBJECTIVES

In response to EPA policy on compliance with environmental statutes, remedial action alternatives must be developed to achieve each of the following objectives or goals:

1. No or minimal action
2. Off-site storage, destruction, treatment, or secure disposal of hazardous substances at a RCRA-approved (or approvable) facility that is also in compliance with other applicable Federal standards
3. Attainment of applicable or relevant Federal public health and environmental standards, guidance, or advisories
4. Exceedance (do better) of applicable or relevant Federal public health and environmental standards, guidance, and advisories
5. Achievement of CERCLA goals to prevent or minimize present or future migration of hazardous substances and protect human health and the environment, but not necessarily to attain applicable or relevant standards

2 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

2.1 INTRODUCTION

Remedial action alternatives that achieve the objectives described above and that address site-specific problems are formulated in an

TABLE 1

COMBE FILL SOUTH LANDFILL
SITE PROBLEMS AND POSSIBLE PATHWAYS OF CONTAMINATION

SITE PHYSICAL CONDITIONS

Exposed debris due to insufficient cover materials
Riffs caused by escaping gases and landfill subsidence
Leachate seeps
Swampy areas
Unrestricted public access
Steep slopes with no stabilization

CONTAMINANT - SOURCES/PATHWAYS

1. Air

- Methane and volatile organic emissions to atmosphere; dust and particulate emissions due to poor cover

2. Groundwater

- Groundwater discharge to surface with leachate in leachate seeps
- Groundwater contamination in upper aquifer from leachate, possibly moving off-site
- Possible groundwater contamination of bedrock aquifer, possibly moving off-site

3. Surface Water

- Unrestricted surface water runoff moving contaminants off-site
- Leachate seeps and contaminated groundwater discharge to surface waters leaving site.

4. Soils/Sediment

- Possible pockets of contaminated soils outside main landfill perimeter
- Possible stream sediment contamination from contaminated surface waters

iterative process that consists of screening remedial action technologies. This process consists of the following major steps:

1. Identify site problems and contaminant pathways. (These problems and pathways should be identified as a result of the site investigations.)

2. Develop a list of technical response categories that may be applicable to site problems, including no or minimal action.

3. Define specific technologies within each response category that may be applicable to site problems.

4. Screen specific technologies for their technical feasibility in relation to site and waste characteristics and limitations and general environmental and economic impacts.

5. Combine successfully screened technologies into alternative sets such that at least one alternative is developed to achieve each of the stated objectives.

6. Screen the alternatives for their technical feasibility and environmental and economic impacts using order-of-magnitude estimates.

7. Select final alternatives for detailed evaluation (at a minimum there must be an alternative that achieves each of the Federal objectives).

2.2 SITE PROBLEMS AND APPLICABLE RESPONSE CATEGORIES

The results of the site investigations, sampling, and analyses indicate that the site conditions create several major contaminated sources and pathways at the site (Table 1):

- Actual physical contact with landfill materials promoting possible physical injury

- Air migration of methane, volatile organic compounds, contaminated dust, and particulate matter
- Possible off-site radial movement of contaminants in groundwater in the upper glacial aquifer and possibly in the bedrock aquifer used as a potable water supply
- Possible off-site radial movement of contaminants via surface waters
- Possible pockets of contaminated soils outside the main landfill perimeter and in-stream sediments contaminated from surface waters

2.3 TECHNICAL RESPONSE CATEGORIES

Ten general response categories that may be applicable to the problems at Combe Fill South landfill have been formulated (see Table 2).

These response categories may address more than one problem or pathways and are summarized below.

No or minimal action may be taken. Minimal action may include a monitoring program to continue to assess site conditions. No remedial action does not preclude removal action under CERCLA.

Access restrictions such as security fencing, locking gates, warning signs, or even security guards can be effective in limiting direct physical contact with waste sources and pathways.

Containment of waste sources acts primarily to minimize interaction of the waste with its environment and subsequently reduce or elimi-

TABLE 2

GENERAL RESPONSE CATEGORIES
APPLICABLE TO COMBE FILL SOUTH LANDFILL

RESPONSE CATEGORY	APPLICABILITY TO SITE
No or Minimal Action	Yes
Access Restrictions	Yes
Containment	Yes
Pumping	Yes
Diversion	Yes
Removal:	
Complete	Probably not
Partial	Yes
Collection and Treatment:	
On-site	Yes
Off-site	Yes
In situ	Probably not
Disposal:	
On-site	Yes
Off-site	Yes
Alternative Water Supply	Yes
Relocation	Yes

nate its migration. Thus, containment actions that can be effective in reducing or eliminating leachate and reducing or eliminating migration of contaminants in groundwater, surface waters, and air can be implemented.

Pumping can be used to control liquid sources and pathways. At Combe Fill South landfill pumping can be used to control leachate, groundwater, and surface water.

Diversion mechanisms are generally associated with control of surface waters, including runoff, and would be suitable for use at Combe Fill South landfill.

Removal actions generally involve the physical relocation of such materials as drums, soils, sediments, or liquid wastes. Complete removal of the waste source, i.e., the entire landfill, would probably be economically infeasible and technically impractical. However, partial removal of specific waste areas or "hot spots" may be practical for Combe Fill South landfill. For example, areas of highly contaminated soils or surface water sediments may be excavated.

Collection mechanisms can be utilized to concentrate waste streams prior to treatment and/or disposal and can be employed at the site for liquid and gas waste streams.

Treatment mechanisms to remove or reduce contaminants by chemical, physical, or biological means can be applied to the air, water, and soil pathways found at Combe Fill South landfill. Treatment mechanisms can be located on the Combe Fill South site or off-site, within certain geographic limits. Most treatment actions involve some method of waste collection with subsequent treatment at a centralized facility. However, in situ treatment mechanisms treat wastes where they lie. Application of in situ treatment methods are for the most part experimental and may not be applicable to the Combe Fill South landfill.

Disposal of treated or untreated wastes, or contaminated media, and any treatment by-products may be made either on- or off-site.

Providing alternative potable water supplies may be necessary for portions of the local population if contaminants have spread to the drinking water aquifer.

Finally, relocation of endangered portions of the local population may also be an action suitable for the site, although it is doubtful that so drastic an action will be necessary.

2.4 SPECIFIC REMEDIAL TECHNOLOGIES

Based on the previous discussion of general technical response categories, it is apparent that a broad range of technologies is possible at the Combe Fill South landfill. In this section, specific remedial actions are screened and their effectiveness is examined within the constraints imposed by the site's and waste's characteristics. Table 3 summarizes this technology screening for the Combe Fill South site.

2.4.1 Gas and Dust Migration Controls

Air carrying gases and dusts has been identified as a possible pathway for movement of contaminants from Combe Fill South landfill.

Spraying of polymers and water over the fill may be effective short-term dust control measures, but other, more effective, long-term measures whose primary benefits may lie in other areas (e.g., infiltration reduction from capping) are available.

Organic gases, including methane, are being generated by the landfill and discharged into the atmosphere. Gas collection, with or without subsequent treatment, may be an appropriate technology for the site. New Jersey regulations require, at a minimum, passive gas collection for landfill closure. Active gas collection may be required if methane or other gas generation is substantial.

Capping, or sealing the surface, of the landfill with an impervious material may prevent or reduce the release of gases from the fill to the atmosphere, although the primary function of surface sealing is to prevent or reduce infiltration.

A synthetic membrane may be sufficiently impervious for such purposes, but may be difficult to properly install (i.e., sealing seams is important) and maintain, due primarily to tearing brought on by landfill subsidence. Natural clays or bentonites may also be used to seal the landfill. Clays, although easily desiccated, are easier to install and maintain than synthetic membranes. Asphalt and concrete are inappropriate surface sealers for landfills be- Schlegel's response?

cause they create a rigid surface that can crack easily during landfill subsidence, creating channels for escaping gases. Chemical sealants/stabilizers such as lime or fly ash contribute cementing properties to soils and help neutralize acid soils. However, they have limited effectiveness in reducing gaseous emissions and are best used for achieving infiltration-reduction objectives. A multilayered, multiobjective cap consisting of a gaseous ventilation layer (generally gravel) for collection and routing of gases and an impermeable layer, such as clay, that combines several of the above-mentioned technologies would be an effective solution to gas control at the landfill.

Vertical barriers consisting of some impermeable material (clay or synthetic membrane) may be used to control horizontal migration of landfill gases, particularly methane. This technology will have limited effectiveness at the Combe Fill South site because there is no impermeable geologic (or manmade) unit beneath the site into which the vertical barrier can be attached, thus allowing the escape of gases underneath the barrier.

2.4.2 Surface Water Controls

Surface waters, including leachate, emanating from the site have been identified as pathways for contaminant migration. Therefore, surface water control technologies will play an important role in remediation of the site. By preventing infiltration of water into the fill and diverting and collecting it prior to discharge, contaminant levels in surface waters can be reduced.

Capping, as discussed above, can be an effective technology for eliminating or reducing infiltration through the fill, thus reducing the amount of leachate being generated. The advantages and disadvantages, discussed above under gas migration control for different capping technologies, also apply to capping as a surface water control technology. In addition, the size and steepness of the fill areas, even after grading, may restrict the use of certain materials such as membranes. At the same time, a minimum slope must be maintained to promote controlled runoff and prohibit ponding and standing water.

Some amount of grading of the site, along with filling and compacting, will be needed to reshape the fill surface in order to promote controlled runoff. Grading can be conducted on the fill itself, but is most effective when used in combination with capping technologies. Scarification, tracking, and contour furrowing are all surface molding techniques that can be used to retard, channel, or otherwise control surface runoff. (Runon is not a problem for the site because it is a topographic high.)

Revegetation of the landfill surface, or preferably the top layer of a cap, is necessary to prevent future erosion and desiccation of such cap materials as clays and synthetic membranes. If grasses are planted they will assure a dense vegetative mat to which soil particles can adhere. Legumes, shrubs, or trees should not be used because their thicker and longer root systems may crack the surface layer, thus promoting unwanted infiltration.

Other short- and long-term surface water control mechanisms can be used to divert and collect runoff (or leachate or groundwater) at the Combe Fill South site. Chutes, downpipes, and berms can be effective short-term measures (during construction), but are not cost-effective on a long-term basis because of maintenance/repair requirements. Terraces and benches can be formed during site grading activities and can be effective long-term runoff control measures. Ditches, trenches, and swales can be effective runoff collection mechanisms, particularly at the site perimeter. Storage ponds can be constructed to dampen the peaks of large amounts of stormwater runoff collected and diverted from the site prior to discharge. Seepage or recharge basins may be used to reinfiltrate diverted uncontaminated runoff in areas outside the fill; however, their success will depend on soil characteristics. Finally, the small amount of surface water at the site makes such mechanisms as levees and flood walls unsuitable for runoff control.

2.4.3 Leachate and Groundwater Controls

Leachate and groundwater on the site have been shown to be contaminated and are pathways for off-site migration. Control of leachate and groundwater movement may be an effective remedial measure for the site.

Capping technologies, as discussed previously, prevent or reduce infiltration into the fill, thereby reducing the amount of leachate generated and entering the surface or groundwaters.

Underground barriers may be used to prevent groundwater movement onto a site, or groundwater and leachate movement off-site. The Combe Fill South site is a groundwater high; therefore, only downgradient barriers are warranted. The direction of downgradient flows has not yet been fully defined, but may be circumferential. The effectiveness of barriers at Combe Fill South may be limited because of site geology. Vertical barriers are generally installed so that they connect to a horizontal barrier, such as a natural clay layer, so that groundwater flows are not diverted underneath the barrier. At Combe Fill South there is no natural impermeable horizontal barrier; the highly fractured bedrock has many channels for the off-site movement of groundwater. Construction of a manmade barrier underneath the fill, in a manner similar to the construction of vertical barriers, may also have limited effectiveness because the fractures may be too large or too numerous to seal effectively.

The materials that can be used to construct these barriers include soil/bentonite, cement/bentonite, grout, sheet piles, and synthetic membranes. Rocky soils and bedrock preclude placement of sheet piles, which would be damaged during driving. A soil/bentonite slurry wall may be constructed but may not be effective in plugging the fractures encountered in the bedrock; construction of a soil/bentonite slurry wall with grout anchors may alleviate some of the problems of effective placement of the wall. The additional support provided by a cement-bentonite slurry wall is not necessary at the site, and as it is more permeable and more expensive than a soil/bentonite wall, it is not appropriate for use at the Combe Fill South site. A synthetic membrane alone or in combination with a slurry wall may be used as a barrier; however, it may be eroded by direct contact with leachate and, if used, would probably be most effective if placed on the downgradient side of a soil/bentonite slurry wall. Grout, injected in formations known as curtains, may be suitable to form barriers at the site because grout

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hardens fast enough to fill large fractures without being "lost" into the voids. However, grout curtains are more expensive than slurry walls and may also be susceptible to chemical attack from direct contact with leachate.

Permeable treatment beds remove, by adsorption, precipitation, or neutralization, contaminants by routing the groundwater through such media as limestone, activated carbon or glauconite greensands placed in the ground downgradient of the groundwater flow. Except for activated carbon (which is expensive), most such materials do not effectively remove organic contaminants, which are a problem at Combe Fill South. Furthermore, the volume of leachate and groundwater flow and direction would require large-scale application of such beds, which would also be expensive. Finally, the highly fractured nature of the bedrock would make effective capture (and subsequent monitoring and control) of the effluent from such systems not possible unless each bed were lined with an impermeable material. If such large-scale measures are needed for effective management, cheaper and more controllable large-scale measures are available for the site.

Groundwater pumping may be used to lower the groundwater table, extract leachate and groundwater, and generally reduce (or even reverse) the off-site flow of groundwater For Combe Fill South, groundwater pumping in conjunction with leachate reduction, such as capping, could be conducted more effectively if reduction or elimination of off-site migration is an objective of remediation. Once again, the highly fractured nature of the bedrock may preclude complete effectiveness of groundwater pumping because it would be impossible to determine whether all groundwater-bearing fractures are intercepted by the pumping well(s).

On-site shallow injection of treated or untreated groundwater/ leachate could be used in an effort to "flush" contaminants from the fill; however, effective monitoring and control of such a system would probably not be possible because the highly fractured bedrock would provide many avenues for groundwater leaving the site. Deep well injection would require an effluent meeting drinking water criteria because the bedrock aquifer is used as a drinking water source.

A well point system consisting of a group of closely spaced wells usually connected to a common header pipe and pump can be used to lower the water table at the site. However, because of the size and shape of the site, a perimeter system alone may not be completely effective, particularly at the center of the site. Deep extraction wells can be used to maintain or contain a contaminant plume in the bedrock; however, there is no assurance that all contaminant-bearing fractures are being tapped, and therefore the system and groundwater must be frequently and intensively monitored. Any well pumping system is highly energy-intensive and will have high operation and maintenance costs.

Subsurface collection systems consisting of pipe drains, ditches, and trenches may be used to collect groundwater/leachate above the bedrock. The effectiveness of trench systems may be enhanced by placing an impermeable liner along the downgradient side of the trench to impede groundwater flow out of the trench; however, complete effectiveness of a trench is questionable because there is no impermeable layer into which the trench can be placed, and the bedrock fractures provide many channels for groundwater movement below the trench. Drainage systems into the fill itself could consist of pipe drains lying in gravel-filled ditches with filter cloth envelopes to prevent clogging. French drains or tile drains, which are easily clogged and difficult to maintain, are therefore inappropriate for a landfill environment.

2.4.4 Excavation and Removal of Waste and Soil

The continued presence of exposed waste and contaminated soil at the site constitutes health and safety hazards from direct physical contact and an indirect health hazard from dispersal of contaminants via air and water. Although some excavation of waste and soil may be necessary as part of site grading or removal of contaminant "hotspots," if found, the volume of waste/soil at the site precludes its complete removal unless a new RCRA facility is created on the site. In addition, the suspected substantial amounts of methane being generated by the landfill would make such work dangerous and expensive.

There is currently no RCRA facility with the capacity to accept the volume of waste/soil located at Combe Fill South. Any new RCRA facility built at or near the Combe Fill South site would probably be required to be an incineration or other treatment facility because land disposal technologies will not be acceptable for future RCRA sites as mandated by the 1984 RCRA amendments.

2.4.5 Removal/Containment of Contaminated Sediments

Where contaminants from the landfill have been washed into nearby surface waters and settled into stream sediments, the opportunity exists for the resuspension of contaminants into the streams and further transport and contact with humans and organisms downstream. By removing the in-stream contaminated sediments, an additional source of future contamination can be eliminated. The streams on or near the landfill, except at times the Black River, have sufficient periods of dry-weather flow so that typical mechanical construction equipment (bulldozers, backhoes, etc.) can be employed without the aid of more sophisticated and expensive hydraulic or pneumatic equipment.

To prevent additional sedimentation into surface waters during remedial activities on site, or if stream flow is not low enough for easy use of mechanical equipment, streams can be temporarily diverted or sheetpile cofferdams constructed. Sheetpile barriers could also be used as part of a long-term remediation plan where slope stabilization is required near a streambed.

2.4.6 In Situ Treatment

Unlike other waste treatment techniques discussed in subsequent paragraphs, in situ methods treat wastes in place. These techniques are most practical where the wastes are well defined and where the contamination is at shallow depths and small in areal extent. None of these characteristics are applicable to the Combe Fill South landfill. Furthermore, the fractured bedrock at Combe Fill South makes complete capture of by-products generated by these methods and overall monitoring of their effectiveness extremely difficult. Additional information on seven general categories of in situ treatment technologies is provided below.

In extraction (soil flushing or solution mining), a solvent is used to flood the site; as it percolates through the waste, it dissolves or chemically reacts with specific contaminants. The elutriate from this flushing is then captured and further treated to recover, if possible, the solvent and dispose of the contaminants. Even assuming that an appropriate solvent is found (water or leachate could be used), this technique is not suitable for the Combe Fill South site because the fractured bedrock would limit effective capture of the elutriate.

Immobilization of contaminants by adsorbents, ion exchange, or precipitation requires that the waste be mixed with adsorbents, clays or resins, or precipitating agents in order to accomplish the immobilization; only sorption with a mixture of additives is effective for both the metals and organic constituents found at Combe Fill South. Such mixing is impractical in light of the size and depth of the landfill and may present serious safety hazards due to the release of methane.

In situ chemical degradation processes (oxidation, reduction, and polymerization) are primarily conceptual technologies with incomplete demonstrated effectiveness. Oxidation of organic contaminants may result in the production of more toxic by-products than the original contaminants. Reduction, particularly of toxic metals, requires either mixing the waste with metal powders or flushing the waste with an alkaline solution. (The difficulties associated with both mixing and capture of elutriate at the site have been previously discussed for other technologies.) Mixing and elutriate capture problems are also associated with polymerization.

Biodegradation utilizes microorganisms to break down contaminants in soils or water. Biodegradation has been successful in treating groundwater contaminated by spills and leaks of "pure products." Such is not the case at Combe Fill South, where a mixture of organic compounds and metals contaminate the soils and water. Maintenance of optimal conditions for site-wide application of biodegradation mechanisms at Combe Fill South would be extremely difficult as there is no identified "spill" area at the site to warrant a discrete application. Effective utilization of biodegradation for contaminant reduction in the bedrock aquifer is not feasible because untapped fractures could easily channel untreated groundwater away from the site.

Photolysis utilizes light energy to drive a chemical reaction and is effective only for surface contamination. Attenuation reduces the concentration of contaminants to acceptable levels by mixing clean soil with contaminated soil. The problems of such mining are discussed above. In addition, the volume of clean soil needed may require significant additional land surfaces for the subsequent spreading of the resulting mixture. To reduce volatilization of organic compounds, the fill could be soaked with water, thus taking up the pore space in which volatilization could occur. This, however, results in the problems of inadequate elutriate capture as discussed previously.

2.4.7 Waste Treatment

Waste treatment to separate and chemically and/or physically alter the contaminants in waste streams at Combe Fill South may be used subsequent to collection or removal measures. The waste at the site to be treated may include direct waste streams, such as air, groundwater, leachate, soils, or solid wastes, or indirect waste streams including gaseous, liquid, and solid/semisolid by-products from treatment processes.

Incineration or destruction measures are generally applied to low-moisture content solid/semisolid or liquid wastes and some gases. (Incineration of gases is discussed separately below.) Inert materials, i.e., soils, are not compatible with such processes. Unless the fill area is excavated for incineration of the previously landfilled waste, the most likely application of incineration at Combe Fill South is the incineration/treatment of sludges and waste products from liquid and gaseous treatment processes. Several incineration processes - rotary kiln, fluidized bed, multiple hearth, and liquid injection - have had extensive commercial application for the treatment of hazardous wastes and may be applicable for use at Combe Fill South. Experimental techniques of unproven or previously limited application to hazardous wastes including starved air combustion/pyrolysis, molten salt injection, and plasma arc pyrolysis, are not recommended for further examination at Combe Fill South.

Gaseous waste treatment can be used at Combe Fill South in conjunction with gas collection systems and/or may be used to treat gaseous by-products from liquid waste treatment processes or incineration. Activated carbon can be used to absorb volatile organic contaminants and may be used in conjunction with other mechanisms such as flaring. In flaring, methane is used as the fuel source and is burned off; at the same time some volatile organics are also oxidized, although their combustion may be incomplete, resulting in smoke. Afterburners are generally high-flow rate incinerators for gases and vapors and provide more complete combustion than flaring, but are not effective for contaminants requiring very high oxidation temperatures. Depending on the amount and type of gases being emitted, recovery and reuse of the gases may be warranted. The most likely candidate for such recovery would be methane generated by the fill; however, recovery may not be cost-effective and will require further examination of the quantities of methane produced.

Biological, chemical, and physical treatment of liquid waste streams including leachate, groundwater and surface water can be an effective remedial technology for use at the Combe Fill South landfill. Such treatment would, however, have to be done at the landfill site because there is no publicly owned treatment works (POTW) in either Chester or Washington Townships (i.e. within a 2.6 mile radius of the site). The final selection of any specific treatment process should be contingent upon a waste characterization and treatability study. A combination of physical, chemical, and biological processes would probably provide for the maximum removal of contaminants.

Biological treatment processes more likely to be applicable to the site include activated sludge, trickling filter and rotating biological contactor (RBC), aerated lagoons, and stabilization ponds (which take up more space and are not as effective as the other processes). Anaerobic filters are generally used as a pretreatment mechanism for strong waste and may not be applicable to waste contaminants or concentrations.

Chemical liquid waste treatment mechanisms that may be applicable to the site in conjunction with other processes include precipitation, flocculation/coagulation, aeration/oxidation and neutralization. Ultraviolet treatment and ozonation as disinfectants are not commonly used; chlorination is the more common disinfectant.

Physical treatment processes for liquid waste streams generally applicable to hazardous waste treatment include flow equalization, sedimentation, filtration, air stripping, and activated carbon adsorption. However, the cost of an activated carbon system generally limits its application to effluent polishing after other waste treatment processes. Some liquid treatment processes such as ion-exchange, reverse osmosis, and steam stripping are technically feasible measures but may not be as cost-effective as other methods. Liquid-liquid extraction and steam distillation are inappropriate technologies because they are considerably more expensive than other equally suitable methods. An oil-water separation may be necessary only if the influent contains large quantities of oils or greases.

Sludge handling and treatment processes would be required in conjunction with a liquid treatment system. Thickening/dewatering mechanisms are used to reduce the volume of the sludge prior or subsequent to treatment or ultimate disposal. These thickening mechanisms include the use of screens (used early in the liquid treatment system to remove larger objects), centrifuges, gravity thickeners, flotation thickeners, vacuum filters, belt filters, and pressure filters.

Additional treatment/disposal of sludges would have to be done on-site because there is no other POTW nearby. A similar problem exists for ultimate disposal at a suitable RCRA-permitted facility. Depending on the physical/chemical composition of the sludge, additional treatment/disposal processes may include neutralization, oxidation/reduction, and incineration. Composting, although technically feasible, may not be possible if the waste is toxic, particularly from concentrations of heavy metals.

Solidification/encapsulation techniques are generally utilized for "pure products" or relatively small quantity, highly concentrated wastes. Most of these techniques require the excavation and/or mixing of the waste with some other media. At Combe Fill South, the mix of contaminants and combined waste/soil volume usually makes direct overall site applications impractical and potentially dangerous because of the explosive potential of methane. Solidification techniques involve the mixing of the waste with some binder or stabilizer. The resultant volume of binder and waste may be up to twice the original volume, thus requiring an increase in the capacity (size) of the landfill. Expansion of the landfill beyond its present boundaries is not desirable.

Specific solidification techniques have other disadvantages, such as:

- Cement, which is porous, may leach organics that are not as effectively bound as other materials.

- Lime merely stabilizes the waste and does not treat organic contaminants.
- Thermoplastic binders, such as asphalt and paraffin, liquify under high temperatures and are not suitable binders for organic solvents.
- Organic polymers may biodegrade, thus releasing contaminants.
- Self-cementing solidification requires that the waste have high sulfate or sulfite concentrations, which are not found at Combe Fill South.
- Glassification combines waste with molten glass and is a very energy intensive and costly process.

Encapsulation physically encloses the waste in such materials as high-density polyethylene. Although suitable for highly contaminated sediments and sludges, most commercial applications are off-site and very expensive.

2.4.8 Land Disposal/Storage

Land disposal/storage of treated or untreated wastes may be possible for remediation at Combe Fill South. However, land disposal is being phased out as an acceptable treatment and disposal mechanism for hazardous waste under the RCRA program.

Landfilling of excavated wastes from the site at an off-site location may be impossible because no RCRA permitted facility has the capacity to accept such large quantities of waste. Therefore, if landfilling is pursued, it must be accomplished by the creation of a new RCRA facility at the present landfill site. In order to achieve RCRA design requirements for landfills, substantial amounts of land would have to be acquired adjacent to the present landfill.

Surface impoundments used merely as storage/holding facilites (not as part of a treatment process as previously discussed) would provide no further treatment of the waste sources on-site and would therefore not be an effective remedial measure. Waste piles have similar limitations.

Deep well injection, of treated waste only, may be unacceptable from a public health standpoint because the bedrock aquifer is used as a potable water source by the community. The individual components of waste collection and treatment prior to such disposal may not be able to provide assurances that wastes are adequately collected and treated to meet drinking water criteria.

Temporary storage of some waste products may be necessary on-site prior to subsequent treatment or disposal. Temporary storage facilities may include lagoons/impoundments, drums, containers, or diked waste piles, depending on the nature of the waste and subsequent treatment or disposal processes being used.

2.4.9 Contaminated Water Supplies

If potable wells reveal concentrations of contaminants above drinking water criteria or which may pose a health risk, alternative sources of drinking water may be supplied. Such actions, however, do nothing to remediate the causes or sources of the waste problems on the site. Suppling alternate drinking water sources may be done on a temporary basis, while other source-specific remedial actions are taken.

Drilling deeper wells for individual residences or perhaps as for local public supply may be possible if the tapped aquifer is not contaminated. Connecting affected residents to the municipal water system may also be possible if the system has the capacity to accept additional hookups and if the water supply lines are within a few miles of the site. Cisterns, tanks, and bottled water may be used to provide potable water but are not effective long-term measures.

If contamination levels are low or isolated, individual home water treatment units may be acceptable remedial measures. However, not all contaminants are amenable to such individual treatment units.

2.4.10 Relocation

Relocation of portions or all of the affected nearby community may be warranted if sufficient health risks from specific contaminant pathways exist or if required to implement specific remedial actions.

For example, the construction of a new RCRA landfill on-site would probably require the purchase of nearby vacant property and the relocation of some residences and/or businesses. Relocation, like providing alternative drinking water supplies, does nothing to remediate the source of the problem.

2.4.11 Access Restriction

Several cost-effective mechanisms exist that can restrict access to the site, thereby limiting the problems of direct contact with the wastes. Warning signs, fences, and locking gates can provide some barriers to the site, although the determined trespasser may still gain entrance. Security guards or other more intensive and costly site security measures may be warranted, depending on the nature of the wastes found or the remedial actions finally selected.