SAMPLING MANUAL
LOVE CANAL SITE
LONG-TERM GROUNDWATER MONITORING PROGRAM

OCCIDENTAL CHEMICAL CORPORATION
LOVE CANAL SITE
NIAGARA FALLS, NEW YORK

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1.0 DESCRIPTION OF SITE

1.1 SITE DESCRIPTION

The Love Canal Site (Site) is a 64 acre rectangular site bounded by Colvin Boulevard on the North, 99th and 100th Streets to the East, 95th and 97th Streets to the West and Frontier Avenue to the South. A Site Plan is provided as Figure 1.1.

1.2 REMEDIAL SYSTEMS

Remedial Action to prevent the off-site migration of chemical contaminants from the Site, began in October 1978 with the installation of a barrier drain along the east and west sides of the south section of the Canal. The barrier drain, intended to intercept shallow lateral groundwater flow, consists of a trench which is 15 to 25 feet deep and 4 feet wide. Installed within the trench is an 8-inch diameter perforated clay tile drain centered in 2 feet of uniformly sized gravel which is overlain to the surface with sand. Lateral trenches filled with sand were dug perpendicular to the barrier drain in the direction of the Canal. The tile drain is graded towards a series of manholes and deep wells where the leachate is collected. The leachate is pumped from these deep wells to underground holding tanks where it is held prior to being treated at an on-site treatment facility (Love Canal Leachate Treatment Facility or LCLTF) and discharged into the City sewer system.

A clay cap was installed over the entire Canal area following completion of the barrier drain collection system. The purpose of the cap was to reduce infiltration of precipitation and losses of volatile organics. The thickness of the clay cap varies from 3 feet at its apex tapering to 1 foot on either side.

Figure 1.1 shows the layout of the Site, including the location of the barrier drain, the collection sumps and the LCLTF. Figure 1.2 is a generalized cross-section of the Love Canal, with the location of the wastes, the cap and the trench system shown.

1.3 MONITORING NETWORK

In order to monitor the effectiveness of the barrier drain system in preventing the spread of contaminants off-site, a network of piezometers and groundwater monitoring wells have been installed on the Site, along the perimeter of the Site and in the surrounding community. The piezometers are used to measure the level of the overburden groundwater to demonstrate that the barrier drains are creating an inward hydraulic gradient toward the drains. There are six series of piezometers at which groundwater levels are measured on a quarterly basis.

In order to measure and monitor groundwater chemistry at the Site, approximately 47 monitoring wells are sampled on an annual basis as part of the Long Term Monitoring Program (LTM).

Figure 1.3 shows the location of the piezometers and long-term monitoring program wells in relation to the barrier drain.

1.4 SITE GEOLOGY

1.4.1 Overburden

The overburden materials in the Love Canal vicinity can be classified, from bottom to top, as:

i) till unit;
ii) clay unit; and
ii) thin upper layer of fill and more permeable glacially-derived materials.

The total thickness of the overburden deposits is about 33 feet for the northern and central portions of the Love Canal property and 36 to 39 feet for the southern portion.

The glacial till in the vicinity of Love Canal varies from 0 to 23.8 feet in thickness. At the Canal itself, the till is roughly 14 feet thick in the north

decreasing to 4 or 5 feet around Read Avenue and then increasing to 18 feet for most of the area south of Wheatfield Avenue. The till generally consists of reddish brown, silty clay containing from 20 to 60 percent gravel and some cobbles.

The glaciolacustrine deposits overlying the till consist of 0 to 31 feet of silty clay. The upper 3 to 8 feet of the silty clay is mostly reddish-brown with dark greyish-brown, greyish-brown and yellowish-brown patches observed. Sandy clay zones were also encountered in the glaciolacustrine deposits.

Various layers of silty sand and clayey silt, as described in the previous section, overlie the silty clay and appear to be derived locally although construction debris and industrial wastes are also present. Industrial wastes encountered included coarse-grained carbon wastes. The thickness of the silty sand and clayey silt layer ranges from 0 to 20 feet but is generally about 5 feet. The variable composition at this upper most unit is due in part to the effect of the past activities of excavations and residential development in the Love Canal area.

1.4.2 Bedrock

Bedrock conditions beneath the Love Canal vicinity are typical of those found on a regional scale. The upper surface of the Lockport Formation is relatively smooth and slopes gently to the south. The bedrock surface elevation is about 540 feet above mean sea level beneath the northern and middle portions of the Canal property and 537 feet beneath the southern portion. The thickness of the Lockport in the Canal area is reported to range from 162 to 178 feet.

1.5 LOVE CANAL HYDROGEOLOGY

The hydrogeological regime at Love Canal has been subdivided into five different zones. From uppermost to lowermost, they are:

i)	Shallow System	-	fill, silty sand and clay loam
		-	seasonally saturated/unsaturated
ii)	Confining Material	-	clay and till overlying the Lockport Dolomite

iii)	Upper Lockport Dolomite	-	main aquifer located in upper 10-15 feet of formation
		-	horizontal bedding joints that are areally extensive
		-	significant vertical fracturing present
iv)	Lower Lockport Dolomite	-	lower part of formation (maximum 165 feet thick)
		-	bedding joints are the primary groundwater conveyance mechanism
v)	Rochester Shale	-	regional aquitard

1.5.1 Overburden

1.5.1.1 Overburden Properties

Hydraulic testing indicated that all zones of overburden materials have relatively low hydraulic conductivities ranging from 1×10^{-5} cm/s for the more permeable shallow system to on the order of 1×10^{-8} cm/s for the confining clay/till layer. The relatively impermeable deeper clay and till, in which fractures have not been noted, directly overlie the bedrock and serve to impede the vertical movement of groundwater between the overburden and Lockport Dolomite.

Overburden groundwater table elevations are generally in the range of 568 to 571 feet above mean sea level (AMSL). For comparison to the overburden groundwater levels, bedrock groundwater levels range from 560 to 565 feet AMSL. These groundwater levels suggest that a significant downward hydraulic gradient exists from the overburden to the bedrock. Figure 1.4 shows a typical overburden groundwater elevations at the Site.

1.5.2 Bedrock

1.5.2.1 Lockport Dolomite

The Lockport Dolomite is the only important aquifer within the Niagara Falls area with an average transmissivity on the order of 13.9 cm^2/s and a storage

coefficient of 0.00015. Within the Lockport, groundwater is present in bedding joints, vertical joints and solution cavities. Of these, bedding joints are the dominant mechanisms of groundwater flow. The nearly horizontal bedding joints, which follow the dip of the formation, are usually less than 1/8 inch in size although some have been enlarged by gypsum dissolution. The bedding joints are of much higher permeability than the surrounding bedrock. The bedding joints are fairly continuous in areal extent so that groundwater may flow over long distances within a single bedding joint. Groundwater levels within these joints were found to decrease with depth. Groundwater movement through vertically oriented joints is relatively significant in the top 10 to 15 feet of the formation. In this zone, weathering and dissolution has widened the joints and created a relatively good aquifer at the top of the dolomite. This upper zone is generally considered much more permeable than the remainder of the underlying bedrock.

Recharge due to precipitation reaches the Lockport throughout the region by migrating through the glaciolacustrine sediments and glacial till. Somewhat higher recharge rates are believed to occur along the Niagara Escarpment where overburden is thin or absent.

In general, groundwater flow in the Upper Lockport Dolomite is to the north or northwest away from the River. The Niagara River is a source of bedrock recharge.

2.0 MONITORING REQUIREMENTS

In order to document that the barrier drain system is functioning as designed, a hydraulic and chemical monitoring program have been established to measure and record overburden groundwater levels quarterly and to collect groundwater samples from the Site for laboratory analysis on an annual basis.

The hydraulic monitoring program consists of the quarterly measurement of water levels in 94 piezometers and 10 wells located in six nested piezometer strings and around the Site as shown on Figure 1.3 and listed on Table 2.1. Water level monitoring procedures are described in Section 6.3. As each of these alignments includes piezometers both within and outside the barrier drain, it is possible to determine the hydraulic gradient in relation to the barrier drain system and to establish whether this gradient is inward (toward the barrier drain) indicating that the system is functioning properly to prevent the outward flow of contaminants from the Site.

The chemical monitoring program consists of the collection of groundwater samples from 19 wells on an annual basis and an additional 28 wells which are monitored on a bi-annual basis. The 28 bi-annual wells are divided into two groups, with each group being sampled in alternating years (i.e. one group in years 1, 3, 5; the second group in years 2, 4, 6, etc.). Table 2.2 lists the monitoring wells to be sampled annually and the two groups of additional wells which are sampled bi-annually. Group I wells were sampled in 1995 along with the annual wells, and will next be sampled in 1997. The group II wells will be sampled in 1996, along with the annual wells. In addition, specific wells from the column titled "additional wells" on Table 2.2 may be selected for sampling pursuant to discussions held with the NYSDEC during the pre-sampling conference.

This chemical monitoring schedule is meant to be flexible, and may be altered by adding, deleting or substituting certain wells in any given sampling event. Alteration of the monitoring network may occur following review of previous analytical results; upon request of the NYSDEC or other regulatory agencies; or for other reasons to adequately monitor performance of the containment system. A pre-sampling conference with the NYSDEC is required prior to conducting the annual chemical

monitoring program, to determine which, if any, changes will be made to the program for that year.

3.0 INFORMATION ON WELLS

Figure 1.3 shows the location of all the piezometers included in the Hydraulic Monitoring Program and the groundwater monitoring wells included in the chemical monitoring program.

Information on construction of the wells included in the long-term monitoring program are presented in Table 3.1.

4.0 MONITORING SCHEDULE

The projected Long Term Monitoring Program Schedule for hydraulic and chemical monitoring through the end of 1997 is presented as Table 4.1. Simply, this consists of a round of groundwater level measurements in all piezometers listed on Table 2.1 during the months of January, April, July, and October each year and chemical monitoring beginning in early May and extending into early June each year.

5.0 PREPARATION FOR SAMPLING

Preparation for the yearly LTM Sampling Program should include the tasks detailed in the following sections.

5.1 AGENCY NOTIFICATIONS

The following agencies should be notified prior to conducting the sampling field work.

- New York State Department of Environmental Conservation.
  Mr. Benjamin Laredo
  50 Wolf Road, Albany, New York 12233-7010
  (518) 458-0927

  - Notify in writing at least 4 weeks prior to start date.
  - Arrange pre-sampling meeting to discuss proposed program.
  - Notification to be made by OxyChem on-Site personnel.

- Love Canal Area Revitalization Association (LCARA)
  9501 Colvin Blvd.
  Niagara Falls, New York
  (716) 283-9501

  - Notify LCARA by phone and in writing 1 to 2 weeks prior to start date.
  - Notify homeowner (as may be necessary depending on which off-site wells are to be sampled - Table 5.1 gives contacts for off-Site wells).
  - Notification is to inform of upcoming sampling in case LCARA receive calls regarding our activities.
  - Notification to be made by OxyChem on-Site personnel.

- New York State Department of Transportation
  Mr. Carl Kapperman
  500 West Avenue
  Lockport, New York
  (716) 434-1480

  • Notify in writing 4 weeks prior to sampling. Provide dates of sampling and identity of wells in LaSalle Expressway Right-of-Way (R.O.W.) to be sampled.

5.2 EQUIPMENT INVENTORY

Table 5.2 lists the equipment used for previous sampling events at this Site. Approximately 6 to 8 weeks prior to sampling, this equipment should be checked to assure availability and that the equipment is clean and operates properly. Any missing or broken equipment or accessories should be replaced or repaired.

5.3 SAMPLING SUPPLIES INVENTORY

Table 5.3 lists the sampling supplies which are expendable and/or disposable. Approximately 6 to 8 weeks prior to sampling, these supplies should be inventoried and adequate amounts ordered as necessary using the Passport System.

5.4 EQUIPMENT OPERATION

The basic operation of the sampling equipment at the Site is presented in the following subsections.

5.4.1 Peristaltic Pump

The peristaltic pump operates on the principle of suction to pump water from the well. The suction is produced using two rollers attached to arms

extending from a rotating shaft. These rollers squeeze a length of soft silicone tubing in a rotary motion which produces suction. This suction lifts the water out of the well through the food grade vinyl tubing and into the appropriate container (bucket, drum, or sample jar). The peristaltic pump at the Site operates on 110 volt AC power, necessitating use of a generator to power the pump. Advantages of the use of this pump are:

- removes high volume of water from shallow wells rather quickly
- easy to use
- portable

Limitations of use of this pump are:

- effective lift of 25± feet. If water levels are deeper than 25 feet below ground surface, the pump will not lift the water; and

- volatile organic compounds must not be sampled using a peristaltic pump because the agitation of the water by the pump during pumping causes the loss of volatile compounds.

Precautions to observe when using this equipment:

- danger of electrical shock from power source;

- drive belt and rollers in pump are pinch points. All power must be disconnected when changing silicone pump tubing; and

- pump discharges under moderate pressure. Contact with water from discharge should be avoided.

Required preparation activities prior to sampling or between wells should include the following:

- ensure generator has sufficient gas remaining to conduct purging/sampling. Have extra gas available;

- replace silicone tubing (length not to exceed 36-inches) within pump rotor. Ensure that an adequate total length of silicon tubing is available to complete all sampling (Note: Silicone tubing replacement not required if dedicated tubing is left in well);

- replace sample tubing. Ensure that an adequate total length of sample tubing is available to complete all purging sampling (Note: Sample tubing replacement not required if dedicated tubing is left in well).

The vendors information contained in Appendix A shows basic information on a similar type of pump.

5.4.2 Geoguard Airlift and Bladder Pumps

These pumps work on the principle of using high pressure air to displace water within the pump to remove the water from the well.

5.4.2.1 Airlift Pump

The Geoguard airlift pump is a stainless steel cylinder 1.5 inches in diameter and either 3 or 6 feet in length (two 3 foot segments can be joined together). The bottom end is a check (ball) valve which permits water to enter the pump and the top is a fitting to accept the well-dedicated coaxial tubing used on-Site (coaxial tubing has the air supply line contained inside the larger diameter water discharge line). The pump is lowered into the well on the end of the dedicated tubing and the air line is connected to a control box which controls the cycle time for the pump. The control box is then connected to a compressor. A solenoid in the control box opens a valve to permit air to flow to the pump, the pressure of the air closes the check valve at the bottom of the pump and displaces the water in the pump. A solenoid on the control box then activates a valve to block air from the pump thereby allowing the pump to re-fill with water. Air is then applied to the pump and the cycle is repeated. The length of the refill and discharge cycles can be manually varied to obtain the optimal pumping rates. The vendors data in Appendix A shows a schematic diagram of an airlift pump.

Advantages of an airlift pump are:

- pumps from a greater depth than a peristaltic pump; and
- can remove water at a moderate rate of flow.

Disadvantages/limitations of using the airlift are:

- pump is not dedicated, necessitating decontamination between wells, therefore increasing possibility of cross-contamination of samples;
- fairly difficult to set up, install and use;
- cannot sample for volatile organics using this pump due to air/water mixing; and
- requires 1 PSI of compressed air per 2 feet of lift.

Precautions to observe when using an airlift pump:

- pump use requires a high pressure air supply;
- moving parts on compressor;
- the compressor(s) are gasoline powered. Be careful when refueling hot engines. Gasoline is flammable;
- be sure compressor engine is located down-wind of the well being sampled to avoid contamination by the compressor exhaust;
- equipment is bulky/heavy. Use proper lifting techniques.

Required preparation activities prior to commencing sampling and/or between wells should include the following:

- decontaminate pump;

- replace sample tubing and air supply line. Ensure that an adequate total length is available to complete all purging/sampling (Note: replacement not required if dedicated tubing is left in well); and

- check to see if compressor is in good working condition. Have repairs made as required. Ensure compressor is full of gasoline prior to purging and that additional gasoline is available on Site.

5.4.2.2 Bladder Pump

The Geoguard bladder pump operates very much like the airlift pump except that an internal teflon bladder is used to provide a barrier between the air and the water, so that no mixing occurs within the pump. Because no air/water mixing occurs, volatile organic compounds can be sampled using this type of pump. The internal teflon bladder can be replaced in the field.

The pumping rate of a bladder pump is slightly less than from an airlift pump.

Required preparation activities prior to commencing sampling and/or between wells should include the following:

- decontaminate pump. Replace internal bladder or decontaminate existing bladder and associated clamps, o-rings, etc.;

- replace sample tubing and air supply line. Ensure that an adequate total length of both is available to complete all purging/sampling (Note: replacement not required if dedicated tubing is left in well); and

- check to see if compressor is in good working condition. Have repairs made as required. Ensure compressor is full of gasoline prior to purging and that additional gasoline is available on Site.

The vendors information in Appendix A shows a schematic diagram of the Geoguard bladder pump.

5.5 METER CALIBRATION

During field activities, several different meters are used to obtain measurements of the groundwater (pH, temperature, conductivity, turbidity) and the

headspace (air above groundwater in the well for presence of VOCs) of the well. This section provides information on the calibration of these meters to assure accurate and reliable readings are obtained.

5.5.1 General

Each meter to be used should be calibrated to the appropriate calibration reference standard(s) prior to use. Be sure reference standards are fresh and have not been contaminated.

5.5.2 pH Calibration

The pH meter takes a measurement of the available hydrogen ions of a solution. The meter reads on a scale of 0 to 14 with 0 being a very strong acid and 14 being a very strong base. A pH of 7 is neutral. The calibration of this meter is affected by the temperature and age of the reference solution(s). FP 3, contained in Appendix D, presents the procedures for calibration of the Orion pH meter used at the Site.

5.5.3 Specific Conductivity Meter Calibration

The specific conductivity meter measures the conductivity of a liquid, which gives an indication of the presence of dissolved ions in solution. The Myron L meter at the Site reads on four scales, 0 to 10 micromhos, 0 to 100 micromhos, 0 to 1000 micromhos and 0 to 10,000 micromhos. A one-point calibration is required for this meter with a 0 point check. FP 4, contained in Appendix D, describes the procedure to be used to calibrate this meter.

5.5.4 Temperature Calibration

A thermometer measures the temperature of a liquid and is used as an indicator of purging stability. Calibration of the thermometer may or may not be necessary. Manufacturers information should be consulted (Appendix A) prior to use.

5.5.5 Turbidimeter Calibration

The turbidimeter measures the turbidity (cloudiness) of an aqueous solution. Measurement is made in nephelometric turbidity units (NTU), with a higher reading denoting a cloudier sample, which can affect certain volatile organic and metals analyses. A 0.02 NTU reference standard is supplied with the meter and frequent calibration of the meter is recommended. FP 5, contained in Appendix D, presents the procedure for calibration of the turbidimeter used at the Site.

5.5.6 Photoionization Detector Meter Calibration

The HNU photoionization detector measures the concentration of ionizable gases having a ionization potential equal to or less than the electron voltage of the ultraviolet light source in the detector. The concentration of these gases is an indication of the presence of volatile chemicals in the air. The meter at the Site uses a 10.2 ev probe.

FP 8, contained in Appendix D, presents the procedure used to calibrate an HNU photoionization detector.

5.6 CLEANING REQUIREMENTS

Any equipment which is not dedicated for use in a specific well must be cleaned before being used and between uses. The cleaning procedure at the Site consists of:

- a wash with a bio-degradable non-phosphate soap;
- a tap water rinse;
- a deionized water rinse; and
- allow equipment to air-dry; and wrap in aluminum foil or plastic to avoid contamination of the equipment.

FP 7 contained in Appendix D more fully describes the cleaning protocols for the Site.

5.7 VENDORS DATA/INSTRUCTION OR USE MANUALS

Vendors data for some of the equipment used at the Site is contained in Appendix A of this manual. Other vendors data and/or user manuals are also available on-site, for a majority of the newer equipment.

5.8 PURCHASE ORDERS

Occidental Chemical Corporation (OxyChem) utilizes an On-Line Purchase Order system (P.O.) in Passport. A PO must be obtained prior to purchasing equipment or supplies. The request for a PO must be initiated through the Passport System. The manuals for use of this system are available at the Site and thus, are not reproduced in this document. A copy of the computer screen print of the purchase order requisition is included as Figure 5.1.

6.0 SAMPLING PROCEDURES

The proper collection of water levels and groundwater samples requires that a consistent set of procedures be followed for every well every time water levels and/or groundwater samples are obtained. Following these procedures will result in the collection of good quality data which is representative of conditions at the Site.

6.1 GENERAL PROCEDURES

Certain activities can adversely affect sample quality, therefore, it is imperative that these activities not be done while sampling.

i) Do not smoke.

ii) Do not use bug repellents.

iii) Do not use wasp/hornet spray near a well.

iv) Do not use aftershaves, cologne or astringents (e.g. alum).

v) Be aware of wind direction. Do not run vehicle or small engines upwind of a well being sampled.

vi) Be cognizant of traffic fumes and nearby activities. Suspend sampling if fumes are strong. Make a notation of any such observations on the Groundwater Purge/Sample Record Log shown on Figure 6.1.

vii) Be cognizant that the NYSDOT uses herbicides near the wells on the LaSalle Expressway. Suspend sampling if such activities are observed and make note of type of applications by NYSDOT in the Sampling Record Log.

viii) Do not handle or pour gasoline or fuel oils near a well being sampled.

6.2 GENERAL HEALTH AND SAFETY

During collection of groundwater samples the following health and safety rules should be applied:

i) Hardhat, safety glasses, long sleeve shirts, full length pants, industrial quality work boots are the minimum required personal safety equipment.

ii) Do not eat, drink or smoke.

iii) Be aware of potential slip, trip and fall hazards and uneven terrain.

iv) Be aware of the hazards of working with portable machinery, electrically operated equipment, gasoline powered equipment and high pressure air.

v) Some heavy lifting is required - use proper lifting techniques.

vi) Some sampling takes place along a high speed expressway. Be aware of moving vehicles.

vii) Groundwater removed during sampling activities should be considered contaminated and handled accordingly.

viii) Use caution when opening protective covers on wells - wasps, hornets or bees may be present.

ix) Headspace readings taken at the well with a photoionization detector may dictate the need for full-face respiratory protection. If elevated readings are noted (i.e., above background) the breathing zone is to be monitored. The required personal protective equipment for various levels of elevated readings (which are an indication of elevated volatile organic chemical presence) is as follows:

HNu Reading Above Background (ppm)	*Required PPE **
0 - 1	No protection required
1 - 5	Don air purifying respirator (full or half face)
>5	Level B required (full air)

Note: * equipment required in addition to 1) above.

6.3 WATER LEVEL MEASUREMENT

Once each quarter, a set of water levels are measured in the six strings of nested piezometers at the Site.

Prior to the yearly sampling event, a single round of Site water levels should be taken in all wells included in the long-term monitoring program. Taking these water levels provides the following:

i) more accurate data for area groundwater table maps;

ii) an opportunity for the sampling team to become oriented to the Site;

iii) supplies data about unusual circumstances such as wells that might be damaged, dry, inaccessible; and

iv) an opportunity to inventory well condition and to perform minor maintenance such as lubricating locks and hinges, replacing lost or faded well tags, etc. A check-off list to be used during well inventory inspections is provided as Figure 6.2.

An electric water level tape will be used for water level measurements in the piezometers and/or wells on-site. FP 1 describes the water level measurement procedures in detail. Water level measurements shall be recorded in a bound field log book with date and time indicated.

6.4 WELL PURGING

Prior to sampling each well, the standing water in the well casing and the water surrounding the well screen will be purged so that representative formation water may be sampled. FP 2 describes the purging procedures in detail.

The volume of water in the well will be calculated by subtracting the depth to water from the total depth of the well. This value (the water column length) will then be multiplied by a coefficient which relates the diameter of the well to gallons per linear foot:

- multiply by 0.163 for a 2-inch diameter well;
- multiply by 0.367 for a 3-inch diameter well;
- multiply by 0.653 for a 4-inch diameter well; and
- multiply by 1.47 for a 6-inch diameter well.

Purging may be conducted by several methods including a peristaltic pump, an air lift pump, a bladder pump, or hand bailing. Non-dedicated equipment must be decontaminated between wells as described in FP 7.

Two criteria will be used to determine if a sufficient volume of groundwater has been purged from the well to yield a representative sample.

These criteria are:

i) the removal of three to five standing well volumes; or
ii) if a well goes dry, purge one time to dryness.

Unless a well goes dry during purging, a minimum of three well volumes will be removed from each well prior to sampling. During purging, field parameters (pH, specific conductance, temperature, and turbidity) will be measured and recorded. One set of readings will be taken at the start of purging and an additional set will be taken after removal of each standing well volume. If the field parameters

stabilize, (pH varies by less than 0.5 pH units; specific conductance varies by less than 10 percent; and temperature varies by less than 1° Celsius for two successive measurements) and remain stable, purging can stop when three well volumes are removed. If the field parameters do not stabilize - purging will continue until a maximum of five well volumes have been removed. Sampling will then take place, even if the field parameters have not stabilized. The meters for measuring the field parameters shall be calibrated each morning and the calibration checked at the end of the day using the procedures provided in FPs 3, 4, 5, and 8. Recalibration of the meters should be done whenever necessary.

If a well is pumped dry, the well will be allowed to recover a sufficient volume to collect the required samples. The water level measurement tape should be used to verify the well has gone dry, especially when using a peristaltic pump which has a limited pumping depth. If the well has not gone dry, troubleshoot the pump or switch purging methods.

6.5 SAMPLE COLLECTION

After completion of well purging, groundwater samples will be collected. Analytical requirements, sample containers, and laboratory arrangements are discussed in Section 7.0.

All samples should be collected using disposable bailers except at Well 10210A, where a dedicated bladder pump allows for sampling with the bladder pump.

Procedures detailing the collection of groundwater samples are presented in FP 6.

Where a well will not yield the volume of water necessary to immediately fill all required sample containers, as many of the containers as possible will be filled, with the remainder filled as water comes into the well. Samples for Volatile Organic Compounds are to be collected within two hours of completion of well purging.

Sampling of wells on the expressway during "rush hour" should be avoided due to possible effects of vehicle exhaust. Also, if possible sampling in the rain should be avoided due to potential for cross contamination from airborne contaminants picked up by the precipitation. Clean wells should be sampled first to prevent potential cross-contamination. Thus, previous analytical results need to be reviewed to determine the order in which wells will be sampled. Previous reports which contain prior analytical sample data should be kept on Site for reference.

6.6 SAMPLE HANDLING AND SAMPLING DOCUMENTATION

The information presented in the following sections describes the proper documentation of field activities, sample storage, sample handling and chain of custody procedures to be used during the annual groundwater monitoring program.

6.6.1 SAMPLING DOCUMENTATION

Documentation is a critical part of sampling. The validity of samples collected in the field can only be proven through the exhaustive use of field written activity records. Field conditions, collection and handling of samples, as well as information about each sample collected will be recorded and stored on a standardized form or in a designated project field notebook. Some information is recorded in the field directly on a standardized form (e.g., Groundwater Field Sample Purge Record form or chain of custody data), and some is recorded and remains in the field notebook (i.e. weather conditions, description of site activities). This type of documentation along with chain of custody documentation provides a permanent record of all significant activities during a field investigation. All notebooks and logs should be completed using waterproof pens to prevent smudging if the notes get wet in the field. Once complete, the notebooks, standardized forms, and logs should be signed and dated on the bottom of each page.

6.6.1.1 Field Notebook

Bound notebooks will be used by the field team for recording all daily logs, sampling events and field observations. Entries in the logbook shall be dated and signed on each page by the person making the entry. The logbook will be kept in a secure dry place. Entries must not be made in water-soluble ink. The type of information to be included in the log is:

i) date;
ii) time;
iii) location;
iv) weather;
v) sample crew;
vi) work progress;
vii) control samples;
viii) delays;
ix) unusual situations;
x) well damage;
xi) departure from established QA/QC field procedures;
xii) instrument problems; and
xiii) accidents.

Additional data may be required in the field logbook, specifics of which are described in the in FPs. Any corrections made to the original entries will be initialed by the observer. Any incorrect entries will be crossed out with a single line using black, permanent ink, and initialed by the observer.

6.6.1.2 Sample Collection Logs

The sampling team shall maintain all sampling logs which record information about each sample collected. The logs will be completed at the time of sampling and will provide documentation to indicate that sampling requirements have been met. In addition to project information and well evacuation data, the following information is also included on the sampling log:

i) physical appearance of samples;
ii) field observations;
iii) results of field analyses;
iv) sampling methods and materials;
v) constituents sampled;
vi) split sample and QA/QC sample information; and
vii) sampling personnel.

An example of the Groundwater Purge/Sample Record Log is shown on Figure 6.1.

6.6.1.3 Instrument Calibration and Use Logs

Standardized Instrument Calibration Logs for each field instrumentation will be maintained during all sampling activities to demonstrate properly functioning equipment. Included in the log should be documentation of time of instrument use, operator and any maintenance performed. Logs for the PID will also include daily calibration, type of calibration gas, warm-up time, and lamp type (10.2 eV UV). This information can be entered into the bound field log book rather than keeping a separate log book.

6.7 SAMPLE CONTAINERS

All samples sent to the laboratory for chemical analyses will be placed in new containers provided by the analytical laboratory. These bottles will be shipped by overnight courier in clean insulated coolers equipped with bottle custody forms. Packing materials will be used to prevent bottle breakage. The samples will be shipped using ice to maintain a temperature of 4 °C within the cooler. Questions regarding sample containers should be directed to Mr. Mike Kargatis (716-286-3448) of OxyChem's Corporate Analytical Staff.

6.8 SAMPLE IDENTIFICATION

Sample labels are necessary to identify and prevent misidentification of the samples. The labels shall be affixed to the sample container (not the caps) prior to the time of sampling. The labels shall be filled out in waterproof ink at the time of collection. The labels will include the following information:

i) sample number/identification code;
ii) name/initials of collector;
iii) date and time of collection;
iv) Site name;
v) project number;
vi) required analysis; and
vii) type of preservation.

A unique sample numbering system will be used to identify each sample collected. An example of a sample identification number is:

A-4341-KPL-01/19/96-001 where;

i) A is the series which designates a group of samples. This might include sample round, or might designate sample type [i.e., groundwater (GW) or soil (S)]. Series is optional;

ii) 4341 is the job number which together with the series allows easier tracking of samples;

iii) KPL is the sampler's initials which identify the sampler and thus allows project personnel to contact the correct person for information regarding that sample and its collection;

iv) 01/19/96 is the sample date which allows monitoring of actual holding time of samples; and

v) 001 is the sample identification designation which identifies the sample location and can be of any numerical or other designation.

It is imperative that a sample key which matches the sample identification designation with the sample location be maintained. This ensures that samples are submitted "blind" to the laboratory (i.e., laboratory does not know sample location) and thus prevents rigged sample results.

6.9 SAMPLE CUSTODY

Sample custody procedures are designed to provide documentation of preparation, handling, storage and shipping of collected samples. In order to maintain the integrity of samples, chain of custody procedures will be followed. The chain of custody procedures are designed to ensure that:

i) the samples are not tampered with;
ii) all persons handling the samples can be traced; and
iii) all persons handling the samples are accountable.

An example of the Chain-of-Custody form, which will be used is shown in Figure 6.3. **(Need OxyChem Chain-of-Custody)**

Samples collected will be the responsibility of identified persons from the time they are collected until they, or their derived data, are incorporated into the final report. Stringent chain-of-custody procedures will be followed to maintain and document sample possession.

6.9.1 Field Custody

The Field Personnel are responsible for the care and custody of the samples collected until they are personally delivered to the analytical laboratory or entrusted to a carrier. Immediately upon collection, the sample will be placed in the laboratory-supplied insulated cooler and chilled with ice to maintain 4°C within the

cooler. Packing materials will be used to prevent bottle breakage. Samples which are not shipped to the laboratory on the same day they are collected will be transferred to the on-Site refrigerator at the end of the day's sampling. The interior of the refrigerator will be maintained at 4°C.

Chain-of-custody forms will be completed to the fullest extent possible prior to sample shipment. These forms will include the following information:

i) sample number;
ii) time collected;
iii) date collected;
iv) sample matrix;
v) number of containers;
vi) parameters to be tested;
vii) preservative; and
viii) name of sampler.

These forms will be filled out in a legible manner, using waterproof ink, and will be signed by the sampler. Similar information will be provided on the sample label, which is securely attached to the sample bottle. In addition, sampling forms will be used to document collection, filtration, and preparation procedures.

6.9.2 Transfer of Custody and Shipment

The following procedures will be used when transferring custody of samples:

i) samples will always be accompanied by a chain of custody record. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the laboratory, Upon arrival at the laboratory, internal custody procedures will be followed;

ii) samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate custody record accompanying each shipment. Shipping containers will be sealed for shipment to the laboratory. At least one copy of the chain of custody should be sealed within the shipping container. One copy should be retained at the Site and a photocopy should be transmitted to the OxyChem Corporate Analytical Staff contact (Mr. Mike Kargatis, phone number 716-286-3448) by the next working day. The method of shipment, courier name, and other pertinent information will be entered in the remarks section of the custody record;

iii) all shipments will be accompanied by the chain of custody record, which identifies the contents of the containers. The original record will accompany the shipment and a copy will be retained by the field sampler; and

iv) proper documentation will be maintained for shipments by common carrier. (i.e. waybills or bills of lading). (Note: Most common carriers, i.e., Fedex or UPS) will <u>not</u> sign chain of custody records).

6.9.3 <u>Sample Shipment Procedures</u>

The following procedures will be followed when shipping samples for laboratory analysis:

i) samples requiring refrigeration will be promptly chilled with ice or "Blue Ice" to a temperature of 4 °C (±2°C) and packaged (with bubble wrap to prevent bottle breakage) in an insulated cooler for transport to the analytical laboratory;

ii) only shipping containers which meet all applicable State and Federal standards for safe shipment will be used;

iii) the shipping containers will be sealed with tape and chain of custody seal. Tape is wrapped around the cooler in two locations (across hinges) and custody seal placed across cooler opening. This allows the receiver to quickly identify any tampering which may have taken place during transport to the laboratory;

iv) a copy of the field chain of custody document will be placed inside the shipping container in a sealed plastic envelop; and

v) shipment of all analytical samples will be by overnight courier. Samples are to be shipped to the laboratory within 48 hours of collection.

6.10 DECONTAMINATION PROCEDURES

Decontamination of non-dedicated sampling equipment at the Site is critical to avoid cross-contamination when this equipment is used at multiple locations at the same or different well locations. All equipment is to be cleaned prior to use in a well and after having been used in any other well.

FP 7 presents general decontamination procedures at the Site. As no solvents are used, decontamination fluids can be collected and disposed to the LCLTF system.

As described in Section 7.2.4, rinse blanks will be collected from cleaned sampling equipment to validate the effectiveness of the decontamination of that equipment.

6.11 WASTE MATERIAL HANDLING

6.11.1 Decontamination Fluids Disposal

The waste liquids generated from the cleaning of non-dedicated sampling equipment can be disposed to the LCLTF for treatment. Washwater should be collected into a 5-gallon pail while in the field or can be placed into the overpack drums used to contain groundwater from purging and sampling activities.

6.11.2 Groundwater Disposal

All groundwater generated from purging and sampling activities will be discharged to the LCLTF for treatment.

Discharge to the LCLTF will take place by pouring or pumping the water into the eastern diked area adjacent to the LCLTF. This diked area pumps to the underground storage tanks for storage prior to treatment. The location of the discharge point is shown on Figure 1.1.

6.11.3 Solid Waste

Solid waste generated during water level monitoring and groundwater sample collection activities will be placed in plastic garbage bags and stored in the Love Canal Drum Storage Facility pending final disposal.

7.0 ANALYTICAL REQUIREMENTS

Analytical requirements for the LTM program consist of analyses of Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Base, Neutral and Acid extractable (BNA) semi-volatile compounds (SVOCs), TCL organochloride Pesticides, and Polychlorinated Biphenyls (PCBs).

Table 7.1 lists the individual analytes to be tested during the LTM program.

7.1 LABORATORY METHODS AND LEVEL OF REPORTING

7.1.1 Analytical Methods

TCL VOCs are to be analyzed by Gas Chromatography/Mass Spectrophotometry (GC/MS) using EPA Method 8240.

TCL BNAs are to be extracted and analyzed using EPA Method 8270.

TCL Organochlorine Pesticides and PCBs are to be extracted and analyzed using EPA Method 8080.

7.2 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control (QA/QC) samples to be submitted during the LTM program include the following:

7.2.1 Field Duplicate Samples

A duplicate investigative sample will be collected in the field. This sample will be assigned a separate number. Field duplicate samples are to be

collected at a frequency of one for each ten investigative samples submitted for analyses. Field duplicates will be submitted "Blind" to the laboratory. Field duplicate samples are used to assess field sampling and laboratory analytical repeatability.

7.2.2 Matrix Spike/Matrix Spike Duplicate Samples

Matrix Spike/Matrix Spike Duplicate Samples (MS/MSD) require extra volume to be collected and submitted with an investigative sample to allow the laboratory to perform internal QA/QC testing of method precision and accuracy. MS/MSD samples are to be submitted at a frequency of 1 per 20 samples or one per week, whichever is more frequent.

7.2.3 Deionized Water Blank

One sample of the deionized water from the on-site deionizer will be submitted to test for the presence of trace contaminants in this water. This sample will be collected by filling a set of sample containers directly from the deionizer.

7.2.4 Rinse Blanks

Rinse blanks from an item of cleaned, non-dedicated sampling equipment will be collected to analyze for trace contaminants which may be attributable to these materials. These samples are to be collected by rinsing the equipment with deionized water from the on-site deionizer and collecting the rinse water into a set of sample containers. Rinse blanks will be analyzed for the same parameters as the investigative samples.

7.2.5 Trip Blanks

Trip blank samples consisting of analyte-free water will be submitted to the laboratory for VOC analyses at a frequency of one per each sample

shipment container containing aqueous VOC samples. Trip blanks will be provided by the analytical contractor.

Trip blank samples (analyzed for VOCs only) will be shipped by the laboratory to the Site and back to the laboratory without being opened in the field. Trip blank analyses will provide a measure of potential cross-contamination of samples during shipment, handling, and from ambient conditions at the Site.

7.3 CONTRACT LABORATORY

The analytical laboratory which will be providing contract analytical services for analysis of the LTM program samples shall be an independent commercial laboratory which has current New York State Department of Health Certification to perform environmental analyses for the parameters defined in Section 7.1 of this report.

Analytical arrangements will be made by the OxyChem Corporate Analytical Staff, (Mr. Mike Kargatis, phone number 716-286-3448).

7.4 BOTTLES, SAMPLE PRESERVATION AND HOLDING TIMES

Table 7.2 presents the required sample containers, preservation and holding times which will be required for the LTM program.

Samples should generally be collected and containerized in the order of the following volatilization sensitivity:

- Volatile Organic Compounds (VOCs);
- Semi-volatile Organic Compounds (SVOCs);
- Total organic carbon;
- Total organic halogens;
- Extractable organics;
- Total metals;

- Dissolved metals;
- Phenols;
- Cyanide;
- Sulfate and chloride;
- Nitrate and ammonia, and
- Radionuclides.

Note that not all of the parameters listed above are necessarily included in the sample sets for Love Canal. The complete list is provided for potential future use only.

8.0 INTERPRETING RESULTS

The analytical results obtained from the laboratory will be used as a determination of whether changes in groundwater chemistry over time are occurring. All analytical results will be subjected to quality assurance/quality control to assess the validity of the data. The validated analytical results, provided by Mike Kargatis, will be compared to historical analytical information for the evaluation.

As a majority of the LTM wells are placed outside the known limits of contamination, the organic chemistry from these wells should be non-detectable at the method detection limits. MW-10135 is located within a known contaminated area and serves as a "Worst Case" well.

9.0 REPORTING

An annual report covering the activities of the previous calendar year (January 1 to December 31) will be prepared for submittal to the NYSDEC in Albany, New York.

This report is to be submitted on February 28 of the following year.

The report should include the following information:

i) a discussion of the major activities occurring at the Site during the reporting period;

ii) a summary of the operation of the barrier drain and treatment system, including monthly average flows and any major problems, equipment repairs, and/or changes in the operation of the system;

iii) a summary of the findings of the four rounds of water level measurements, including hydrographs demonstrating hydraulic gradients;

iv) a summary of the groundwater sampling program, including a listing of the wells sampled, a discussion of the analytical results, and a comparison of the analytical results to historical site chemistry;

v) tables listing the water level measurements, the analytical results by well, and the monthly treatment plant flows;

vi) a conclusion regarding the overall effectiveness of the remedial systems at the Site; and

vii) a certification by a representative of OxyChem.

10.0 REQUIRED DATES FOR SUBMISSION OF DATA

The annual report is to be submitted by February 28 following the reporting period.

The quarterly hydrographs and water level results are to be reported as part of the annual report or within one month of the date the readings were taken.

11.0 TROUBLESHOOTING

Troubleshooting is described in the Manufacturer's literature provided in Appendix A. Additional information may be found in specific equipment manuals at the Site or by contacting the equipment manufacturer's customer service department.

12.0 LTM PROGRAM TRAINING

OxyChem personnel involved with the Love Canal LTM Program will undergo the following training specific to the Site:

i) review of this sampling manual and the FPs provided. (Annually before the sampling program);
ii) six weeks (one sampling round) under the supervision of an experienced field technician. (One time);
iii) one round of water levels in the on-Site piezometer strings under the supervision of an experienced field technician. (One time);
iv) successfully pass the written exam supplied for this sampling manual (20 of 25 questions correct). (One time); and
v) sign certification page (Appendix F) which states all trainees have read and understand manual and attended training sessions.

The written exam and exam answers are included in Appendix F.

Additional training for specific OxyChem procedures will be given as required. This may include:

i) specific safety SOP training;
ii) annual OSHA training;
iii) OxyChem Passport System training; and
iv) Site-Specific FP training.

13.0 AUDIT CHECKLIST

During some of the on-Site LTM activities, an unannounced field audit will be conducted to determine whether proper procedures are being followed during these activities.

Some items to be evaluated during the audit are:

- Have proper notifications been made?
- Is the sampling manual and the site health and safety plan available at the Site?
- Are workers familiar with program requirements, procedures, and goals?
- Are samples being handled in a proper manner (i.e., placed immediately on ice; VOC samples filled without air; correct number of containers being filled at each location?
- Are samples are properly stored and packed for shipping)?
- Are Chain of Custodies being properly completed?
- Are custody seals being used during shipping?
- Is the bound field log book being kept up to date?
- Are instruments being calibrated property and are records being kept of calibration data?
- Is non-dedicated sampling equipment being used? If so, are proper cleaning procedures being followed? Are rinse blanks being taken?
- Is sampling progress being tracked to a sampling schedule made out or posted as available?

During Water Level Measurements

- What type of equipment is being used?
- If non-dedicated, is this equipment being cleaned between wells:
- Are measurements being made to the nearest 0.01 foot?
- Are location, measurement, time and date being noted on the field sheet?
- Are proper health and safety procedures being employed?
- Are vinyl latex gloves being worn for water levels? Are they being changed between wells?
- Are wells locked and/or otherwise secured?
- Are measurement points and identification marks affixed to wells?

FIGURES

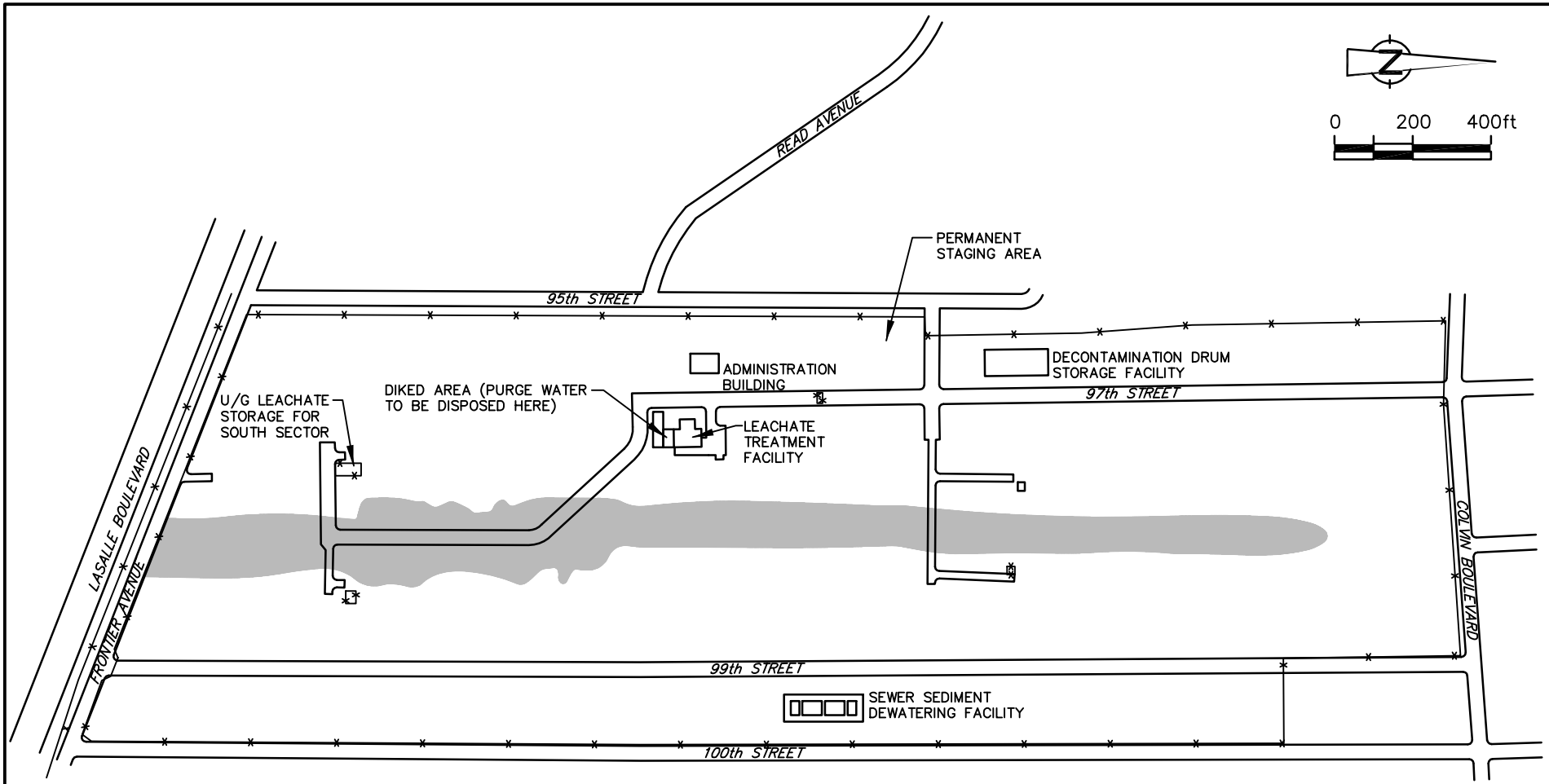


figure 1.1

SITE PLAN
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

CRA

4341 (13) DEC 13/95(W) REV.0 (P–43)

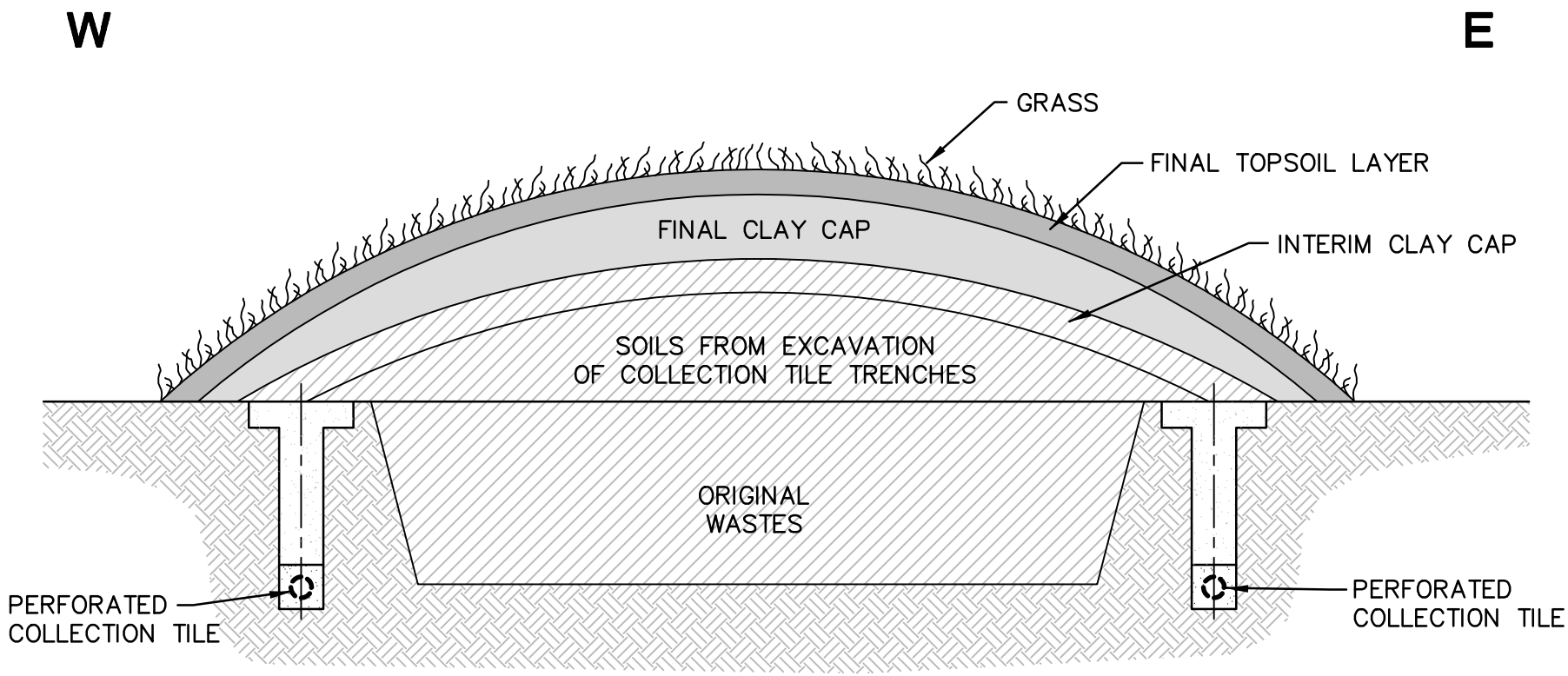
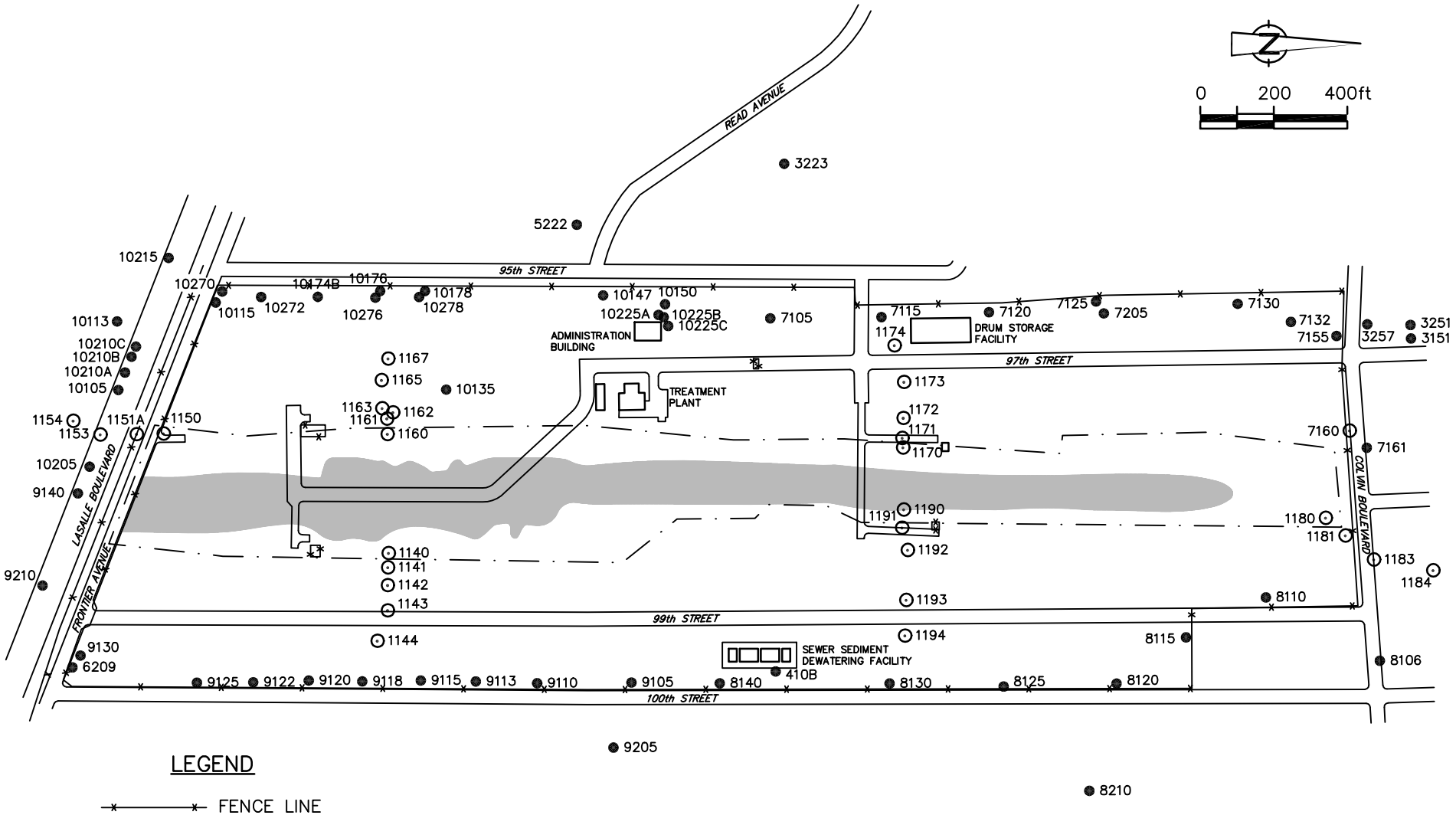


figure 1.2

GENERALIZED CROSS–SECTION
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

CRA

4341 (13) DEC 13/95(W) REV.0 (P–44)



LEGEND

- FENCE LINE
- BARRIER DRAIN
- 7105 PIEZOMETER WELL
- 1167 OBSERVATION WELL
- APPROXIMATE LIMITS OF DISPOSED WASTE

CRA

figure 1.3

BARRIER DRAIN, WELL AND PIEZOMETER LOCATIONS LOVE CANAL LONG–TERM MONITORING PROGRAM

Occidental Chemical Corporation

4341 (13) DEC 13/95(W) REV.0 (P–45)

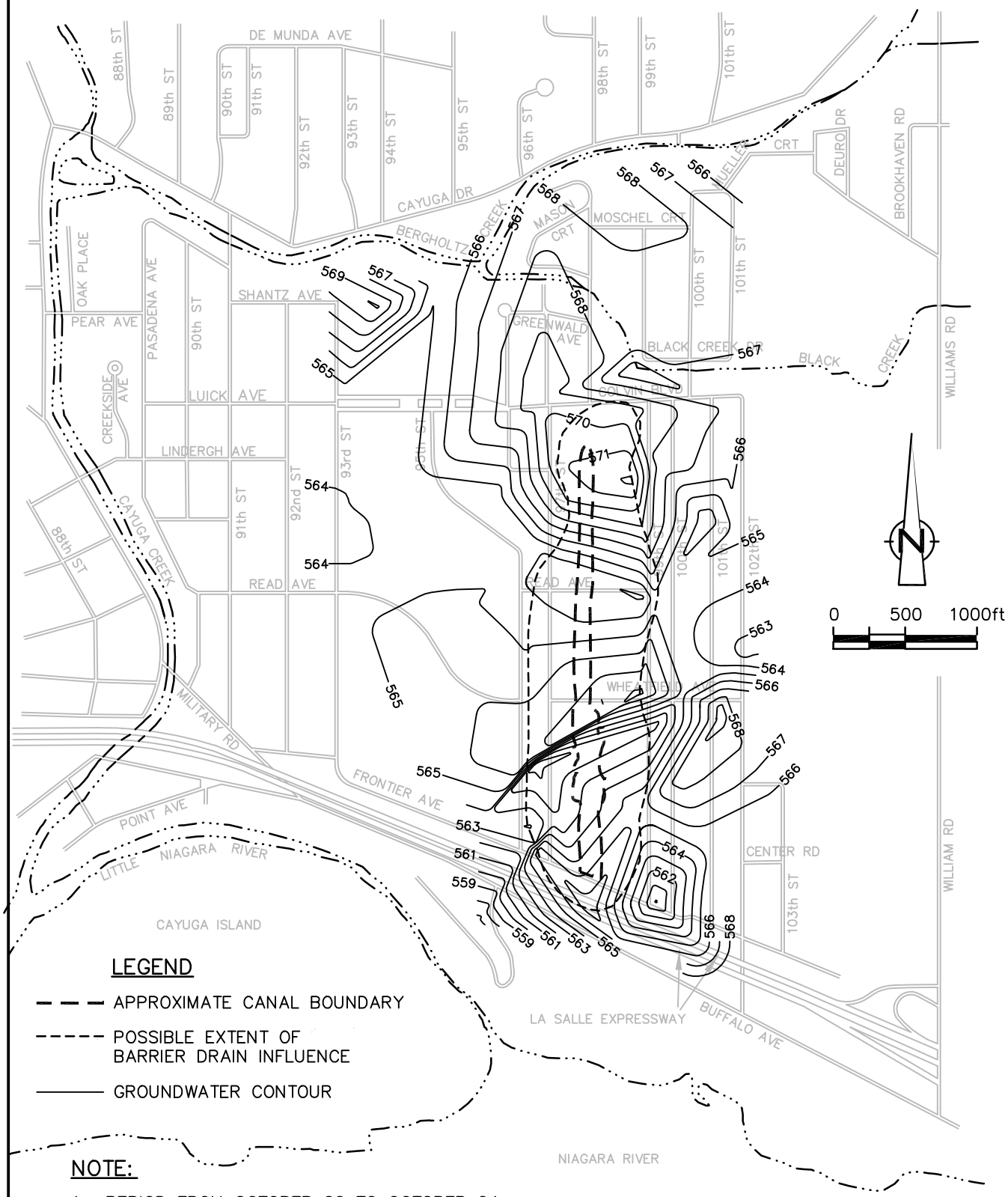


figure 1.4

TYPICAL OVERBURDEN GROUNDWATER CONTOURS
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

CRA

4341 (13) DEC 13/95(W) REV.0 (P–42)

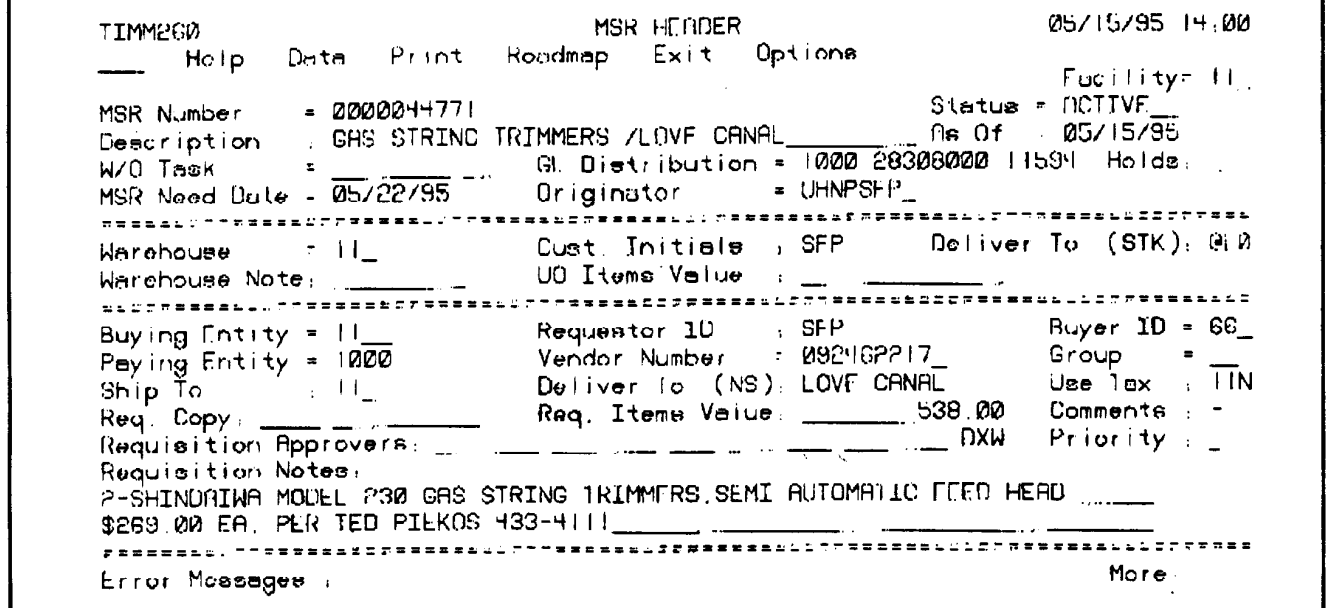


figure 5.1

SAMPLE PURCHASE ORDER REQUISITION
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

OCCIDENTAL CHEMICAL CORPORATION

GROUNDWATER FIELD SAMPLE/PURGE RECORD

STATION # _____ DATE: _____

WEATHER NOTES: _____

VOC LEVEL: AMBIENT _____ HEADSPACE _____

WELL DEPTH: _____ FT. WATER DEPTH: TOW _____ FT.

WELL VOLUME: _____ GAL. TOTAL VOLUME PURGED _____ GAL.

SAMPLE PURGE DATA:

@INITIAL _____ GAL.	@ _____ GAL.	@ _____ GAL.
TEMP. _____ DEG.F.	TEMP. _____ DEG.F.	TEMP. _____ DEG.F.
SPCON _____ MOHS	SPCON _____ MOHS	SPCON _____ MOHS
TURBID. _____ NTU'S	TURBID. _____ NTU'S	TURBID. _____ NTU'S
pH _____	pH _____	pH _____
TIME _____	TIME _____	TIME _____
HR/MIN _____	HR/MIN _____	HR/MIN _____
PURGE	PURGE	PURGE
VOL. _____ GALS.	VOL. _____ GALS.	VOL. _____ GALS.
@ _____ GAL.	@ _____ GAL.	@ _____ GAL.
TEMP. _____ DEG.F.	TEMP. _____ DEG.F.	TEMP. _____ DEG.F.
SPCON _____ MOHS	SPCON _____ MOHS	SPCON _____ MOHS
TURBID. _____ NTU'S	TURBID. _____ NTU'S	TURBID. _____ NTU'S
pH _____	pH _____	pH _____
TIME _____	TIME _____	TIME _____
HR/MIN _____	HR/MIN _____	HR/MIN _____
PURGE	PURGE	PURGE
VOL. _____ GALS.	VOL. _____ GALS.	VOL. _____ GALS.

REMARKS/OBSERVATIONS _____

_____

_____

_____

_____

_____

_____

TIME SAMPLED: _____ DATE: _____

QA/QC Y/N MS? MSD? FIELD BLANK? _____

DEC SPLIT Y/N VOA'S. BNA'S, PESTICIDES/PCB'S

PURGING CREW _____

SAMPLING CREW _____

figure 6.1

SAMPLE COLLECTION LOG FORM
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

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INSPECTION CREW MEMBERS: _____ SUPERVISOR: _____

DATE OF INSPECTION | | | | | | | | (MM DD YY)

Well I.D. Number	*Lock*	*Surface Seal*	*Protective Casing*	*Riser*	*Water Level (ft. BTOC)*	*Well Depth (ft. BTOC)*	*Other Comments*

Additional Comments: _____

figure 6.2

WELL INSPECTION SUMMARY
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

CRA

OXYCHEM ®

CHAIN OF CUSTODY RECORD

EP8-01

PROJECT/PROGRAM	SHIP TO:	REQUESTED ANALYSIS ✱
SAMPLER (SIGN AND PRINT NAME)		
FACILITY/LOCATION	SAMPLE SITE	

SAMPLE IDENTIFICATION	DATE M/D/Y	TIME	MATRIX	COMP	GRAB	OTHER	CONTAINER TYPE ✱	NUMBER OF CONTAINERS							SAMPLE REMARKS	SAMPLE PRESERVATION
TOTAL NUMBERS OF CONTAINERS									✱ SUGGESTED CODES LISTED ON FIGURE 6.3B							

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	EMPLOYER	CUSTODY REMARKS
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	EMPLOYER	
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	EMPLOYER	
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	EMPLOYER	
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	EMPLOYER	CONTACT (PRINT) / CONTACT PHONE

figure 6.3A

SAMPLE CHAIN OF CUSTODY FORM
LOVE CANAL
LONG–TERM MONITORING PROGRAM
Occidental Chemical Corporation

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SUGGESTED CODES

SAMPLE MATRIX

WW	WASTE WATER
GW	GROUNDWATER
DW	DRINKING WATER
SW	STORM WATER
PW	PROCESS WATER
RW	RIVER WATER
SANIT	SANITARY SEWER WATER
SOIL	SOIL
SLUDGE	SLUDGE
SED	SEDIMENT
ORG	ORGANIC LIQUID
NAPL	NONAQUEOUS PHASE LIQUID
APL	AQUEOUS PHASE LIQUID
OIL	OIL
UL	UNIDENTIFIED LIQUID
US	UNIDENTIFIED SOLID
CONST	CONSTRUCTION WASTE
ASH	ASH, FLYASH, BOTTOM ASH
RES	RESIDUE
SOL	SOLVENT

CONTAINER TYPE

G	GLASS
T	TEFLON
PP	POLYPROPYLENE
PE	POLYETHYLENE
P	PLASTIC
A	AMBER
C	CLEAR
WM	WIDE MOUTH
NM	NARROW MOUTH
40HV	40ML HYPO VIAL
L	LITER
PINT	PINT
Q	QUART
GALLON	GALLON
CUBIT	PLASTIC CUBITAINER

PRESERVATION

4° C	STORE AT 4± 2° C
THIO	0.008% SODIUM THIOSULFATE
H2S04	PH<2 WITH SULFURIC ACID
HN03	PH<2 WITH NITRIC ACID
HCL	PH<2 WITH HYDROCHLORIC ACID
ASCORBIC	0.6G ASCORBIC ACID
NAOH	PH>12 WITH SODIUM HYDROXIDE
ACETATE	ZINC ACETATE + SODIUM HYDROXIDE PH>9
DARK	STORE IN DARK
PH5-9	PH>5 AND <9
PH4-5	PH>4 AND <5
FILTERED	SAMPLE FILTERED

ANALYSIS METHOD

EPA	EPA NDPES METHODS
SM17	STANDARD METHODS VOLUME 17
SW846	EPA SOLID WASTE METHODS
ASTM	ASTM METHODS

figure 6.3B

SUGGESTED CODES
LOVE CANAL
LONG-TERM MONITORING PROGRAM
Occidental Chemical Corporation

CRA

4341 (13) JAN 15/96(W) REV.0 (F-04)

TABLES

TABLE 2.1

LIST OF PIEZOMETERS TO BE MEASURED QUARTERLY
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Piezometer Identification	*Zone Monitored*	*Top of Riser Elevation (feet AMSL)*
North Sector Wells		
1170A	A	584.68
1170B	B	584.56
1171A	A	583.37
1171B	B	583.63
1171C	C	583.26
1172A	A	581.73
1172B	B	581.78
1172C	C	581.77
1173A	A	578.14
1173B	B	578.36
1173C	C	578.45
1173D	D	578.60
1174A	A	577.77
1174B	B	577.73
1174C	C	578.14
1174D	D	577.78
1180A	A	582.59
1180B	B	582.47
1180C	C	583.27
1181A	A	576.81
1181B	B	577.15
1181C	C	577.07
1190A	A	586.53
1190B	B	586.22
1191A	A	584.91
1191B	B	584.90
1191C	B	585.18
1192A	A	583.43
1192B	B	583.46
1192C	C	583.85
1193A	A	579.97
1193B	B	579.45
1193C	C	579.60
1193D	D	579.60
1194A	A	578.40
1194B	B	578.03
1194C	B	578.56
1194D	C	578.54

TABLE 2.1

LIST OF PIEZOMETERS TO BE MEASURED QUARTERLY
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Piezometer Identification	*Zone Monitored*	*Top of Riser Elevation (feet AMSL)*	
South Sector Wells			
1140A	B	583.50	
1140B	A	583.50	
1141A	B	581.70	
1141B	A	581.90	
1142A	C/D	579.70	
1142B	B	579.50	
1142C	A	579.60	
1143A	C	577.70	
1143B	C	577.20	
1143C	B	576.70	
1143D	A	576.80	
1144A	D	579.70	
1144B	B	576.90	
1144C	C	577.30	
1144D	A	577.20	
1150A	A	579.80	
1150B	B	578.08	
1160A	A	584.20	
1160C	C	583.50	
1161A	A	582.30	
1161B	B	582.61	
1161C	C	582.50	
1161D	D	582.20	
1161E	B	583.81	
1162A	-	581.35	*
1162C	-	581.60	*
1162D	-	582.14	*
1163A	A	581.40	
1163B	B	581.20	
1163C	C	581.30	
1163D	D	581.20	
1165A	A	589.40	
1165B	B	592.20	
1165C	C	592.40	
1165D	D	589.90	
10176A	A	573.60	

TABLE 2.1

LIST OF PIEZOMETERS TO BE MEASURED QUARTERLY
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Piezometer Identification	***Zone Monitored***	***Top of Riser Elevation (feet AMSL)***
South Sector Wells Cont'd		
10176B	B	573.60
10176C	C	573.60
10176D	D	573.60
10276	-	-
Frontier Avenue and Lasalle Expressway		
1151A	A	578.06
1151B	B	578.08
1151C	C	578.27
1151D	D	578.36
1153A	A	577.46
1153B	B	576.67
1153C	C	577.68
1153D	D	577.31
1153E	D	576.80
1154A	A	572.87
1154B	B	573.93
1154C	C	574.03
1154D	D	573.81
Colvin Boulevard Area		
1183A	A	576.62
1183B	B	576.54
1183C	C	577.33
1183D	D	576.91
1184A	A	575.08
1184B	B	575.54
1184C	C	575.08
1184D	D	574.95

TABLE 2.1

LIST OF PIEZOMETERS TO BE MEASURED QUARTERLY
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Piezometer Identification	***Zone Monitored***	***Top of Riser Elevation (feet AMSL)***
Other Wells		
6290 (south East Canal)	-	-
5222 (Read Ave. Across Admin.)	-	-
3251 (At Church)	-	-
8210 (101 St.)	-	576.83
9205 (100th & Wheatfield)	-	577.66

Zone Monitored

A = Glacial till
B = Lower soft silty clay.
C = Upper stiff silty clay (fractured clay)
D = Upper fractured stiff clay or fill

* *Top of riser elevations are not confirmed.*
\- *Information not available.*

Within a series of piezometers - similarly suffixed wells were placed at the same elevation within a geologic stratum.

TABLE 2.2

SAMPLE SCHEDULE
LOVE CANAL FACILITY
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Annual Wells	*Bi-Annual Wells*		*Additional Wells (1)*
	Overburden Wells	*Overburden Wells*	
Bedrock Wells	*Group I (1995)*	*Group II (1996)*	
3257	3151	7115	1150
5222	7120	7125	1151
7205	7155	8115	1205
8210	7161	8125	3257
9205	8110	9105	6209
9210	8120	9113	8106
10205	8130	9122	8120
10210A	8140	9130	8130
10210B	9110	10105	9140
10210C	9115	10115	10176A
10225A	9120	10150	10180A
10225B	9125	10178	10215
10225C	9140		10270
10272	10113		
10278	10147		
	10174A		

Overburden Wells

7130
7132
9118
10135

Note:

1) Specific wells to be sampled selected in consultation with NYSDEC.

TABLE 3.1

WELL CONSTRUCTION DETAILS
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Well Number	*Ground Elevation*	*Well Type*	*Zone Monitored*	*Depth of Well (feet)*	*Casing Diameter (inches)*	*Well Diameter (inches)*	*Well Material*
Annual Wells							
3257	-	Bedrock	BR	29.4	4	2	PVC
5222	-	Bedrock	BR	37.4	-	4	-
7205	574.1	Bedrock	BR	48.0	4	2	SS
8210	573.7	Bedrock	BR	43.8	4	2	SS
9205	574.5	Bedrock	BR	48.7	3	2	SS
9210	582.4	Bedrock	BR	82.3	4	2	SS
10205	578.4	Bedrock	BR	54.3	4	2	SS
10210A	577.2	Bedrock	BR	217.0	4	2	SS
10210B	577.1	Bedrock	BR	140.3	4	2	SS
10210C	577.1	Bedrock	BR	84.0	4	2	SS
10225A	574.5	Bedrock	BR	205.0	4	2	SS
10225B	574.4	Bedrock	BR	137.7	4	2	SS
10225C	574.7	Bedrock	BR	62.5	4	2	SS
10272	-	Bedrock	BR	47.7	-	2	-
10278	-	Bedrock	BR	47.0	-	2	-
7130	574.3	Overburden	A/B	27.0	4.25	2	SS
7132	574.6	Overburden	A	28.0	4.25	2	-
9118	574.1	Overburden	A	35.5	4.25	2	-
10135	577.1	Overburden	A/B	29.5	4.25	2	SS
Bi-Annual Wells							
GROUP I							
3151	-	Overburden	-	25.1	-	2	-
7120	575.0	Overburden	A/B	30.3	4.25	2	SS
7155	573.2	Overburden	A/B	25.6	4.25	2	SS
7161	573.0	Overburden	A/B	21.7	4.25	2	SS
8110	576.5	Overburden	A/B/C	24.0	4.25	2	SS
8120	573.6	Overburden	A/B	27.0	4.25	2	SS
8130	574.6	Overburden	A/B	29.1	4.25	2	SS
8140	574.7	Overburden	A/B	31.0	4.25	2	SS
9110	573.9	Overburden	A/B	24.0	4.25	2	SS
9115	574.0	Overburden	A/B/C	17.9	4.25	2	SS
9120	574.2	Overburden	A/B	20.5	4.25	2	SS
9125	573.5	Overburden	A/B	23.9	4.25	2	SS
9140	578.9	Overburden	A/B	29.0	4.25	2	SS
10113	573.4	Overburden	A/B	27.8	4.25	2	SS
10147	574.4	Overburden	A/B	28.0	2	-	-

TABLE 3.1

WELL CONSTRUCTION DETAILS
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Well Number	*Ground Elevation*	*Well Type*	*Zone Monitored*	*Depth of Well (feet)*	*Casing Diameter (inches)*	*Well Diameter (inches)*	*Well Material*
GROUP II							
10174B	-	Overburden	-	22.9	-	2	-
7115	574.7	Overburden	A/B	31.0	4.25	2	-
7125	574.3	Overburden	A/B	24.5	4.25	2	-
8115	574.6	Overburden	A/B	28.5	4.25	2	-
8125	573.6	Overburden	A/B	27.5	4.25	2	-
9105	573.9	Overburden	A/B	29.4	4.25	2	-
9113	573.4	Overburden	A	34.0	4.25	2	-
9122	573.3	Overburden	A	33.5	4.25	2	-
9130	574.3	Overburden	A/B	30.5	4.25	2	-
10105	577.3	Overburden	A/B	29.5	4.25	2	-
10115	-	Overburden	-	33.7	-	2	-
10150	574.2	Overburden	A/B	31.0	4.25	2	SS
10178	-	Overburden	-	19.2	-	2	-
Additional Wells							
1150A	576.5	Overburden	A	27.0	4.25	2	SS
1151A	575.2	Overburden	A	27.5	4.25	2	SS
1205	-	-	-	-	-	-	-
3257	-	-	-	-	-	-	-
6209	-	Bedrock	BR	42.0	-	2	-
8106	573.1	Overburden	A/B	17.0	4.25	2	-
8120	573.6	Overburden	A/B	27.0	4.25	2	SS
8130	574.6	Overburden	A/B	29.1	4.25	2	SS
9140	578.9	Overburden	A/B	29.0	4.25	2	SS
10176B	-	Overburden	-	19.0	-	2	-
10180A	573.2	Overburden	A/B	18.0	-	-	-
10215	578.2	Bedrock	BR	59.4	4	2	SS
10270	574.5	Bedrock	BR	47.0	N/A	2	SS

Notes: - Information not available.

A = Glacial till
B = Lower soft silty clay.
C = Upper stiff silty clay (fractured clay)
D = Upper fractured stiff clay or fill
BR = Bedrock

TABLE 4.1

PROPOSED MONITORING SCHEDULE THROUGH 1997
LOVE CANAL SITE
LONG-TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Activity	1995						1996												1997											
	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
Water Levels	X			X			X			X			X			X			X			X			X			X		
Groundwater Sampling											■	■											■	■						
Quarterly Hydrograph Reports			◯			◯			◯		◯				◯			◯			◯			◯			◯			◯
Annual Sampling Report								◯												◯										

TABLE 5.1

SUMMARY OF OFF-SITE WELL CONTACTS
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

[TO COME]

TABLE 5.2

SAMPLING EQUIPMENT INVENTORY
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Equipment Item	*Manufacturer/ Supplier*	*Calibration Required*	*Comments*
Geoguard Purge Pump	Geoguard Inc.	No	Disassemble and decontaminate
Geoguard Bladder Pump	Geoguard Inc.	No	Disassemble and decontaminate
Geoguard Compressor	Geoguard Inc.	No	Gasoline engine driven
Geoguard Controller	Geoguard Inc.	No	Requires 12V Battery
Geoguard Coaxial Tubing	Geoguard Inc.	No	Dedicated for each well where required and stored on spools. Check.
Honda Generator	Honda Motor Co.	No	Gasoline engine driven
Peristaltic Pump	Masterflex/ Homemade	No	Assure tubing is available - (Silicone and Vinyl)
Electronic Water Level Tape	Slope Indicator Co.	No	Decontaminate before use
pH Meter	Orion	Yes	Check and calibrate
Specific Conductivity Meter	Myron-L	Yes	Check and calibrate
Turbidimeter			(Instrument on order)
Organic Vapor Meter	H-Nu	Yes	Check and calibrate
Water Deionizer	Park	No	Check operating condition
Ice Machine		No	Check operating condition
Gasoline Cans (OSHA Approved)	Various	No	For generator/compressor
Plastic Drip Pans	Various	No	For catching spillage during purging/sampling
Nalgene Containers (5 gallon)	Nalgene	No	For deionized water
Well Keys	--	--	--

TABLE 5.2

SAMPLING EQUIPMENT INVENTORY
LOVE CANAL SITE
LONG TERM MONITORING PROGRAM
NIAGARA FALLS, NEW YORK

Equipment Item	*Manufacturer/ Supplier*	*Calibration Required*	*Comments*
Screwdriver, Wrenches, Pliers, Knife	--	--	--
Clipboard and Well Sampling Sheets	--	--	--
Bound Field Logbook	--	--	--
Airline for compressors	Various	No	Check fittings
Purge water containers (carboys or buckets)	Various	No	
Extension Cord	Various	No	
Ground Fault Interrupter Device	Various	No	Test for proper operation

TABLE 5.3

LOVE CANAL SITE
LONG-TERM MONITORING PROGRAM
EXPENDABLE SUPPLIES INVENTORY
NIAGARA FALLS, NEW YORK

Item	*Manufacturer/ Supplier*	*Suggested Quantity*	*Comments*
Custody Tape	Various	4 - 5 Rolls	Can use custody seal provided by lab
Clear Tape-2"	Various	3 - 4 Rolls	For labels, etc.
Duct Tape/Strapping Tape	Various	3 - 4 Rolls	Misc./sealing coolers
String (cotton)	Various	1,000 - 2,000 Feet	200 ft balls
Bottom-Loading Disposable Bailers (Polyethylene)	Voss	24 - 36 (Unweighted)	3 feet long
Bottom-Loading Disposable Bailers (Polyethylene)	Voss	24 - 36 (Weighted)	3 feet long
Vinyl Tubing - food grade	KD Supply -	1,000+ feet	3/8 inch ID x 1/2 inch OD
Conductivity Standards	Various	1 Pint	Check expiration date
pH Standards (4 - 7 - 10)	Various	1 Pint (each)	Check expiration date
Quart size Ziplock Bags	Various	100 Bags	For ice and chain of custodies
6 mil Poly Sheeting	Various	1 roll	To place around well during purging
Pens (Black indelible ink) and Markers	Various	3 - 4 each	
Safety Equipment *			
Non-coated (White) Tyvek	Various	2 - 3 Cases	Sized to sampling personnel
Latex Surgical Gloves	Various	2 - 3 Cases	Rinse blank required
Rubber Overboots	Various	1 Per Sampler	
Organic Vapor/Acid Gas HEPA Filters	Various	1 - 2 Boxes	Appropriate for respirators worn

Note:

* - Each sampler to have own respirator, work boots, hard hat and safety glasses with side shields.

TABLE 7.1

LIST OF LONG TERM MONITORING PROGRAM PARAMETERS
LOVE CANAL SITE
NIAGARA FALLS, NEW YORK

Method 8240 - Target Compound List Volatile Organics

Compound
(Units of Measure = µg/L)

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethylvinyl ether
Chloroform
Chloromethane
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
trans-1,2-Dichloroethylene
1,2-Dichloropropane
cis-1,3-Dichloropropane
trans-1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methylene chloride
4-Methyl-2-pentanone
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Vinyl acetate
Vinyl chloride
Total Xylenes

TABLE 7.1

LIST OF LONG TERM MONITORING PROGRAM PARAMETERS
LOVE CANAL SITE
NIAGARA FALLS, NEW YORK

Method 8270 - Target Compound List Base/Neutral/Acid Extractables

Compound
(Units of Measure = µg/L)

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Benzoic acid
Benyzl alcohol
Bis(2-chloroethoxy)methane
Bis(2-choroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenylphenylether
Butylbenzylphthalate
4-Chloroaniline
2-Chloronaphthalene
4-Chlorophenylphenylether
Chrysene
Dibenzo(a,h)anthracene
Dibenzofuran
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
2,6-Dinitrotoluene
2,4-Dinitrotoluene
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene

TABLE 7.1

LIST OF LONG TERM MONITORING PROGRAM PARAMETERS
LOVE CANAL SITE
NIAGARA FALLS, NEW YORK

Method 8270 - Target Compound List Base/Neutral/Acid Extractables (continued)

Compound
(Units of Measure = µg/L)

Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
N-nitroso-di-n-propylamine
N-nitrosodiphenylamine
Phenanthrene
Pyrene
1,2,4-Trichlorobenzene
2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
4,6-Dinitro-o-cresol
2,4-Dinitrophenol
2-Methylphenol
4-Methylphenol
2-Nitrophenol
4-Nitrophenol
p-Chloro-m-cresol
Pentachlorophenol
Phenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

TABLE 7.1

LIST OF LONG TERM MONITORING PROGRAM PARAMETERS
LOVE CANAL SITE
NIAGARA FALLS, NEW YORK

Method 8080 - Target Compound List Organochlorine Pesticides/PCBs

Compound
(Units of Measure = µg/L)

Aldrin
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC
Chlordane
Alpha Chlordane
Gamma Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Heptachlor
Heptachlor epoxide
Toxaphene
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Endrin ketone
Methoxychlor
Endrin Aldehyde

TABLE 7.2

CONTAINER, PRESERVATION, HOLDTIME, AND SHIPPING REQUIREMENTS
LONG-TERM MONITORING PROGRAM
LOVE CANAL SITE
NIAGARA FALLS, NEW YORK

Analysis	*Sample Containers*	*Preservation*	*Maximum Holding Times*	*Volume of Sample*	*Shipping Means*
TCL Volatiles	2 x 40 mL glass teflon septum vials	pH<2 with HCI Cool to 4°C (±2°C)	10 days from collection to analysis	Fill completely	Overnight Courier
TCL BNA	2 x 1 L amber glass bottle	Cool to 4°C (±2°C)	7 days from collection to extraction 40 days from extraction to analysis	Fill completely	Overnight Courier
PCBs and TCL Organochlorine Pesticides	2 x 1 L amber glass bottle	Cool to 4°C (±2°C)	7 days from collection to extraction 40 days from extraction to analysis	Fill completely	Overnight Courier