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File No. 1049

Ms. Pamela Sprague
Waste Management Division
New Hampshire Department of Environmental Services
P.O. Box 95, 6 Hazen Drive
Concord, NH 03302-0095

1994-00252 Log #

Re: North Country Environmental Services Facility
Bethlehem, New Hampshire

Dear Ms. Sprague:

On behalf of North Country Environmental Services, Inc. (NCES), Sanborn, Head & Associates, Inc. (SHA) has prepared this letter in response to item (a) of your September 29, 1994 letter requesting an evaluation of water quality trends at the site including elevated concentrations of volatile organic compounds (VOCs) in the 100-series groundwater monitoring wells and the seep, and low concentrations in MW406U.

Site groundwater quality was discussed during a September 22, 1994 meeting attended by representatives of NCES and both the Waste Management Division (WMD) and Water Supply and Pollution Control Division (WSPCD) of NHDES. The information provided in this letter is consistent with the discussions that took place during that meeting.

Groundwater quality at the NCES facility has been monitored since 1984. Currently, monitoring is performed in accordance with the requirements of a groundwater permit (No. GWP-870433-B-001) issued by the WSPCD. The monitoring program includes sampling 16 monitoring wells and one surface water location designated as the seep. Monitoring wells B-101, B-102, B-102S, B-103, and B-103D (100-series wells) are included in the monitoring well network. Water level and flow data gathered during hydrogeologic studies of the site indicate that these wells are located downgradient of the area where the unlined landfill had been located at the site. The network also includes monitoring wells MW-401 through 406. MW-401 serves as an upgradient well at the facility while the remainder of the 400-series wells are located downgradient of Stage I. The locations of the monitoring wells are shown on the enclosed figure, Sheet GW-1.

In 1989, NHDES issued Solid Waste Permit No. DES-SW-89-009 for the Stage II expansion of the facility, located in the area of the unlined landfill. As a preconstruction compliance requirement, the Solid Waste Permit required that solid waste/refuse in the unlined landfill area and a single-lined 1¼-acre extension area located to the northeast be excavated and relocated into Stage I, a double-lined landfill.

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The relocation of refuse began in December 1991 and the final refuse was moved into Stage I in October 1993 after the Stage I Phase IV operating permit was issued by NHDES. The excavation of refuse was extended to the natural soil subgrade. The approximate extent of the excavation based on a comparison of pre- and post-excavation surveys completed by Cartographics Associates, Inc. of Littleton, New Hampshire, is indicated on Sheet GW-1.

Following the refuse relocation on October 19 and 20, 1993, SHA observed and logged 38 test pits excavated in the relocation area to observe soils for evidence of contamination such as staining and to obtain soil samples for field screening and laboratory analysis for VOCs. The results of SHA's work were presented in a November 1993 report entitled "Contamination Assessment, Refuse Relocation Project, Consumat Sanco, Inc. Landfill, Bethlehem, New Hampshire." As indicated in SHA's report, widespread surficial soil staining was not observed in the excavation area. VOC screening of the excavated soils with an organic vapor meter indicated readings from non-detect to 13 parts per million (ppm). Laboratory testing did not detect the presence of VOCs in the test pit soil samples submitted for analysis. Xylenes were detected in a soil sample obtained from a soil stockpile in the excavation area at a concentration of 20 micrograms per kilogram (ug/kg). This material was hauled and placed in Stage I following completion of SHA's field work. Based on SHA's field observations and the quantitative. analytical data, significant residual VOC concentrations were not present in the soils in the excavation area. SHA's report was submitted to NHDES. Following NHDES approval, the excavation area was graded and seeded.

Through this process, the unlined landfill was closed in a more effective manner than would be the case had the landfill been capped in place. Excavating the materials in the unlined landfill resulted in the elimination of a long-term source impacting groundwater quality; construction of the double liner for Stage II will serve to cap the underlying soil and any residual contamination contained in the underlying vadose zone.

Hydrogeologic data and a description of site hydrogeology were presented in a March 1987 report entitled "Hydrogeologic Study, Sanco Landfill Expansion, Bethlehem New Hampshire" prepared by GZA GeoEnvironmental, Inc. and submitted in support of the permit application for Stage I of the facility. A summary of hydrogeologic conditions is presented below:

- Overburden at the site is characterized by a sequence of very dense glacial sediments composed of a lower till overlain by stratified drift which in turn is overlain by an upper till. Explorations encountered bedrock at depths of 113 feet to more than 250 feet below the ground surface.

- The stratified drift deposit at the site is composed of very dense, generally discontinuous units ranging from silts and clays to sands and gravelly sands. The glacial till deposits are composed of a non-stratified, heterogeneous mixture of clay, silt, sand, and gravel-sized particles.

- Though not continuous throughout the site, the gravelly sands within the stratified drift deposit represent the most permeable subsurface material observed at the site, with estimates of hydraulic conductivity based on field tests and correlations with grain size ranging from 24 to 31 feet per day (ft/day). Glacial till soils and the sand, silt, and clay units within the stratified drift deposits are materials of lower hydraulic conductivity with estimates ranging from 0.08 to 1.5 ft/day.

- Groundwater elevation data presented in GZA's 1987 report indicate the presence of a local north-south oriented groundwater divide within the stratified drift and upper till deposits. Within these deposits, groundwater to the west flows northwesterly, eventually discharging into the Ammonoosuc River; whereas groundwater to the east of the divide (in the area where the unlined landfill was located) flows northeasterly, also eventually discharging to the Ammonoosuc River. Within the lower glacial till, groundwater flow occurs in a generally northeasterly direction across the site.

  Figure GW-1 shows groundwater elevation contours based on water level data obtained in the monitoring wells at the site on July 7, 1994. The groundwater flow patterns shown on Figure GW-1 are similar to those described by GZA, however, the groundwater divide appears to have shifted somewhat to the east, likely due to the elimination of recharge as a result of construction of the Stage I liner system.

- West of the groundwater divide, the predominant groundwater flow path is through the gravelly sand within the stratified drift where the GZA report indicates seepage velocities ranging from 2.0 to 2.6 ft/day. East of the groundwater divide, the GZA report indicates estimated seepage velocities ranging from 0.006 to 0.1 ft/day in the stratified drift, and 0.27 to 0.35 ft/day in the lower glacial till. We anticipate that higher seepage velocities, similar to those identified in the coarse gained soils west of the groundwater divide may exist in coarser grained soils east of the divide.

- Measured groundwater hydraulic gradients range from 0.002 to 0.044 ft/ft, with the highest gradients occurring in the northwestern and northeastern portions of the site. Observed vertical gradients indicating groundwater recharge areas are primarily located in the north-central portion of the site. Upward vertical gradients generally occur within western portions of the site.

- Groundwater quality monitoring has been performed at the site since 1984. Water quality data summarized in GZA's 1987 report indicate that groundwater affected by leachate from the unlined landfill was migrating in a northeasterly direction toward the Ammonoosuc River, likely in part through a preferential groundwater flow path of coarser- grained soils from the site to seep outbreaks northeast of the site.

Water quality monitoring is performed in accordance with the Groundwater Permit. The analytical laboratory reports are provided to NHDES following each sampling round. The most recent annual summary tables of water quality data prepared in accordance with the Groundwater Permit for the site are attached. A summary of the total concentration of VOCs measured in samples from the monitoring wells is provided in Table 21. The predominant VOCs detected in the 100-series wells include the ketones, (acetone, 2-Butanone (MEK), 4-Methyl-2-Pentanone (MIBK), and Hexanone). Toluene, ethylbenzene and xylenes have also been detected as have 1,1 DCA, methylene chloride and benzene.

Reviewing the data, it appears that the concentrations of total VOCs in the 100-series wells generally began to increase in the time period from about October 1992 to April 1993. The last data available was from the July 1994 sampling round and indicate a further increase in the concentrations of VOCs in samples from monitoring wells B-101, B-102, B-102S, and B-103D during the time period between April and July 1994.

The seep on the slope above the Ammonoosuc River about 800 feet to the northeast of the refuse relocation area is sampled on a monthly basis. Results of VOC analyses of samples obtained from the seep indicate total concentrations of VOCs ranging from below detectable levels to in excess of 400 micrograms per liter (ug/l). Data from the analysis performed on a seep sample obtained on August 25, 1994 indicated the total concentration of VOCs of 1172 ug/l, which are higher than those previously measured. SHA has reviewed the water quality data and note that the specific VOCs detected in recent analyses of seep samples are consistent with those detected during previous sampling rounds at the site and are consistent with those detected in groundwater at the site.

Additional data are required to evaluate the consistency of the elevated concentrations of VOCs in the seep. In any event, the increase in VOCs should not be unexpected given the time period when concentrations increased in the 100-series wells (October 1992 - April 1993) to August 1994 (about 16 to 22 months) in conjunction with our understanding of seepage velocities in the gravelly sands (about 2 to 2.6 ft/day) and the travel distance of about 1000 to 1200 feet.

Based on groundwater flow data, impacts to the water quality in the vicinity of the 100-series monitoring wells and seep are not unexpected. Hydrogeologically, these sampling locations are downgradient of the unlined landfill area. The removal of the fill material during relocation of the unlined landfill resulted in disturbance of the waste and possible release of additional constituents. In addition, the excavation process inherently resulted in more infiltration into the waste mass than had been occurring previously, resulting in the short-term generation of additional leachate. Finally, the excavated area was extended below surrounding grades resulting in containment of runoff and excellent sedimentation control, but also in increased infiltration and flushing of residual from the vadose zone.

SHA believes that the higher VOC concentrations observed in the monitoring wells at the site are in large measure attributable to the increased infiltration that occurred during and subsequent to the waste relocation and increased flushing of residual constituents from the vadose zone. Importantly, the source, that is the unlined landfill, has been removed, and explorations and laboratory testing of soil samples obtained from the excavation area did not indicate the presence of significant residual contamination. Therefore, we expect water quality conditions will improve with time.

As indicated in the permit modification request, monitoring wells MW-405 U&L and MW-406 U&L will be decommissioned. Monitoring wells MW-405U&L and MW-406U&L are clusters with upper wells screened within stratified drift from depths of about 25 to 35 and 22 to 37 feet below the ground surface, respectively. The upper well screen intercepts the groundwater surface. The lower wells are screened in the lower glacial till units from depths of about 60 to 80 feet (MW-405L) and about 65 to 80 feet (MW-406L). Water quality data for the wells are generally consistent with background water quality data with the exception of the detection of low concentrations of VOCs in samples from monitoring well MW-406U during recent monitoring rounds. The VOCs detected in samples obtained from MW-406U consist of methylene chloride, 1,1-dichloroethane (1,1-DCA), toluene and xylene, as indicated below:

Date	Methylene chloride	1,1-DCA	Toluene	Xylenes
7/15/93	4	2	ND	ND
4/13/94	9	8	ND	ND
7/7/94	22	9	1	1

These constituents have also been detected in the 100-series monitoring wells. Monitoring well clusters MW-405U & L and MW-406U & L are located within about 10 to 20 feet of the limit of the excavation created during the refuse relocation project. The screened interval in these wells straddles the groundwater table. Given the proximity of the monitoring well MW-406U to the waste in the unlined landfill, a likely source of the low concentration of VOCs is mounding occurring during the relocation of waste. Another possible source of VOCs is landfill gas which

could migrate into the well in the screened zone above the water table. Landfill gas typically contains VOCs such as methylene chloride, 1,1 DCA and other VOCs also found in landfill leachate.

SHA does not believe the double-lined Stage I landfill is a source for the low concentrations of VOCs detected in MW-406U. Little, if any flow has been detected in the secondary leachate collection system of Phase I, indicating the primary liner is providing effective containment. Further, a groundwater divide passes through Phase I of Stage I such that groundwater to the east of the divide flows to the northeast through the Stage II area, while groundwater to the west flows in a northerly to northwesterly direction. The groundwater flow data indicate the upgradient area tributary to MW-406U constitutes only a small portion of the double-lined landfill area and, importantly, lies at the upgradient end of the Phase, where head levels on the liner are expected to be negligible. Finally, no VOCs attributed to the landfill have ever been detected in the other 400-series monitoring wells which are located downgradient of the much larger portion of Stage I including areas where the head on the liner is expected to be greater.

We note that through the permitting and development of Stage II, which required relocation of the unlined landfill prior to construction of the double liner system, the total volume of contaminants has been greatly reduced by eliminating an ongoing source of water quality impacts. Accordingly, we expect that the overall improvement in groundwater quality should occur much more quickly than would otherwise be the case if the unlined landfill had been capped in place. Further, construction of the Stage II liner system will effectively cap the majority of the unlined landfill area, eliminating infiltration and providing for more effective closure than would be accomplished had the unlined landfill been closed in place.

Given the variations in soil type and hydraulic conductivity, the presence of residual VOCs in the vadose zone where the former unlined landfill was located will continue to contribute to groundwater quality impacts until it has been flushed as a result of infiltration, or infiltration is eliminated by the double liner system for Stage II. The time period before improvements in water quality occur is difficult to predict, and is best evaluated through continued monitoring.

Importantly, the key issue to keep in focus is that a significant and ongoing source of contamination, the former unlined landfill, has been eliminated through the permitting and development of Stage II. Short term water quality impacts directly associated with this relocation project will abate with time and coupled with the construction of the double lined Stage II Landfill, will provide significant environmental improvement, fully consistent with your goals and expectations as set forth in your permit for the Stage II expansion.

We believe this letter provides an explanation for the cause of elevated VOCs in the vicinity of the area where the unlined landfill was located. Should you have any questions, please do not hesitate to call.

Very truly yours,
SANBORN, HEAD & ASSOCIATES, INC.

R. Scott Shillaber, P.E.
Principal

Paul M. Sanborn
President/Principal

RSS: ljm
cc: John Regan, WSPCD
James Bohlig
Larry Lackey

enclosures: Sheet GW-1
Water Quality Data Tables

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