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September 29, 1989

Frank V. Bifera, Esq.
NYSDEC
50 Wolf Road
Albany, New York 12205

Dear Mr. Bifera:

Re: Interim Remedial Measures Work Plan
Clark Property, Syracuse, New York

Enclosed for your review is the Interim Remedial Measures Work Plan for the listed portion of the Clark Property in Syracuse, New York. Please contact me at your convenience to discuss this document.

Sincerely,

John P. McBurney

c: M. Shanley
R. Brazell
T. Male
T. Johnson

JPM/kkr

INTERIM REMEDIAL MEASURES WORK PLAN

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A. INTRODUCTION

This document describes the proposed work plan to implement interim remedial measures at the Clark Property, Syracuse, New York. The property is located at the south end of Onondago Lake, east of the Barge Canal (Figure 1). The site is a listed inactive hazardous waste site by the State of New York.

The work plan addresses itself to on-site soils as an operable unit within the context of the RI/FS, Remedial Design, and Remedial Action elements for the site. The overall objective of this plan is to maintain consistency between long term objectives and interim goals.

A.1 Site Concerns

The principal site concern is the potential for human exposure to known and suspected carcinogens which may be migrating through soil, sediments, air, surface water, and groundwater from sources located on the Clark property. Environmental degradation via migration of contaminated groundwaters and surface waters into the barge canal and Onondaga Lake is another potential concern. A detailed quantitative discussion of the public health risks is contained in the site risk assessment prepared for site #734048 and entitled "Baseline Risk Assessment for the Clark Property."

A.2 Remedial Objectives

The following remedial objectives have been established for the site:

- o Control or eliminate direct contact with contaminated site soil, surface water, and sediments in excess of 10^{-4} to 10^{-7} excess cancer risk.

- o Control or eliminate off-site migration of contaminated groundwater in excess of 10^{-4} to 10^{-7} excess cancer risk.

- Control or eliminate on-site and off-site airborne contamination (particulate or VOC) derived from the on-site VOC source in excess of 10^{-4} to 10^{-7} excess cancer risk.

- Control or eliminate off-site migration of contaminated runoff and sediment into the barge canal and Onondaga Lake in excess of 10^{-4} to 10^{-7} excess cancer risk.

A.3 General Response Actions

The following general response actions have been identified as potentially appropriate for the site.

1. No Action/Institutional Actions

   - Deed restrictions
   - Access controls (i.e., fencing)
   - Environmental monitoring

2. Containment Technologies

   - Capping
   - Passive hydraulic barriers
   - Active hydraulic barriers

3. <u>In-Situ Treatment</u>

- Volatilization
- Biodegradation
- Soil flushing
- Stabilization
- Vitrification

4. <u>Excavation and Off-Site Treatment/Disposal</u>

- Excavation
- Bulk transport
- Containerized transport
- Off-site treatment/disposal

5. <u>Excavation and On-Site Treatment</u>

- Incineration
- Soil Washing
- Solidification
- Volatilization
- Biodegradation

6. <u>Groundwater Collection and Treatment</u>

- o Groundwater withdrawal

- o Physical/chemical treatment

A.4 <u>Interim Measures Strategy</u>

The purpose of interim measures is to mitigate public health hazards or prevent further environmental degradation resulting from uncontrolled hazardous materials. Important goals in planning interim measures at the site include:

1) Ensure that potential health and safety hazards are mitigated as quickly as practicable;

2) Ensure that interim measures are conducted safely with respect to both the public and the workers in implementation;

3) Ensure that interim measures are compatible with the long-term remediation and development of the site; and,

4) Implement effective remediation of the source and affected soils and groundwater.

The interim measures strategy for the site is designed to accomplish all four of these goals. The elements of the proposed interim measures strategy are described below, including a discussion of how each element supports accomplishment of the interim measures goals:

- o <u>Limit Direct Contact with Contaminated Materials</u> - This element has already been accomplished by installing fencing and providing security guards to limit public access to the Carousel Center properties. Also, all work performed on-site with a potential for exposure will be undertaken in accordance with the Safety Plan (in accordance with OSHA 1910) developed for the site.

Additional future actions in support of this element may include isolation or removal of VOC-contaminated sediments in the on-site ditch.

This element is consistent with Goal 1 in that it eliminates (at least temporarily - until long-term measures are in place) the direct contact threat to the public. This element also is consistent with Goal 2, as it protects worker health and safety on the site.

o <u>Halt Further Migration Off Site of Contaminated Surface Water and Groundwater</u> - This element may be accomplished by isolating or removing VOC-contaminated sediments in the on-site ditch (which also is a direct-contact hazard, as discussed above), and by providing subsurface hydraulic isolation. Groundwater isolation can include pumping and treatment of groundwater to induce gradients toward the Clark property, thus halting the advance of the plume of contamination. Groundwater withdrawal wells may be installed and operated to provide hydraulic isolation, provided a water treatment system is installed to meet the applicable effluent standards for discharge. Another method of groundwater withdrawal would be construction of an interceptor trench with pumping (and subsequent treatment) to establish a hydraulic gradient toward the trench. The installation of a barrier wall surrounding the contaminated source area is the most positive method of halting further off-site migration of groundwater. A barrier wall is an example of an active hydraulic barrier. A barrier wall is also effective in implementation of other elements of this interim measures strategy. Vacuum extraction or excavation of soils as potential interim measures require dewatering of the soil. Dewatering is best achieved if a barrier wall is installed to minimize the inflow of groundwater from adjacent areas.

This element is consistent with Goal 1 in that it prevents further degradation of off-site groundwater and, via a probable interconnection with the barge canal, degradation of off-site surface waters. Goal 2 is accomplished by observing the appropriate worker health and safety requirements during implementation, as well as the technical permitting requirements for surface water and atmospheric discharges. This element also is consistent with Goal 3, in that hydraulic isolation and groundwater withdrawal are an element of every remedial alternative (except No Action) under evaluation; hence, this element may be incorporated into a future long-term remedy of the site. Likewise, groundwater isolation poses little or no risk of interfering with potential long-term remedies under evaluation.

o Isolate or Remove the On-Site Source of VOC - This element may be accomplished by on-site groundwater pumping and vapor extraction of the VOC source which has been identified in previous studies. The Terra-Vac pilot test (in progress) will determine the effectiveness of this treatment technology on the site. If the results of the pilot testing are favorable for full scale application, scale-up and operation of the system could begin shortly thereafter. All testing and operations are being conducted under the provisions of the site Health and Safety Plan (in accordance with OSHA 1910), and discharges to surface waters and the atmosphere will be in accordance with the technical requirements of any applicable programs. The Terra-Vac system installed at this site is the dual extraction type. That is, it withdraws water as well as air from the subsurface. Water withdrawal is necessary at this site since the natural water table is above the contaminated soil matrix. Dual extraction artificially lowers the water table to create a vadose zone so that the Vapor Extraction System (VES) can pull volatile organics from the soil matrix. Other groundwater extraction systems, such as well points or an extraction trench, would be employed to attain the necessary lowering of the water table and increase the effectiveness of the VES. A barrier wall may be used in combination with the groundwater extraction system to eliminate recharge to the area being treated thereby reducing the contaminated water loading to the aqueous phase treatment system. This will reduce the cost of liquid treatment, and reduce the water discharge quantity to the receiving system.

This element is consistent with Goal 1 in that it prevents further degradation of groundwater, surface water, and subsurface soil, and potentially may provide significant cleanup and restoration of the environmental media. Goal 2 is accomplished by observing the appropriate worker health and safety and discharge requirements. This element is consistent with Goal 3 in that long-term remediation of the site may involve similar technical approaches for groundwater withdrawal. For instance, all of the remedial alternatives undergoing detailed analysis (except No Action) involve groundwater withdrawal and treatment; the groundwater extraction wells and water treatment systems used for in-situ vacuum extraction could be integrated into any of the remedial alternatives. Likewise, vacuum extraction poses little or no risk of interfering with implementation of other potential remedies under evaluation. Finally, if vacuum extraction is demonstrated to be an effective long-term remedy for the site, Goal 4 may be satisfied also.

A.5 Adherence to Standards

All interim remedies which are considered for use at the site have a common requirement to comply with the substantive requirements that govern releases. For remedial actions at the site these releases can occur via discharges to air or to water. Discharges to air can occur via releases into ambient air while undergoing activities on the site. The site Health and Safety Plan addresses safeguards to personnel engaged in remedial actions on site. Operating process equipment may produce an air discharge stream. This air discharge stream will typically be equipped with activated carbon filtration and be routinely monitored.

Discharges to water will occur for remedial actions which require contact with the groundwater. The Clark property water table is relatively high and most of the contamination on the property exists below the water table. Many of the remedial actions enumerated require removal of groundwater. This groundwater will be discharged, directly or indirectly, to surface water bodies near the site. Treatment and discharge of withdrawn groundwater to adjacent surface water will require compliance with applicable discharge guidelines. The treatment system will be designed to comply with best available technology through the use of activated carbon or other appropriate water treatment system to treat groundwater prior to discharge.

B. IN-SITU SOIL TREATMENT

Vacuum Extraction System (VES) - After completing the site hydrogeological characterization, it became apparent that VOC contamination was emanating from a source in the south portion of the Clark property. By late 1988, it was determined that in-situ volatilization using vacuum extraction could be effective in removing both soil and groundwater VOC contamination with minimal disturbance of the site. Terra-Vac has developed a system which, to date, is one of only two technologies which has successfully completed the demonstration phase of the EPA Superfund Innovative Technologies Evaluation (SITE) Program. Terra-Vac has been retained to utilize their vacuum extraction system, with appropriate modifications, at the site in order to implement interim remedial measures.

This interim measure will consist of expanding the pilot system to include more extraction wells throughout the contaminated portion of the Clark property. The spacing of the additional wells will depend and be based on the results of the initial phases of operation of the system. Additionally, measures to achieve maximum dewatering of the site, such as additional pumping wells, extraction trench or well points, will be implemented.

B.1 Process Description - Vacuum Extraction System (VES)

Under normal static conditions within the soil matrix, Volatile Organic Compounds (VOC's) are partitioned between four possible phases: 1) vapor, 2) liquid, 3) dissolved in soil water, 4) adsorbed to solid particles. These four phases define the aggregate constituent concentration in the subsoils. The vapor phase partitioning is a complex function of water content, organic content, solubility, temperature and vapor pressure. It is not necessary to define the exact relationship between soil concentration and vapor concentration as a function of time in order to understand that reductions in extracted vapor concentrations are driven by continuous partitioning to the vapor phase which corresponds to reductions in soil concentrations. Furthermore, as concentrations in soils are reduced significantly, vapor phase partitioning is generally controlled by Henry's Law. As vast volumes of soil vapor are removed by the vacuum process, fresh air naturally recharges the vadose zone from the surface. Fresh air moves through the affected zone as VOC's are partitioned from the soil matrix to the vapor phase and move to the extraction wells. With vacuum induced volatilization and air stripping of the soil matrix, cleanup occurs continuously.

As constituent vapors are removed from the soil's pore volume, the three other phases (liquid, adsorbed and dissolved) of VOC's vaporize in place, further reducing the aggregate soil concentration. Because VOC's vaporize readily, the vacuum extraction process continually drives the constituents within the soil matrix to the vapor state. Under static conditions, the concentration of VOC's in the soil vapor are proportional to the aggregate constituent concentration in the soil. During the vacuum extraction process, vapors extracted at the wellhead represent essentially an aggregate soil-gas concentration near the screened interval.

Progress of the vacuum system can be monitored by the concentration of VOCs in the extracted vapors. As VOC's are vacuum extracted from the soils, the removal rate declines with time. The declining removal rate results in a lower concentration of VOCs at the well head indicating cleanup of the soils.

Based on the subsurface hydrologic conditions (high water table) at the site, Terra-Vac will implement the VES technology including a technical variation of the VES termed "Dual Extraction." This technique operates in essentially the same manner as vacuum extraction except that one or more of the vapor extraction wells is outfitted with a groundwater pump to depress the groundwater table. If it is apparent that other dewatering measures may be more effective than pumping wells, then such measures will be employed so that maximum dewatering can be achieved to effectively test the VES. The depressing of the water table produces an artificial vapor zone. The VES technology works best in unsaturated conditions. Thus, each vacuum extraction well serves a "dual" purpose, by extracting contaminated groundwater at the same time as soils are being cleaned. The VES system will result in air and water discharges which will be treated to meet discharge requirements established by NYSDEC.

Air and vapor discharges will be routed through a vapor phase carbon adsorption treatment system, while liquid discharges will be routed through a holding tank and a liquid phase carbon adsorption treatment system. Final discharge will be either to on-site surface waters or to a local publicly owned treatment works (POTW) system.

B.2 Contaminant Loads and Treatability

Contaminant Loads to the VES have been determined based on the soil and groundwater characterization presented in Dunn's September, 1988 report entitled "Hydrogeologic Conditions at the Clark Property". Treatment of these media are described in the engineering report for the Terra-Vac Pilot Plant by Dunn dated August 18, 1989.

The installation of an additional containment wall on the remaining perimeter of the Clark property will limit the contaminant load to be removed from the soil and groundwater to only the contaminants which presently exist on the Clark property. An existing slurry wall borders a portion of the Clark property; the additional containment wall would completely enclose the contaminated portion of the property. Groundwater pumpage during in-situ soil treatment will cause a lowering of the groundwater level within the contained area. The containment walls would reduce the potential for groundwater from adjacent properties (i.e. Hess) from flowing onto the Clark property. The lowered groundwater level can be maintained using a lower pumping rate than if the additional containment wall were not installed. This would result in increased efficiency of the vacuum extraction process.

Carbon usage rates during the initial phases of operation of the existing VES within a fully contained site would be the same as those identified in Dunn's August, 1989 Engineering Report. However, the reduced pumping rates resulting from the installation of an additional containment wall would also result in a significant increase in the life of the carbon treatment units.

B.3 Pumping Rates and Carbon Usage

Initial operation of the dual extraction VES indicate that a combined total pumping rate of approximately 10 gallons per minute is expected from the extraction wells. This rate may be enhanced slightly by the continued application of the vacuum to the system. Groundwater will be pumped to a 13,000 gallon holding tank for batch processing at a rate of 30 gpm. The treatment system will consist of one half of the system presented in Dunn's August, 1989 Terra-Vac Pilot Plant Study Engineering Report.

Batch processing will occur over a period of approximately 7 hours (12,600 gallons). Assuming that the carbon usage rate for the representative feed composition, with a 30 minute residence time, is 495 pounds per day, than the carbon usage during the batching treatment process can be calculated as follows.

$$495 \text{ lb/day} \times \frac{1 \text{ day}}{24 \text{ hr.}} \times 7 \text{ hours} = 144 \text{ lb.}$$

Numerical modeling of the groundwater flow at the site indicates that a containment wall installed to completely surround the contaminated area would reduce pumping rates by a factor of 6 while maintaining maximum drawdown. This decrease in pumping rate would reduce the volume of water to be treated, significantly prolonging carbon life and reducing the amount of carbon to be disposed of or regenerated.

B.4 Duration of Operations

The duration of operation of this remedial interim measure will be determined by the performance monitoring described below. The intent of this workplan is to continue operation of this measure until concentrations of contaminants in the soil and groundwater are significantly reduced.

B.5 Performance and Operations Monitoring

A monitoring program will be conducted in order to evaluate the effectiveness of the VES system. To accomplish this, the liquid stream flow rate will be routinely monitored and recorded. Sampling of the liquid stream will be performed on a regular basis as it passes through the Terra-Vac System in order to evaluate the quality of the discharge. On a less frequent basis, samples will be collected of the aqueous-phase treatment system influent and also between the primary and secondary aqueous-phase carbon units.

Breakthrough of the primary activated carbon canister will be monitored using analytical results for 1,1-DCA (1,1-Dichloroethane) as stated in the August 1989 Engineers Report for the Terra-Vac pilot test. If breakthrough occurs, the primary carbon units will be removed and the secondary units will become the primary units. New units will then be placed in the secondary position. In addition, because vinyl chloride is present in the groundwater at the site, vinyl chloride will be monitored in the aqueous phase carbon treatment system effluent. If the concentration of vinyl chloride in the system effluent records. 50% of the daily maximum allowable concentration for 3 consecutive readings. The carbon system will be changed.

Air emissions will be monitored to determine gas concentrations at the stack, the well head, and at locations before and after the primary carbon unit on a regular basis. Samples will be collected weekly from the sampling port between the air-water separator and from the sampling port downstream from the secondary carbon unit. Field analysis will be conducted for selected volatile organics.

In addition to monitoring and sampling of the liquid stream discharge and the carbon usage, soil samples will be collected in order to monitor the contaminant concentrations in the vadose zone.

Results of a shelby tube bench test conducted by Terra-Vac indicate that the vacuum extraction process is applicable at the Clark property. During the test period, a 97% decrease in vapor concentrations occurred. Soil analysis after 96 hours of extraction showed a VOC concentration decrease from 108 ppm to 17.7 ppm for one sample and a decrease of VOC contaminants from 467 ppm to 0.2 ppm in a second sample.

Dewatering of the soils is the key to a successful cleanup. The test showed VOC removals will be minimal during the dewatering, but will rapidly increase once the pore water has been extracted.

C. EXCAVATION AND EX-SITU TREATMENT

Excavation of contaminated soil is effective in removing soil for subsequent treatment or disposal. Excavation is expected to be limited to the depths required for construction purposes and will extend through the fill into the natural lacustrine sediments at the site. The use of a barrier wall which surrounds the contaminated soil, and dewatering will be necessary to allow for excavation below the natural water table.

C.1 Ex-Situ Treatment

Ex-Situ Treatment consists of construction of a cutoff wall and ex-situ VES treatment cells, groundwater withdrawal and treatment, excavation of contaminated soils and placement in the treatment cells, vacuum extraction of VOC, and environmental monitoring. Volatile organics which are present in these excavated soils can be extracted from the soil matrix once these soils have been placed in a treatment cell in the vicinity of the excavation area. The use of the Terra-Vac soil vacuuming system can then be employed without having to simultaneously, artificially suppress the water table as in the in-situ case to allow for air stripping of the VOCs from the soil. This process may decrease the time required to reach an equilibrium state at the soil particle surface thus accomplishing soil cleanup in a shorter period of time.

The groundwater withdrawal will take place at a high rate to dewater the excavation - the cutoff wall will assist in isolating the excavation hydraulically. Each treatment cell will conceptually consist of an earthen berm with underliner, upper membrane seal, and a gravel drainage layer with embedded vacuum extraction pipes and drainage pipes. Contaminated soils will be placed loosely on top of the gravel drainage layer, be vacuum treated in batches to below action levels, then moved outside the cell for stockpiling until the treated soils can be replaced on-site. The groundwater removed as a result of dewatering, and the vapor extracted from the treatment cells will be treated using activated carbon.

C.1 <u>Contaminant Loads and Treatability</u>

Contaminant loads to the VES have been determined based on the soil and groundwater characterization presented in Dunn's September, 1988 report entitled "Hydrogeologic Conditions at the Clark Property". Treatment of these media are described in the engineering report for the Terra-Vac Pilot Plant by Dunn dated August 18, 1989. As part of this measure, groundwater will be removed to permit subsequent excavation and treatment of soil.

The installation of an additional containment wall on the open portion of the perimeter of the Clark property will limit the contaminant load to be removed from the soil and groundwater to only the contaminants which presently exist on the Clark property. An existing slurry wall borders a portion of the Clark property; the additional containment wall would complete the enclosure of the contaminated portion of the property. Groundwater pumpage during excavation dewatering will cause a lowering of the groundwater level within the contained area. The containment walls would prevent groundwater from adjacent properties (i.e., Hess) from flowing onto the Clark property. The lowered groundwater level can be maintained using a lower pumping rate than if the additional containment wall were not installed.

C.2 Pumping Rates and Carbon Usage

Dewatering would be required prior to excavation for this interim measure. To achieve the desired depths of excavation, the installation of an additional containment wall section to fully encircle the contaminated portion of the Clark Property would be required. The pumping rates to achieve this level of dewatering are presented above (section B.3). The carbon usage during dewatering, as described in Section B.3, would be less than that calculated and presented in Dunn's August, 1989 Engineering Report. The actual carbon usage for both the liquid and vapor phases of this interim measure would be determined during the initial phase of operation of the in-situ extraction system.

C.3 Duration of Operations

The duration of operation of this remedial interim measure will be determined by the performance monitoring described below. The intent of this measure will be to continue operation until concentrations of contaminants in the soil and groundwater are significantly reduced.

C.4 Operations Monitoring

During the groundwater dewatering phase of this measure, the liquid stream discharge will be routinely monitored and recorded. Sampling of the liquid stream will be performed on a regular basis as it passes through the Terra-Vac System in order to evaluate the quality of the discharge. On a less frequent basis, samples will be collected of the treatment system influent and also between the primary and secondary carbon units. Breakthrough of the primary activated carbon canister will be monitored as described in B.5 of this document.

Air emissions will be monitored using the same method as that used for the vacuum extraction system (see Section B.5). Variation of the VOC concentrations in the soil may occur due to the transport of the soil from the ground to the treatment cell.

In addition to monitoring and sampling of the liquid stream discharge and the carbon usage, samples of the excavated and treated soil will be collected in order to monitor the reduction of contaminant concentrations and to determine the effectiveness of the treatment.

C.5 Off-Site Disposal

The large quantity of contaminated soil for disposal will require bulk transport. Bulk transport is effective for transporting large volumes of waste material for eventual treatment or bulk disposal. If the off-site treatment or disposal facility were located along a waterway in the Syracuse area, barge transport may be feasible (because the Clark property is near the barge canal and Onondaga Lake).

D. CAPPING

Capping would be effective in controlling direct contact with contaminated surface soils and on-site sediments. Capping also would eliminate off-site migration of surface soils and sediments and reduce off-site migration of contaminated groundwater (due to a reduction of on-site infiltration). Since the Clark property is a regional discharge zone, capping would not completely eliminate off-site migration of contaminated groundwater.

E. GROUNDWATER WITHDRAWAL AND TREATMENT

Groundwater Withdrawal - Groundwater withdrawal is a commonly used technology for restoration of contaminated aquifers when used in conjunction with a treatment system. Design of the system is dependent upon its purpose. The reliability of withdrawal systems is generally good if the wells are designed, installed, and developed properly.

Physical/Chemical/Biological Treatment - These systems are effective for removing or detoxifying organic and inorganic contaminations, but the choice of process options, including combinations of multiple unit processes, depends upon the characteristics of the wastewater and required effluent standards. Both liquid-phase and vapor-phase carbon absorption are reliable and relatively simple processes for removing organic contamination, but pretreatment (such as oil-water separation, flocculation, precipitation, ion exchange, or microfiltration) may be necessary to prevent fouling of the carbon. Applying air stripping to the aqueous stream ahead of carbon treatment transfers organic load onto vapor phase carbon where absorption economics are usually more favorable. Biological treatment systems, particularly fixed film reactors, are effective and reliable for degrading organic contamination. A large number of processes have been fully demonstrated.