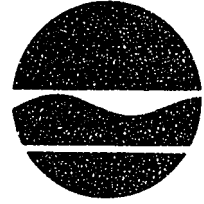


— SITE CONTAINMENT Project 1 L.C. —  
12/87

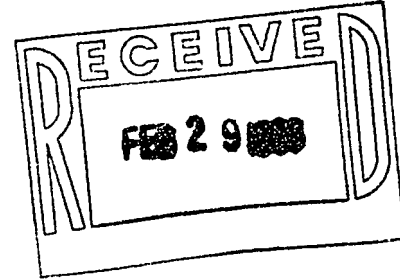
A. Gabalski

New York State Department of Environmental Conservation  
50 Wolf Road, Albany, New York 12233



Thomas C. Jorling  
Commissioner

FEB 29 1988



Mr. George Pavlou  
United States Environmental  
Protection Agency, Region II  
26 Federal Plaza  
New York, New York 10278

Dear Mr. Pavlou:

Re: Love Canal - Project 1, Site Containment System,  
Site No. 9-32-020

Enclosed for your information is CH2M Hill's Final Engineering Report entitled "Love Canal - Project 1, Site Containment System, Niagara Falls, New York".

If you have any questions on this project, please call Ms. Deborah Aldrich, P.E. at (518) 457-4343.

Sincerely,

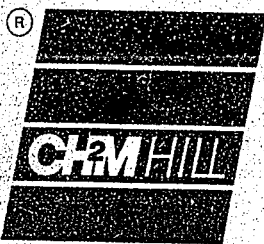
Robert W. Schick, P.E.  
Chief, Western Remedial Action Section A  
Bureau of Western Remedial Action  
Division of Hazardous Waste Remediation

Enclosure

cc: J. Liddle, CDC (ATSDR), w/enc.  
E. Martin-Leff, NYSDOL, w/enc.  
R. Tramantano, NYSDOH, w/enc.

DA:tv:bcc:

w/enclosure: M. O'Toole  
N. Nosenchuck  
J. Willson  
N. Parratt  
A. Gabalski ✓  
D. Aldrich



Engineers  
Planners  
Economists  
Scientists

FINAL ENGINEERING REPORT

LOVE CANAL--PROJECT 1  
SITE CONTAINMENT SYSTEM  
NIAGARA FALLS, NEW YORK

RECEIVED  
FEB 29 1988  
BUREAU OF ENVIRONMENTAL ACTION  
DISPATCH  
EPA/600/3-88/001

Prepared by:

CH2M HILL  
P.O. Box 4400  
Reston, Virginia 22090

December 1987

WDR301/016

RECEIVED  
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WDR301/017

## I. ABSTRACT

On February 8, 1982, CH2M HILL issued an Environmental Information Document that was to become the basis for the remedial activities at Love Canal.

The project originally included a concrete cutoff wall surrounding the site, a synthetic membrane cover, new offsite drainage facilities, severing and plugging of the existing utilities, demolition of the 99th Street School, and other site enhancements.

The project was publicly advertised and bid in August and September 1982. The low bidder was Severson Construction Corp. of Niagara Falls, New York, at a bid price of \$3,939,549.00.

During the course of the project, several substantial changes were made, including (1) the deletion of the concrete cutoff wall (2) addition of televising and cleaning the barrier drain, and (3) repairing the existing barrier drain system.

The final construction cost is \$5,187,598.29, including 49 change orders totaling \$735,090.51 and a Supplemental Agreement for \$789,160.20 of which \$587,455.88 worth of work was performed.

The original construction schedule stipulated two phases of construction work: one in the fall of 1982 and the second in the summer and fall of 1983. Because of additions to the contract, the contractor's inexperience with certain elements of the work, and other factors, the major elements of work were not completed until the fall of 1984.

## II. BACKGROUND

On February 8, 1982, the final draft of CH2M HILL's Environmental Information Document (EID) was submitted to the U.S. EPA. The purpose of the EID was to develop and evaluate alternatives for Project 1, the remedial action to be performed within the Ring II fence. One alternative which was selected by the U.S. EPA and New York State Department of Environmental Conservation (NYSDEC) was further evaluated and developed in detail. This alternative resulted in the project that is the subject of this report.

The NYSDEC's work directive stated the following objectives of Project 1:

- o Prevent the movement of contaminants offsite through the storm and sanitary sewers, roads, and/or other utility systems.

- o Isolate the transport of surface runoff from the site and increase the volume of runoff, thus reducing the downward percolation of surface runoff.
- o Improve the collection of contaminants in the shallow groundwater within the leachate collection system.
- o Reduce the flow of shallow groundwater from the site.

The EID addressed alternatives in terms of their ability to meet these project objectives as well as other performance criteria such as cost, environmental impact, health and safety, technical reliability, system reliability, community acceptance, and construction duration.

Several preliminary plans were chosen for further evaluation. They were:

- o One no-action plan, providing for continued operation of the existing leachate collection system and treatment facility.
- o Three variations of a plan to expand the existing leachate collection system. All three would increase the amount of contaminated groundwater that was intercepted, thereby minimizing the migration of contaminated groundwater from the site.
- o Three plans that included partial containment of the site within a slurry wall extending from ground surface to an impermeable clay formation occurring at a depth of approximately 14 feet, plus expansion of the existing clay cap.

Preliminary cost analyses indicated that life cycle costs for the containment plans were substantially lower than for the other plans due to lower operation, maintenance, and replacement costs. Health and safety considerations, environmental effects, and several other criteria also favored implementation of a containment plan.

Subsequently, a containment plan was selected for detailed development and evaluation. The selected plan included surrounding the entire site with a slurry wall and covering the contained area with a clay cap, graded to promote rapid surface runoff from the site. All existing utility lines were to be severed and plugged. The existing monitoring wells were to be maintained, and new water and wastewater lines were to be provided to serve the leachate treatment

plant. Additional items of work such as cleaning contaminated deposits from existing sanitary and storm sewers and alternative construction methods for the slurry wall were to be evaluated on the basis of bid prices.

The New York State Department of Transportation's (NYSDOT) contract for the demolition of Ring I and Ring II homes was scheduled for implementation during the spring and summer of 1982. In view of the potential for coordination problems, a meeting was held in January 1982 involving NYSDEC, NYSDOT, and CH2M HILL to develop an implementation program that would maximize cost-effectiveness and safety and minimize potential coordination problems.

CH2M HILL, continuing under authorization from the U.S. EPA and NYSDEC, began preparation of the bid documents. During this design phase, several changes were made to the containment plan. Specifically, (1) the slurry wall was replaced with a concrete cutoff wall to provide lower permeability, and (2) the extension of the clay cap was replaced with the installation of a synthetic membrane to provide a better seal to the site at a reduced cost. The bid documents were finalized and ready for distribution prior to the August 1982 Notice to Bidders.

### III. BIDDING AND PRECONSTRUCTION ACTIVITIES

The Notice to Bidders for Project 1 was issued on August 17, 1982, and was published in Buffalo, Niagara Falls, Syracuse, Rochester, and Albany newspapers. Plans and specifications were available for purchase from NYSDEC in Albany and were available for examination in several locations throughout the state.

Addenda Numbers 1 through 4 were prepared and issued as follows:

- Addendum No. 1--August 26, 1982
- Addendum No. 2--August 30, 1982
- Addendum No. 3--September 7, 1982
- Addendum No. 4--September 9, 1982

A pre-bid meeting was held at the LaSalle Community Center on Colvin Boulevard in Niagara Falls on August 26, 1982. Representatives of NYSDEC and CH2M HILL were available to answer questions and to allow for a site inspection by prospective bidders. Attendance at the pre-bid meeting was a condition of bidding. Meeting minutes were distributed to all attendees.

CH2M HILL received two letters during the bidding period addressed to NYSDEC. The first was a protest from J.E. Breneman Co. of Philadelphia dated August 27, 1982, dealing



with the specified method of excavation for the concrete cutoff wall and suggesting as an alternative the vibrated beam method of slurry construction. In a response prepared by CH2M HILL and sent to NYSDEC on September 3, 1982, it was recommended that the alternative not be accepted.

The second letter was from the ICOS Corporation of New York City dated August 30, 1982, and raised several questions relative to excavation for the cutoff wall under the dry trench method with the alternative for slurry construction. Those questions were subsequently addressed by Addendum No. 3, which provided for excavation of the entire cutoff wall to be performed "under slurry."

By Addendum No. 2, the bid opening date was postponed until September 16, 1982. At that time, nine bids were received, publicly opened, and read aloud at the NYSDEC offices in Albany.

The nine base bids and the engineer's estimate were:

|  |                |
|--|----------------|
| Engineer's estimate                              | \$4,711,213.45 |
| Sevenson Construction Co.<br>Niagara Falls, NY   | \$3,939,594.00 |
| Sicoli & Massaro<br>Niagara Falls, NY            | \$4,349,639.75 |
| H. F. Darling<br>Williamsville, NY               | \$4,633,971.00 |
| Wm. W. Kimmins & Sons<br>Kenmore, NY             | \$4,793,150.00 |
| D'Appolonia<br>Pittsburgh, PA                    | \$5,134,223.45 |
| Stimm Associates<br>Cheektowaga, NY              | \$5,317,455.00 |
| ABC Paving Co.<br>Buffalo, NY                    | \$5,481,475.00 |
| Smith Brothers Construction<br>Niagara Falls, NY | \$5,820,046.00 |
| ICOS Corporation<br>New York, NY                 | \$6,587,411.00 |

On September 21, 1982, representatives of CH2M HILL interviewed Mr. Michael Elia (Vice President) and

Mr. Patrick Stoutamire (Chief Estimator) of Severson Construction Corporation, the low bidder. During the meeting, additional submittals not previously furnished were requested by CH2M HILL. A list of current projects was obtained, and questions relating specifically to Project 1 were answered by the Severson firm. As a result of this interview and other investigations, CH2M HILL recommended to NYSDEC that Severson Construction Corporation be awarded the contract.

A pre-construction meeting was held on December 2, 1982, with representatives from NYSDEC, Severson Construction Corporation, and CH2M HILL. During this meeting, items such as project staff, health and safety, site security, scheduling, submittals, payments, changes in the work, communications, coordination meetings, record drawings, permits, easements, and other miscellaneous items were discussed. As a result of this meeting, a conditional Notice to Proceed was issued. This Notice allowed Severson Construction Corporation to place the temporary construction facilities but did not permit any construction until the health and safety and security aspects of the project were satisfactorily resolved.

A second meeting was held on December 10, 1982, to discuss the details of the health and safety plan and to resolve other outstanding administrative issues.

#### IV. OVERVIEW OF CONSTRUCTION ACTIVITIES

The Contract for Construction specified that the work would be performed in two phases. Phase I was to be complete within 45 days from Notice to Proceed and was to consist of:

- o Clearing and grubbing
- o Construction of a sewer line to the existing leachate treatment facility
- o Construction of the concrete cutoff wall at seven street crossings
- o Plugging and abandonment of existing onsite water, gas, and sewer utilities
- o Cleaning of storm and sanitary sewer lines
- o Construction of offsite drainage facilities

Phase II, then, was to commence in the spring of 1983 and was to be complete within 150 days from the issuance of the second phase Notice to Proceed. Phase II was to consist of:

- o Construction of concrete cutoff wall around the site
- o Recomposition of existing clay cap
- o Installation of an extended synthetic membrane cover over the canal portion of the site
- o Modifications to existing roadways
- o Construction of gravel access roads
- o Earthfill placement and grass establishment
- o Demolition of the 99th Street School

It was anticipated that construction would begin early in the fall of 1982 and that Phase I work would be complete by January 1, 1983.

Due to administrative delays associated with finalizing the contract with Severson firm, work did not begin on Phase I activities until December 6, 1982.

The Contractor made two rescheduling requests toward the beginning of Phase I activities. The first was to demolish the 99th Street School during Phase I and the second was to defer construction of the portions of the cutoff wall corresponding to the seven street crossings until Phase II.

It was agreed that the isolated portions of the cutoff wall could be constructed during Phase II with the remainder of the wall, provided that the utilities were severed and that the trench was backfilled with clay prior to the completion of Phase I. Due to the time required to obtain legal access to demolish the 99th Street School, permission could not be granted to perform that work ahead of schedule.

Phase I work began with clearing and grubbing activities. Severson's subcontractor, Wizard Methods, Inc., began to encounter delays in the cleaning of the storm and sanitary sewers.

The contract specifications called for a bucket cleaning and power flushing of the sanitary and storm sewers that were to be abandoned within the Ring II fence. The initial bucketing effort progressed slowly and produced a minimal amount of solids. The primary reasons for the decreased production involved equipment problems. The subcontractor claimed that

the equipment problems were due to the inclement weather. CH2M HILL's field observations, however, indicated that they were a result of poor equipment maintenance.

In an effort to increase production and to meet his schedule, the Contractor proposed to eliminate the bucketing of the sewers and to obtain the required degree of cleaning through the power flushing only. The subcontractor agreed to perform as many passes with the power flushing equipment as necessary to perform the work to the satisfaction of the Engineer. While this work was to be performed at the original unit price per lineal foot bid in the contract, the additional work items of cleaning the catch basins and power flushing storm sewer laterals were included at no additional cost. These items had not originally been included in the contract because it was believed that they would not require cleaning. However, clay placed by the NYSDOT contractor over the demolished homes had eroded and silted into the catch basins and laterals. Since it appeared that both the Contractor and NYSDEC would benefit from this proposal, it was accepted.

Production rates for sewer cleaning did increase, but not substantially enough to bring the project back on schedule.

Equipment-related problems continued to occur during the sewer cleaning operations. When the cleaning of the catch basins and storm laterals began, those problems were compounded by the high concentration of solids encountered.

The ineffective filtration of the sewer cleaning water added to the problems and delays. A series of sand filtration devices and sedimentation facilities were used. Equipment problems continued, and the added problem of equipment freeze-up was encountered.

As Phase I construction neared completion, several revised construction schedules were submitted. These schedules reflected a lengthened period of construction for Phase I with a shortened period of construction for Phase II. The Contractor expressed confidence that time lost during Phase I could be made up during Phase II. Actual completion of Phase I construction was March 28, 1983.

Phase II construction began on June 6, 1983. Work during Phase II was to include construction of the concrete cutoff wall, demolition of the 99th Street School, abandonment of designated streets, final grading, installation of a synthetic membrane, placement of earthfill above the membrane, construction of gravel access roads, placement of topsoil, seed, and mulch, and project closeout.

In 1982 and 1983, separate from the Severson Contract, NYSDEC engaged O. H. Materials, Inc., to clean portions of the barrier drain system. As a result of those cleaning operations, it became evident that barrier drain repairs were required at a number of locations. As a result, NYSDEC elected to televise, clean if necessary, and then repair the barrier drain system as required.

The Severson firm solicited subcontractor proposals to perform the cleaning and televising and selected Scan N Seal Environmental Services of Syracuse, New York. The televising operations were hampered, as unexpected amounts of debris were encountered.

A number of barrier drain repairs were required. Generally, the damage consisted of crushed pipes, misaligned joints, and areas of differential settlement. Because of the hazardous nature of the work and the fact that the existing granular backfill had to be sheeted, the repair work was very time consuming.

Shortly after Phase II construction began, NYSDEC and U.S. EPA, based on newly available information, decided to delete the installation of the concrete cutoff wall.

The decision resulted from (1) information gathered by E. C. Jordan Co., while performing a borehole investigation around the perimeter of the site and (2) the results of groundwater modeling performed by Geotrans, Inc. The borehole investigation indicated that some contaminants were located outside the proposed alignment of the cutoff wall. The groundwater modeling effort demonstrated that a limited benefit would be realized by constructing the wall.

As a result of this decision, a change order was issued which deleted the concrete cutoff wall in its entirety. Later it was decided to construct 60-foot-long concrete cutoff walls at each of the original utility crossing locations. Another change order was prepared to accomplish this work.

The nature of the barrier drain repair work was such that most other items of work in the original contract (particularly those on the critical path) could not be performed simultaneously. The resulting schedule slippage precluded completion of the project in 1983. Nevertheless, earthfill placement continued until December when weather conditions became so severe that work activities were suspended for the winter. Final items of work performed in 1983 were those required to secure the site, to minimize erosion of imported earthfill, and to provide temporary access to the pump chambers by the plant maintenance staff.

Accomplishments during the 1983 Phase II construction period included demolition of the 99th Street School, completion of the 60-foot-long concrete cutoff walls at each of the utility crossing, televising, cleaning, and repair of the barrier drain system, fabrication and delivery of a synthetic membrane liner, and earthfill placement in the southern sector.

During the winter months of 1983/84, NYSDEC and Severson Construction Corp. conducted a series of negotiating sessions to agree on fair compensation, scheduling, and other factors related to extending the construction work through the summer and fall of 1984. The negotiations were completed on May 15, 1984, and resulted in a Supplemental Agreement dated June 25, 1984 between the Department and the Severson firm.

Work began in the spring of 1984 with fabrication of the liner panels into 30-foot-wide sheets. This work was performed at the Severson shop on Lockport Road in Niagara Falls.

The 40-mil high-density polyethylene (HDPE) synthetic membrane was furnished by Oxford Liners, Inc. Fabrication of the membrane was performed by G. M. Plastics of Quebec, Canada.

After delivery of the HDPE material to the site, it was learned that the Severson firm was unable to make satisfactory arrangements to have the membrane installed by the supplier. As a result, the Severson firm leased and purchased equipment and added staff to install the membrane with their own forces.

As the placement of earthfill on the site progressed, field installation of the synthetic membrane began. The membrane was installed across the site from east to west and began in the southern sector and progressed to the north.

The installation of the HDPE was plagued with problems from the outset. While the quality of the installation was never compromised, the effect on the construction schedule was significant. The operations fell behind schedule immediately. The inexperience of the Severson construction crews, the apparent shortage of experience liner welding technicians, and Severson's inability to obtain adequate equipment all led to the delays.

Four methods of observation and testing of the liner were employed. First, visual inspection of all HDPE placed and all seams welded was performed to locate imperfections, field damage, or improper seams. Second, vacuum testing of seams was performed. Third, coupons were obtained from each

panel seam and were tested onsite for tensile strength and for peel failure. Last, coupons were removed and shipped to Hauser Laboratories of Boulder, Colorado, where independent testing was performed to supplement the onsite testing.

In every instance where testing indicated an air leak or a strength failure, the material was repaired and retested.

Although behind schedule, the membrane installation progressed through the summer and fall of 1984. The protective earthfill cover, topsoil, and seed followed closely behind. With the exception of punchlist items of work, the construction was complete on November 12, 1984.

#### V. PROJECT ADMINISTRATION

The administration of activities associated with the competitive bidding of this project was shared by NYSDEC and CH2M HILL. NYSDEC placed the Advertisement for Bids, handled the issuance of plans and specifications, received bids, reviewed insurance and bonds, and executed the final construction contract. CH2M HILL prepared and distributed addenda, conducted the pre-bid meeting, and responded to technical questions raised during the bid period.

The original, signed construction Contract, bonds, and insurance certificates are on file at the NYSDEC office in Albany.

Forty-nine change orders and one Supplemental Agreement to the original contract were issued. The following is a list of the Contract Modifications and total project costs.

| <u>Change Order</u> | <u>Description</u>                           | <u>Cost</u>  |
|---------------------|--|--------------|
| 1.                  | Clean monitoring well extensions             | \$ 1,024.45  |
| 2.                  | Provide wooden pallets for drum storage      | \$ 1,274.62  |
| 3.                  | Provide 360 55-gallon drums                  | \$ 18,000.00 |
| 4.                  | Store contaminated solids in onsite vehicles | \$ 4,914.03  |
| 5.                  | Prepare 55-gallon drums for disposal         | \$ 30,244.90 |
| 6.                  | Clean and televise barrier drain system      | \$128,196.87 |

|     |   |                  |
|-----|---|------------------|
| 7.  | Demolish existing<br>sludge holding tank  | \$ 17,000.00     |
| 8.  | Construct manhole access<br>to existing leachate<br>holding tank                                  | \$ 1,814.11      |
| 9.  | Delay start of concrete<br>cutoff wall from<br>April 1, 1983, until<br>June 15, 1983              | \$ 15,042.16     |
| 10. | Install 35.5 vertical feet<br>of full diameter manhole<br>extensions to barrier<br>drain manholes | \$ 5,605.45      |
| 11. | Install new overhead<br>electrical service to<br>leachate treatment<br>plant and pump stations    | \$ 24,246.22     |
| 12. | Modify existing under-<br>ground electrical<br>distribution system                                | \$114,969.56     |
| 13. | Perform barrier drain<br>repairs from August 10,<br>1983, until September 9,<br>1983              | \$ 94,293.60     |
| 14. | Salvage power poles<br>and wire   | [\$ 232.52]      |
| 15. | Delete construction of<br>concrete cutoff wall  | [\$1,103,000.00] |
| 16. | Modify existing Health<br>and Safety Plan   | \$ 10,977.97     |
| 17. | Premium time from<br>September 30, 1983,<br>until November 13, 1983                               | \$ 77,271.89     |
| 18. | Construct 60-foot-long<br>cutoff walls at seven<br>utility crossing<br>locations                  | \$137,779.00     |
| 19. | Unload and stage<br>55-gallon drums   | \$ 6,000.00      |



|     |  |              |
|-----|--|--------------|
| 20. | Mobilize concrete batch plant in preparation for constructing concrete cutoff wall           | \$172,120.56 |
| 21. | Clean and televise barrier drain system  | \$ 56,507.73 |
| 22. | Perform barrier drain repairs from September 12, 1983, until October 2, 1983                 | \$170,455.79 |
| 23. | Clean and televise barrier drain system  | \$102,072.46 |
| 24. | Clean pump chambers, reinstall pumps, decon equipment, perform other site closure activities | \$153,782.18 |
| 25. | Perform barrier drain repairs from October 3, 1983, until October 24, 1983                   | \$106,093.13 |
| 26. | Perform barrier drain repairs from October 25, 1983, until November 17, 1983                 | \$ 18,253.97 |
| 27. | Construct temporary access drives to four existing pump chambers                             | \$ 6,507.00  |
| 28. | Perform medical surveillance and safety training   | \$ 3,499.82  |
| 29. | Perform decontamination of granite curbing   | \$ 3,993.80  |
| 30. | Provide additional locker and shower facilities  | \$ 1,100.00  |
| 31. | Provide additional equipment and materials for vehicle contamination                         | \$ 619.22    |
| 32. | Unused   |              |

|     |  |                |
|-----|--|----------------|
| 33. | Perform additional work related to unanticipated groundwater conditions at concrete cutoff walls | \$ 22,373.12   |
| 34. | Provide pretreatment of sewer line flushing water  | \$ 21,425.00   |
| 35. | Dispose of tree stumps and roots onsite  | \$ 29,505.00   |
| 36. | Correction for labor benefits payment for previous time and material change orders               | \$ 3,449.16    |
| 37. | Modify synthetic membrane installation to accommodate deletion of the concrete cutoff wall       | \$106,000.00   |
| 38. | Reserved   |                |
| 39. | Delete soil sterilant below synthetic membrane   | \$ [36,000.00] |
| 40. | Delete termination trench  | \$ [11,000.00] |
| 41. | Perform miscellaneous items of extra work from June 27, 1984, until July 31, 1984                | \$ 11,027.26   |
| 42. | Perform miscellaneous items of extra work from August 1, 1984, until August 31, 1984             | \$ 43,658.17   |
| 43. | Perform miscellaneous items of extra work from September 1, 1984, until September 30, 1984       | \$ 29,986.79   |
| 44. | Perform miscellaneous items of extra work from October 1, 1984, until November 30, 1984          | \$ 35,925.50   |
| 45. | Credit for NYSDEC acceptance of non-conforming earthfill   | \$ [15,000.00] |

|     |  |                |
|-----|--|----------------|
| 46. | Repair and replace portions of the Ring II fence | \$ 4,777.50    |
| 47. | Furnish and install additional earthfill         | \$ 72,371.00   |
| 48. | Additional physical examinations                 | \$ 26,664.04   |
| 49. | Prepare, label, and transport 190 drums          | \$ 9,500.00    |
|     | Total Change Orders                              | \$ 735,090.51  |
|     | Original Contract Work Performed                 | \$3,865,051.90 |
|     | Supplemental Agreement (Work Performed)          | \$ 587,455.88  |
|     | Total Project Cost                               | \$5,187,598.29 |

Several significant changes to the base contract were made during the course of the work. They include:

- o The previously discussed deletion of the concrete cutoff wall. This change and the several related contract modifications (Change Orders 9, 15, 18, 20, 33, and 37) resulted in a net deduction of \$649,685.16 from the original contract.
- o The cleaning and televising of the barrier drain system (Change Orders 6, 21, and 23) resulted in additional costs of \$286,777.06. Still under review by NYSDEC is an additional \$56,280.00 claim associated with these change orders.
- o The resulting barrier drain repairs (Change Orders 13, 22, 25, and 26) were probably the single most important factor in delaying the completion of the project beyond the 1983 construction season. The cost was \$389,096.49.

A number of noteworthy project problems were encountered:

- o The inability to award the construction contract to the Severson firm in a timely manner (due to apparent administrative problems) resulted in beginning the construction work in the winter rather than in the early fall as planned. The

exact impact of this on the overall schedule is difficult to determine. However, there is no question that some schedule slippage resulted. The lost time was never made up.

- o The volume of solids recovered from the sewer cleaning operations was greater than anticipated, due primarily to the eroded clay that had been used by NYSDOT as capping material following home demolition. Solids handling, dewatering, and disposal became a major undertaking during the course of the work. The fact that the sediment was potentially dioxin-laden resulted in difficulty in determining the final disposal method. These materials were stored by decanting the free liquid and mixing the remaining material with an absorbent. These solids are currently staged in 55-gallon drums onsite.
- o During clearing and grubbing operations, allegations were made that a Severson employee improperly disposed of or attempted to dispose of trees that were removed from the site. The allegation was made that there was an attempt to sell the trees as firewood when in fact the contract required disposal at a sanitary landfill. The alleged incident resulted in adverse project publicity, and it is reported that litigation followed.
- o Prior to the deletion of the concrete cutoff wall, there was correspondence with the Contractor relative to the necessity for using the "excavation under slurry" method of construction. At that time, prior to the commencement of Phase II, the Contractor offered a credit to delete the slurry based upon what was understood to be a price quote from his slurry subcontractor. However, it was learned that the reported price quote was either misunderstood or misrepresented by the Severson firm. While the entire issue of slurry vs. dry trench excavation became "academic" due to the deletion of the cutoff wall, the resolution of the situation involved all parties, resulted in unnecessary costs, and created ill will and an atmosphere of suspicion that lingered for the duration of the project.
- o As previously discussed, the Contractor's inexperience in installing synthetic membrane resulted in considerable delays during the course of the project. The resident engineering staff was expanded to compensate for the ineffectiveness of the Contractor's quality assurance program.

- o Throughout the course of the construction work, it became increasingly more difficult to negotiate lump sum change order costs and to arrive at other arrangements with the Contractor relative to scheduling work and other construction-related issues. The Severson representatives claimed that this situation occurred as a result of late payments and failure to make payments for earlier work performed on this project.

The net result was increasing inefficiency in the conduct of the work and a further deterioration of the relationship between the Owner and the Contractor.

#### VI. CONTRACTED ENGINEERING TASKS

Nine engineering tasks were included in the original contract between CH2M HILL and NYSDEC:

- Task 1 Finalization of Bid Documents, Evaluation of Bids, and Recommendation for Award of the Construction Contract
- Task 2 Preparation of Maps and Descriptions for Taking of Easements
- Task 3 Preparation of Detailed Topographic Maps of the Site
- Task 4 Appraisal of the Value of the 99th Street School
- Task 5 Contract Administration and Onsite Construction Observation
- Task 6 Materials Testing
- Task 7 Assistance in Public Participation Program
- Task 8 Final Engineering Report
- Task 9 Post-Construction Inspection and Report

Task 1 actually began on August 25, 1982, an arbitrary date signifying the transition required as a result of the Cooperative Agreement executed between the U.S. EPA and NYSDEC.

Activities under Task 1 included a number of coordination meetings with NYSDEC representatives to finalize the design drawings and specifications, printing, and distribution of documents, attendance, and technical support at a pre-bid meeting, preparation and distribution of Contract Addenda,

preparation of a detailed cost estimate, bid review, and recommendation for award of contract.

The activity under Task 1 culminated with the issuance of the document:

EVALUATION OF BIDS  
FOR  
LOVE CANAL--PROJECT 1  
SITE CONTAINMENT SYSTEM  
NIAGARA FALLS, NEW YORK  
SEPTEMBER 24, 1982

Three copies of that document are on file with NYSDEC.

Under Task 2, CH2M HILL prepared maps and descriptions for taking of easements to permit construction and long-term maintenance by NYSDEC. The activity was completed in the fall of 1982 with the furnishing of the final documents to NYSDEC. During the course of the work, several meetings were held with NYSDEC representatives James West (who is responsible for real property) and Ed Goodrich (who is responsible for land surveying standards).

Task 3 was the preparation of detailed topographic maps of the site. The original design of the remedial project was without benefit of field survey to establish site topography. As a result, certain elements of work required additional detail, such as existing grades for earthwork, storm sewer inverts, and roadway locations and grading.

CH2M HILL performed field surveys and mapping to accommodate the design and construction activities. The work was completed in the fall of 1982.

Appraisal of the value of the 99th Street School was accomplished under Task No. 4. A subcontractor, Grant Appraisal and Research of Buffalo, performed the work under the direction of NYSDEC officials. The Appraisal was performed in the fall of 1983, with the final Appraisal report furnished on December 7, 1983. Copies of the Appraisal report are on file with NYSDEC.

Task 5 was for contract administration and onsite construction observation. Work under this task began with the issuance of the Notice to Proceed to the Contractor and was completed with the review of the Contractor's final payment application.

The duration of the effort was approximately 4 years, beginning on December 6, 1982, and ending on October 22, 1986.

The narrative of the construction-related activity is included earlier in this report; additional activities performed under Task 5 included:

- o Onsite construction observations--at all times construction was being performed until the final revised punchlist of work items was prepared on August 14, 1985.
- o Weekly construction coordination meetings with the Contractor, his subcontractors, CH2M HILL, and representatives of NYSDEC. Minutes of all meetings were prepared by CH2M HILL and are on file at NYSDEC.
- o Review of Contractor's monthly payment applications.
- o Review of claims and preparation of change orders. This element of the work became a significant activity because of the changes in the scope of work that were initiated.

Task 6 was for materials testing and included onsite soil testing for earthfill and onsite and laboratory testing of HDPE membrane liner.

All test results are on file with NYSDEC.

Soil testing included gradation analyses and compaction testing by sand cone and nuclear density gage.

Onsite membrane testing was performed at the Contractor's shop and at the site where panels were fabricated. The procedure included tension and peel tests of seams to compare strength of seams to the strength of parent material. Other onsite testing included visual inspection and the use of a vacuum box to check the integrity of the shop and field welds.

Laboratory testing was performed by Hauser Laboratories of Boulder, Colorado, in accordance with ASTM D-638.

Field and laboratory testing of materials began in the spring of 1983 and continued until December 1984.

CH2M HILL provided assistance to NYSDEC in the implementation of the Public Participation Program under Task 7. Efforts under this task were performed throughout the duration of the project and included attendance at meetings with NYSDEC public participation specialists, attendance at public meetings, and preparation of graphics for displays and newsletters.

Task 8 was for the preparation of this Final Engineering Report.

Task 9, the Post-Construction Inspection and Report, was deleted by agreement between CH2M HILL and NYSDEC.

Supplemental Agreements I and II added several additional tasks. They were:

Task 10 Design of Electrical Modifications

Task 11 Preliminary Investigation of Vehicle Decontamination Facility

Task 12 Health and Safety Consultations

Task 13 Redesign of Site Grading and Liner System

Task 14 Easement Monumentation

Task 15 Interim Services

Task 16 Design of Hazardous Waste Storage Facility

During the course of Phase I construction, it became evident that the existing site-electrical system was in a state of disrepair. It was determined that a new electrical distribution system would be installed above the liner system for ease of future access. CH2M HILL's evaluation of the old system and design of the new system were included under Task 10. The work was performed during the summer of 1984 and resulted in issuance of Change Order 12.

Task 11 required that CH2M HILL investigate the feasibility of constructing a permanent vehicle decontamination facility at the Love Canal site. CH2M HILL performed this work early in 1983. NYSDEC elected not to construct the facility due to cost and other factors.

Task 12 included basic health and safety training for the NYSDEC staff and provided for ongoing consultations between NYSDEC's onscene coordinators and CH2M HILL's health and safety representatives. The training sessions were held during the summer of 1983, and the consultations were ongoing throughout the duration of the project.

Task 13 was to redesign the drainage system south of Frontier Avenue. This task was deleted by agreement between NYSDEC and CH2M HILL.

Task 14 included the installation of permanent monumentation for easements. This task was deleted by agreement between NYSDEC and CH2M HILL.



Task 15 permitted CH2M HILL to recover costs incurred on behalf of NYSDEC that were incurred prior to the effective date of the original contract.

Task 16 was to design an interim storage facility onsite for wastes placed in 55-gallon drums. This task was deleted by agreement between NYSDEC and CH2M HILL.

The following table shows the budgets and actual costs for the tasks performed by CH2M HILL under the original Agreement and the two Supplemental Agreements.

| <u>Task</u> | <u>Description</u>            | <u>Budget<sup>a,b</sup></u> | <u>Cost<sup>b</sup></u> |
|-------------|-------------------------------|-----------------------------|-------------------------|
| 1           | Eval. of Bids                 | \$35,297                    | \$32,916.54             |
| 2           | Easement Maps                 | \$7,561                     | \$7,572.78              |
| 3           | Topo Maps                     | \$15,581                    | \$13,583.20             |
| 4           | Appraisal 99th Street School  | \$9,820                     | \$6,266.88              |
| 5           | Admin & Onsite Observ.        | \$525,273                   | \$594,795.87            |
| 6           | Materials Testing             | \$20,720                    | \$27,344.81             |
| 7           | Public Participation          | \$8,682                     | \$3,419.96              |
| 8           | Final Report                  | \$26,174                    | \$87.75                 |
| 9           | Post-Const. Insp.             | \$2,847                     | \$0.00                  |
| 10          | Elect. Modifications          | \$14,244                    | \$10,794.54             |
| 11          | Vehicle Decon. Facility       | \$3,663                     | \$3,282.49              |
| 12          | Health & Safety Consultations | \$8,526                     | \$4,147.93              |
| 13          | Redesign of Liner System      | \$12,776                    | \$0.00                  |
| 14          | Easement Monumentation        | \$4,520                     | \$0.00                  |
| 15          | Interim Services              | \$2,377                     | \$2,371.44              |
| 16          | Design of Storage Facility    | \$8,849                     | \$0.00                  |

<sup>a</sup>Reflects rebudgeting efforts due to scope changes.

<sup>b</sup>Does not include fixed fee of \$64,017.

The one significant variation between budget and cost occurred under Task 5, administration and onsite observation.

As is typical for these types of services, the final cost results largely from the efficiency of the Contractor's operations and the extent to which the owner modifies the original work scope.

#### VII. PROJECT RECORDS

Early in the project CH2M HILL furnished to NYSDEC a project file index with the intent that duplicate files be established by CH2M HILL and NYSDEC. Subsequently, throughout the duration of the project, CH2M HILL has furnished copies of all documents for NYSDEC's files. It is intended that the Engineer's files will be kept in the CH2M HILL Reston, Virginia, office for future reference.

Copies of the Record Drawings have been furnished to NYSDEC under separate cover along with one set of sepia reproductions. These drawings have been prepared, in part, on the basis of information compiled by others. They are not intended to represent in detail the exact location, type of component, or manner of construction.

Also under separate the Engineer has furnished to NYSDEC a set of project photographs (35mm color slides).

A separate report entitled "Evaluation of Bids for Love Canal--Project 1, Site Containment System, Niagara Falls, N.Y." was furnished to NYSDEC on September 24, 1982. This report summarizes the prebid and bidding activities and details CH2M HILL's review of the bids and recommendations.

Minutes of all regular weekly coordination meetings and other special meetings have been furnished to NYSDEC and are also available in the Engineer's files.

The original signed contract, bonds, insurance, change orders, and the Contractor's Supplemental Agreement are on file with NYSDEC.

All project files in the possession of CH2M HILL will be maintained in storage by CH2M HILL. In the event that CH2M HILL elects to discard this information, it will first be offered to NYSDEC.

WDR301/018

