northgate
environmental management, inc.

March 9, 2010

Mr. Matt Paque
3301 NW 150th Street
Oklahoma City, Oklahoma 73134-2009

RE: Pre-Confirmation Sampling Work Plan
Remediation Zones RZ-A through RZ-E
Phase B Investigation, Tronox Facility, Henderson, Nevada
Project # 2027.01

Dear Mr. Paque:

During a meeting held on February 22, 2010, a program for implementing a pre-confirmation sampling plan at the Tronox Henderson Facility (Site) was presented to the Nevada Department of Environmental Protection (NDEP). Tronox presented maps showing proposed boundaries of potential excavation areas where particular chemical constituents are present in the upper 10 feet of soil at concentrations above various comparison criteria[1], based on the results of sampling during the Phase A and B Environmental Compliance Assessment (ECA) programs. Tronox also presented proposed pre-confirmation sampling locations to further refine the vertical and horizontal extent of the excavation areas.

At the conclusion of the meeting, NDEP and Tronox reached an agreement on the conceptual scope and implementation of the pre-confirmation sampling program. This Work Plan describes and documents the approach and methodology for pre-confirmation sampling within each of the agreed upon remediation zones.[2]

OBJECTIVE

The objective of the pre-confirmation program is to refine remediation planning while establishing the vertical and horizontal extent ("cutlines") of the proposed excavations in shallow soils (0 to 10 feet below ground surface [bgs]). In addition to determining the extent of

[1] Criteria 1 (dark blue polygons): Arsenic greater than 18 milligrams per kilogram (mg/kg), chrysotile long fiber count greater than 13, amphibole long fiber count greater than 1, dioxin greater than 2,200 parts per trillion (ppt), all other constituents greater than NDEP worker basic comparison levels (BCLs).
Criteria 2 (light blue polygons): Arsenic greater than 7.2 and less than 18 mg/kg, chrysotile long fiber count greater than 5 and less than or equal to 13, dioxin greater than 1,000 and less than or equal to 2,200 ppt, and low levels of polycyclic aromatic hydrocarbons (PAH)s,
Criteria 3 (teal polygons): one long amphibole fiber with no other risk drivers.

[2] For investigation purposes, the Site was divided into four areas (I, II, III, IV). For remediation planning purposes, it was agreed that the Site would be divided into five Remediation Zones (RZ-A, RZ-B, RZ-C, RZ-D, RZ-E).

remediation, identification of cutlines will allow final risk assessment calculations to be prepared in parallel with excavation of soils exceeding NDEP limits. This will facilitate completion of remedial excavation by the end of 2010 as required by the NDEP Order dated December 14, 2009 (NDEP, 2009).

BACKGROUND AND SAMPLING RATIONALE

For general background information, the reader is referred to the *Phase A Source Area Investigation Work Plan Tronox LLC-Henderson, Nevada* (ENSR, 2006) and the Phase B work plans for Area I, Area II, Area III and Area IV describing the Phase B Source Area Investigations for the individual investigation areas (AECOM, 2008).

Chemical analyses from soil samples collected during the Phase A and B sampling programs showed that within the upper 10 feet of soil, there are locations where dioxin, hexachlorobenzene (HCB), and other semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs)[3], asbestos, metals, organochlorine pesticides (OCPs); and/or perchlorate exceed the various criteria as defined in footnote 1.

Voronoi/Thiessen polygons were generated for the Site using the Phase A and B soil analytical data. The polygons define areas with BCL exceedances or other criteria (as specified on Figure 1-1 and defined in footnote 1). There are a few locations where total petroleum hydrocarbons (TPH) exceed 100 milligrams per kilogram (mg/kg) but concentrations of individual TPH constituents such as benzene, toluene, ethyl benzene, xylenes (BTEX)[4] or the individual PAHs do not exceed worker BCLs. As approved by NDEP, "TPH only" polygons are not included as potential excavation locations. In total, 107 polygons have been retained for additional evaluation and/or remediation.

During the meeting on February 22, it was agreed that the Site would be divided into five remediation zones that are roughly based on geographic groupings of elevated detections of contaminants and conceptual site model (CSM) considerations. Figure 1-1 shows the five remediation zones (named RZ-A through RZ-E).

[3] There was only one instance where PCBs exceeded the BCL in shallow soil (aroclor-1260 within boring SA165), however, deeper soil samples (1.0-1.5' and 1.5-2.0') at that location were found to be below the BCL for PCBs, therefore, no additional analyses for PCBs are recommended.
[4] There were no samples within the upper 10 feet of soil with where BTEX compounds were reported above worker BCLs.

Table 1 incorporates analytical data collected during Phase A and B of the Source Area Investigations for each of the 107 remediation polygons for RZ-B, -C, -D, and -E. The Table includes a description of the proposed pre-confirmation sampling program and includes a brief description of the sampling rationale. There are no remediation polygons within the southernmost zone (RZ-A); therefore, no further pre-confirmation sampling is proposed in RZ-A.

As shown in Table 1, there are two types of boring locations associated with the pre-confirmation sampling program: 1) borings to be installed adjacent to existing Phase A and B sampling locations (***existing locations***); and 2) borings to be installed at new locations (***new locations***). Sample locations are shown on Figures 1-2 through 1-5 for remediation zones RZ-B through RZ-E. Analytical data for constituents exceeding the NDEP worker BCLs or other criteria in the upper 10 feet of soil are shown on these maps[5].

Data from the new borings installed at ***existing locations*** will be used to establish remediation depths (i.e., used as pre-confirmation samples and will establish cutlines). Eighty-two borings are proposed at existing locations as shown on Figure 1-1.

Borings installed at ***new locations*** will define the horizontal extent of remediation. Sampling at new locations will also include vertical delineation. Ninety-one new sampling locations are proposed.

Asbestos/Arsenic

Asbestos is generally only expected within the surficial soil. When asbestos is co-located with other contaminants that will result in the removal of the surficial soil, additional asbestos sampling is not proposed with the following exceptions:

- If a polygon contains dioxin and asbestos only and the dioxin concentrations are in the range of 1,000 to 3,000 ppt, there is the potential that the results of the bioaccessibility extraction testing program (Northgate, 2010) may preclude the need for removal of the dioxin; therefore, asbestos in the soil that occurs at concentrations above the established criteria must be sampled and analyzed to establish the cutline for removal.

[5] Analytical results of samples from the next depth sampled below 10 feet bgs are also shown on Table 1 and Figures 1-2 through 1-5 for reference purposes.

- If a polygon contains perchlorate and asbestos only, there is potential for perchlorate flushing to be used in this area; therefore, asbestos must be sampled to establish the cutline for removal.

- If a polygon contains arsenic and asbestos only, and the arsenic is relatively low in concentration, it may be found to be within background levels; therefore, asbestos must be sampled to establish the cutline for removal.

Sampling locations for arsenic are not based on a specific concentration level since the BCL for arsenic (1.77 mg/kg) is less than background levels. The polygons were developed based on arsenic concentrations greater than 7.2 mg/kg; however, a specific level for cutline has not been agreed upon at this time. During the February 22nd meeting, NDEP and Tronox reviewed the draft Table 1 and determined the locations where additional arsenic evaluation sampling was recommended. The revised Table 1 reflects the agreed-upon sampling locations for arsenic. Samples for arsenic will be collected in the range of 3 to 9 feet bgs for existing locations and 1 to 10 feet bgs for new locations. Samples within these depth ranges will be selectively analyzed to provide an indication of the spatial variability considering the statistical background calculations. Final decisions regarding arsenic remediation will be based on a statistical evaluation of background.

SCOPE OF WORK

Work will be conducted following BMI standard operating procedures (SOPs). Specific SOPs employed are described below.

Vertical Delineation Sampling at Existing Locations

The vertical delineation sampling for constituents of interest other than asbestos at the existing Phase A and B sampling points will start at approximately 3 feet bgs, as Phase A and B data generally exists for the interval from 0 to 2 feet bgs and at 10 feet bgs. Samples will be collected at 1-foot depth intervals to a depth of 9 feet bgs (3, 4, 5, 6, 7, 8, and 9 feet).

At locations where dioxin and/or HCB are scheduled for analysis, a subset of these samples will be screened in the field. If the sample results are lower than the BCL or other criteria, the sample will be submitted to a fixed laboratory for confirmation. Additional deeper confirmation analysis for dioxin or HCB may be necessary if the confirmation result does not pass the BCL or other criteria.

At locations where metals, OCPs, or SVOCs other than HCB are scheduled for collection and analysis, the samples will be submitted to a fixed laboratory and a subset of the samples will be analyzed on an iterative basis to establish cutlines. At least one confirmation sample will be analyzed for each of the constituents scheduled for sampling at a particular location to establish that an acceptable cutline.

Analytical data from samples collected at a depth of 10 feet bgs during the previous source identification programs are included in Table 1. At select locations, previous analytical results indicate that soil at 2 and 10 feet bgs contains constituents that exceed the risk criteria. This plan includes deeper sampling at a few locations to provide additional information for final grade design.

Horizontal Refinement and Vertical Delineation Sampling at New Locations

Sampling at the new step-out locations (except for asbestos) will start at 1 foot bgs. Samples will be collected at 1-foot depths to a depth of 10 feet bgs. A subset of these ten samples will be analyzed as necessary to establish an acceptable cutline as described in the previous section.

Asbestos Sampling

Asbestos samples will be collected according to SOP-12 (BRC, 2009c). Samples for horizontal refinement (step-out locations) will be collected at two depths: a surface sample collected from 0 to 2 inches bgs, and a second sample collected from 4 to 6 inches bgs, which will be held pending the results of the analysis of the surficial sample. Samples associated with the existing Phase A/B locations already have results for the 0- to 2-inch bgs, so samples will be collected from 4 to 6 inch bgs interval at these locations for confirmation purposes. If the 4- to 6- inch bgs sample does not produce results below the acceptable criteria for asbestos, an additional sample will be collected and analyzed from a depth of 8 to 10 inches bgs.

Sampling Techniques

Soil samples may be collected using a variety of methods consisting of one or more of the following: sonic, hollow-stem auger, Geoprobe™ drilling and near surface sampling with shovel and trowel. Soil borings at locations not previously sampled will be logged in the field using the procedures as described in *SOP-14 Field Documentation* (BRC, 2009d) and *SOP-17 Soil Logging* (BRC, 2009e). Soil samples will be collected following the procedures described in *SOP-07 Soil Sampling* (BRC, 2009b). If a sonic drill rig or hollow-stem auger drill rig is employed, a split-spoon sampler fitted with brass liners will be used to collect soil samples for laboratory analyses using the procedures described in BRC *SOP-23 Split Spoon Sampling* (BRC,

2009g). If a Geoprobe™ drill rig is used, soil samples will be collected using a Macrocorer™ sampler fitted with acetate liners.

Equipment cleaning or decontamination procedures will be followed using the procedures described in *SOP-31 Drilling Equipment Decontamination* (BRC, 2009h).

Sample containers will be sealed, labeled, and placed on ice inside an ice chest and provided to the mobile laboratory or to the fixed laboratory under chain-of-custody protocol using the procedures described in *SOP-06 Sample Management and Shipping* (BRC, 2009a).

Analysis of the vast majority of the samples will be placed on hold pending initial screening in the field lab of dioxin and HCB samples. Screened samples will be logged under a chain-of-custody and will be stored on site in a refrigerated, locked truck for proper storage and maintenance of samples prior to analysis. The samples that are not included in the screening program, but must be analyzed by a fixed laboratory, will be shipped directly to the fixed laboratory for sample storage and/or analysis.

Each borehole will be abandoned once the target depth has been reached and the necessary samples are obtained. The boreholes will be abandoned by backfilling with a bentonite/neat cement grout using the procedures described in *SOP-19 Borehole Abandonment* (BRC, 2009f). Soil cuttings (including unused soil cores) will be temporarily stored in U.S. Department of Transportation (DOT)-approved steel 55-gallon drums while awaiting receipt of the final laboratory results. Each drum will be managed according to the procedures described in *SOP-34 Investigative Derived Waste (IDW) Management* (BRC, 2009i). At the end of each day, equipment decontamination water will be temporarily stored in DOT-approved 55-gallon drums. Each drum will be marked with water-proof labels and water-proof markers. Each drum will receive a unique identification number and will be catalogued for waste containment documentation purpose. Following characterization, each drum of material will be disposed of as appropriate per federal, state, and local requirements.

Analytical Program

The analytical program is outlined in Table 1. Analyses are proposed for the following chemical constituents:

- Dioxin (81 borings);
- SVOCs:
    - HCB (65 borings),

    - benzo(a)pyrene (6 borings),
    - benzo(a)anthracene (1 boring),
    - benzo(b)fluoranthene (1 boring),
    - dibenzo(a,h)anthracene (2 borings),
    - indeno(1,2,3-cd)pyrene (1 boring);
- Asbestos (71 borings);
- Metals:
    - arsenic (61 borings),
    - cobalt (5 borings),
    - lead (2 borings),
    - magnesium (6 borings),
    - manganese (16 borings),
    - total chromium (4 borings);
- Perchlorate (24 borings); and
- OCPs:
    - beta-BHC (2 borings),
    - 4,4-DDE (5 borings),
    - 4,4-DDT (2 borings).

The chemical constituents to be analyzed at each location are based on the result of the Phase A and B Investigation (see Table 1 for specific analyses to be conducted at each boring location).

There are three fundamental analysis programs:

1) The asbestos analytical program follows the procedures outlined in SOP-12. This plan requires that a sample collected for asbestos analysis be submitted to the analyzing laboratory for determination of the short and long fiber chrysotile and amphibole content of the sample. The *Phase B Quality Assurance Project Plan (QAPP)* (AECOM, 2009) and (AECOM/Northgate, 2009) will be used as the applicable quality assurance/quality control (QA/QC) guidance for field and laboratory QA/QC samples and for the reporting of asbestos analytical data. All asbestos samples will be submitted for analysis to the laboratory. At the new locations where samples from two depths are being collected (0-2" and 4-6"), analysis of the deeper samples will be put on hold pending results of the

analysis of the shallow sample. If the risk criterion is exceeded in the shallow sample, the deeper sample will be analyzed and the results reported.

2) The dioxin and HCB analysis program incorporates a screening methodology using a combination of mobile and fixed labs (depending on sample volume) to establish the cutline and the horizontal delineation criteria. Dioxin screening will be performed using method 4025 and HCB screening using a modified method 8081. Once a field-screened value falls below the risk criteria, the sample will be submitted to a fixed laboratory (capable of providing EQuIS™ deliverables) as the compliance sample for full analyses using the applicable laboratory analytical method (8290 for dioxin and 8270C for SVOCs). Results for the full suite of each analytical method will be reported. The screening data will only be used to evaluate the depth of a potential passing sample.

3) OCPs, SVOCs other than HCB, and metals will not be screened. OCPs samples will be analyzed using method 8081A, SVOCs will be analyzed using method 8270B, and individual metals, as necessary for each location (refer to Table 1for metal to be analyzed at each location), will be analyzed by methods 6010B/6020. Results for the full suite of OCPs, the full suite of SVOCs, and the individual metals will be reported with EQuIS™ deliverables.

Field Quality Assurance/Quality Control Requirements

Field QA/QC requirements will follow the procedures defined in the Phase B Sampling and Analysis Plans (SAPs) and QAPP (June 2009). Summary information is provided below for these requirements.

Field QA/QC Samples

Field QA/QC procedures will be followed to ensure viability and integrity of sample analytical data. The field investigative team will be responsible for submitting QA/QC samples to the laboratory. QA/QC samples include field duplicates, equipment decontamination blanks, and field blanks. In addition, matrix spike and matrix spike duplicate samples will be collected at five percent of the sampling locations to supplement laboratory quality control sample analyses.

Field Duplicate Samples

One field duplicate will be collected for every 10 samples submitted for analysis. The duplicate sample will be tested for the same suite of analytical parameters as the corresponding original sample.

Equipment Decontamination Blank Samples

Equipment decontamination blanks will consist of laboratory-grade distilled water rinsed through clean sampling devices. These devices include the soil sampling equipment used in the investigation. Equipment decontamination blanks will be collected at five percent of the sampling locations.

Field Blank Samples

Field blank samples consisting of the decontamination source water will be analyzed for the full suite of analytes shown on Table 1, except for asbestos. Field blank samples will be collected from water used for the equipment blank samples. As with the previous Phase B sampling, the decontamination water source will be laboratory-grade water obtained from the Tronox onsite laboratory.

CLOSING

If you have any questions or comments on this Work Plan, please contact either of the undersigned.

Sincerely,
Northgate Environmental Management, Inc.

Deni Chambers, C.E.G., C.Hg.
Principal-in-Charge

Derrick Willis
Project Manager

Enclosures: **Attachment A** - References

Table 1 - Proposed Pre-Confirmation Sampling Plan – Remediation Zones RZ-B, RZ-C, RZ-D, RZ-E

Figure 1-1 - Exceedance Polygons for Shallow Soils (<10 feet bgs) Direct Contact Exposure

Figure 1-2 - Remediation Zone B (RZ-B) – Unit Buildings and Current Leach Plant Production Area

Figure 1-3 - Remediation Zone C (RZ-C) – Ammonia Perchlorate Production Area, Koch Material Area, Pond and Diesel Storage Tank Area, Manganese Tailings Area

Figure 1-4 - Remediation Zone D (RZ-D) – Trade Effluent Ponds and AP Pad/Drum Recycling Area

Figure 1-5 - Remediation Zone E (RZ-E) – Beta Ditch