Appendix A

NDEP and TRONOX Correspondence

...LEN BIAGGI, *Administrator*

Im... ...ation
at... ...Control
r
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STATE OF NEVADA
KENNY C. GUINN
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R. MICHAEL TURNIPSEED, *Director*

Federal Facilities
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DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
(Las Vegas Office)
1771 E. Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837

February 11, 2004

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Supplemental Phase II Report – Environmental Conditions Assessment

Dear Ms. Crowley,

The Nevada Division of Environmental Protection (NDEP) has reviewed the:

Supplemental Phase II Report – Environmental Conditions Assessment; Kerr-McGee Chemical LLC, April 25, 2001.

NDEP's comments to the aforementioned report are contained in Attachment A. In summary, characterization work performed to date does not appear to be technically defensible and additional work will be required. Some specific points include: 1) a need to identify all potential contaminants associated with the site; 2) appropriate background sampling; 3) use of inappropriate action levels; and 4) existence of data gaps. Before additional work is completed, the NDEP recommends that Kerr-McGee Chemical LLC (KM) meet with the NDEP to discuss the comments and development of a plan to move forward.

30 days - per Rakiva 3-4-04

By ~~March 8~~, **2004**, KM should provide to the NDEP a schedule for addressing the issues outlined herein. Should you have any questions or concerns, please do not hesitate to contact me at (702) 486-2870.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Remediation and LUST Branch
Bureau of Corrective Actions
NDEP – Las Vegas Office

BAR/bar
Encl: Attachment A

CC: Jim Najima, NDEP, BCA, Carson City
Jon Palm, NDEP, BWPC, Carson City
Todd Croft, NDEP, BCA, Las Vegas
Jennifer Carr, NDEP, BCA, Carson City
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Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Carrie Stowers, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BEC, 875 West Warm Springs Road, Henderson, Nevada 89015
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015

Attachment A

NDEP Comments on the *Supplemental Phase II Report – Environmental Conditions Assessment*

1. **Submission of documents**
   a. Two copies of all reports should be provided to Brian Rakvica in the Las Vegas office of the NDEP and two additional copies should be provided to Mr. Jeff Johnson in the Carson City office of the NDEP.
   b. An electronic copy of all reports in PDF format should also be provided to Mr. Brian Rakvica.
   c. All laboratory data should be formatted to comply with the Division's Electronic Data Deliverable's (EDD) format. These data packages will need to be compatible with Earthsoft's EquIS Data Management System (relational database written in Visual Basic and using the Microsoft Access engine). The specific formatting requirements of this data will be provided to KM under separate cover at a later date.
2. **Project Personnel**
   a. NDEP needs to understand what personnel are being applied to this project. Please provide current resumes and/or curricula vitae for each project staff member. This is a multi-disciplinary project and the following expertise may be needed to complete this project: hydro-geologist, engineer, toxicologist, radiochemist, risk assessor, expert in fate and transport, statistician and chemist.
   b. Please provide an organizational chart for the project team.
   c. Please identify the Nevada Certified Environmental Manager (CEM) for this project.
3. **Presentation of Calculations and Data**
   a. Calculations: When a significant calculation is performed and referenced in the text an example calculation should be included in the report. The formulae used and the reference for the formulae should also be shown for the example calculation. These example calculations could be summarized in an appendix to the report, in a footnote, or in the body of the text. The NDEP is also amenable to alternate presentation forms.
   b. Data: Data for soil shall not be separated from data for groundwater. One drawing should be presented for each site-related chemical to illustrate the three dimensional extent of contamination. Information to be included on each drawing is summarized below.
      i. All soil analytical data shall be presented.
      ii. All potential source areas for the chemical being evaluated shall be clearly identified and highlighted. Potential source areas include areas where concentrations in soil exceed background and those portions of the facility where chemicals were used or stored. Source areas may include several Letter of Understanding (LOU) study areas.
      iii. All groundwater analytical data shall be presented.

iv. Iso-concentration contours for groundwater data illustrating the extent of the groundwater plume shall be presented. Property boundaries are not to be used for termination of the delineation of the chemical plumes.

v. Any location that is considered a background location for any chemical in soil or groundwater shall be clearly identified on all drawings.

vi. All site features that may impact contaminant transport (surface and subsurface) shall be identified.

c. Drawings shall be self-explanatory without the need to refer to the text to interpret what is being presented. The presentation of more than one site-related chemical on a drawing is appropriate when the chemicals are similar (e.g.: VOCs, metals, etc.), are migrating together and have common sources. The above presentation is required to complete a conceptual site model. The conceptual site model should be updated as more data is collected.

4. **Averaging of Analytical Data**

a. In previous reports, analytical data on several tables are averaged. The NDEP can not evaluate the adequacy of site characterization work based on analytical data that are averaged. Risk assessment is the only phase of the project where analytical data should be averaged. Analytical results should be presented discretely and compared to appropriate risk based criteria; Applicable or Relevant and Appropriate Requirements (ARARs); or approved background levels.

b. Composite soil samples are appropriate where justification is provided and NDEP approval is obtained. Composite samples may not be appropriate for risk-based closures without a rigorous statistical analysis.

5. **Phase II Consent Agreement Reporting and Public Involvement Obligations**

a. KM is reminded that quarterly progress reports are due to the NDEP in accordance with Section XIII of the Phase II Consent Agreement.

b. KM is further reminded that participation in the Public Involvement Plan (PIP) is required in accordance with Section V.2. of the Phase II Consent Agreement. This PIP requires a copy of all key documents to be submitted to the Public Information Repository located at the James I. Gibson Public Library in Henderson, Nevada.

6. **Site Groundwater**

a. The Nevada Revised Statutes and the Nevada Administrative Code consider all groundwater of the State of Nevada to be potential sources of drinking water; prohibit the discharge of pollutants into the groundwater without a permit; and require the source of any pollutant to be eliminated. It has been well documented that the water beneath the KM plant site has the ability to reach the Las Vegas Wash. The Las Vegas Wash is a tributary to Lake Mead. Lake Mead and the Lower Colorado River are the drinking water supply for over 20,000,000 people. The NDEP would like to stress the importance of: elimination of the migration of pollutants from

the KM site; delineation of the extents of the off-site contamination in the form of a conceptual site model (CSM); and management and remediation of all off-site pollutants. Characterization of off-site pollutants in groundwater may require broad suite analyses. These analyses should include (at a minimum) the following chemical classes: VOCs, SVOCs, PAHs, Pesticides, Radionuclides, Metals, Inorganics, Dioxins/Furans, and PCBs. Please note that the radionuclide analyses should include (at a minimum): the uranium series, the thorium series, radium 226/228 (and all daughter products), as well as potassium 40.

b. It should also be noted that "Beneficial Use Standards" have been developed for the Las Vegas Wash and are presented in NAC 445A.144 and NAC 445A.199-NAC 445A.201.

c. The NDEP requests that KM provide a summary of the on-going monitoring of the site groundwater. This summary should include a list of the monitoring wells; the analytes that each well is monitored for; and the frequency of the analysis.

d. The Division requests that plume maps be developed for each of the site-related chemicals including data that extends off-site. See also comment 3.

7. **Pond GW-11**

a. Pond GW-11 has received effluent from the chromium mitigation system and the perchlorate remediation system. The contaminants in this effluent have been evapo-concentrating in pond GW-11. It is the Division's understanding that the contents of pond GW-11 will eventually be processed through the new fluidized bed reactor (FBR).

   i. Please provide any data on analyses that have been performed on the contents of Pond GW-11.

b. Broad suite analyses may be appropriate for pond GW-11. It is not clear to the NDEP that the contents of pond GW-11 are well characterized.

8. **Chromium Mitigation System**

a. The existing chromium mitigation system treats a limited quantity of groundwater on the plant site. From plume maps provided by KM, it is obvious that there is a large plume of chromium downgradient of the plant site slurry wall. KM has implemented a temporary remedial system to address the elevated hexavalent chromium concentrations at the Athens Road well field.

   i. Please explain KM's long-term plan for the remediation of chromium (total and hexavalent) at the Athens Road well field. It appears to the Division that the concentrations will continue to increase in this location (based on available data).

b. The existing total chromium plume maps terminate near the property boundary and are delineated to 1.0 ppm.

   i. Please provide complete mapping of the existing total chromium plume down to ND(0.05 mg/l). Also, include a 0.1 mg/l contour (current MCL for total chromium).

ii. It is requested that chromium plume mapping eventually be coordinated with the development of the perchlorate plume maps. Maps should be of identical orientation, scale and sampling date. Please identify a schedule by which this mapping can be coordinated with the perchlorate mapping.

iii. Please provide any information on sampling conducted to date for total and hexavalent chromium in the Muddy Creek Formation and Muddy Creek Aquifers.

c. Please provide any available data for the influent concentrations of total and hexavalent chromium to the on-plant site chromium mitigation system.

9. **Site-Related Chemicals**

a. The NDEP is concerned that site-related chemicals have not been adequately identified for the KM facility. Site-related chemicals include all raw materials, products processed, byproducts, waste products and any other chemical used at the facility. All degradation products associated with any chemical that may have been used at the facility are also site-related chemicals. All site-related chemicals need to be identified in accordance with USEPA guidance (see *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, EPA/540/1-89/002, December 1989*). If it is unknown whether or not chemicals are present at the site, ~~or~~ if all chemicals associated with historical operations have not been adequately documented, then a broad suite analysis is warranted for those chemical classes that may be present. Please note that some chemicals associated with the site may not be covered by broad suite analyses. Site-related chemicals associated with the KM facility need to be identified and justified for each chemical class including but not limited to: metals, radionuclides, volatile organic compounds, semi-volatile organic compounds, dioxins, furans, pesticides, and polycyclic aromatic hydrocarbons (PAHs). A detailed discussion on site-related chemicals is required for any risk assessment. During risk assessment, the list of site-related chemicals is reduced to a list of chemicals of potential concern (COPC). Please note that the term COPC is specific to risk assessment and should only be used after the completion of site characterization and the development of a CSM.

b. For example, if the suite of metals associated with the site cannot be identified, then a broad suite of metals needs to be analyzed. Twenty-four metals are considered site-related chemicals for the Upper and Lower Ponds east of Boulder Highway (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium (total), chromium (VI), cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, titanium, tungsten, vanadium and zinc). These 24 metals should be included in the list of site-related chemicals for the KM facility or the abbreviated list of metals that were analyzed during the previous investigations needs to be justified.

c. Another example is the unknown chemicals and wastes at the site. In the April 1993 Phase I Environmental Conditions Assessment there are several examples of unknowns at the site.
    i. U.S. Government Activities – "Detailed records describing the quantities of waste produced and the location(s) for disposal...were not found during this study".
    ii. Other previous lessees on KM property – "The actual locations leased and operations conducted by these companies are not well documented".
    iii. Hardesty/Amecco Chemical – "residue from the manufacturing process was pumped directly into a steel tank truck and removed to a remote location and burned". The by-products from this incomplete combustion process are unknown but may include: dioxins, furans, PAHs, as well as components of the residue that were burned. KM should identify this potential source area.

d. The analytical methods for the list of site-related chemicals must be presented for review by the NDEP.

e. The development of a comprehensive list of site-related chemicals should be the first priority for this project.

10. **Data Quality**

a. In this report and previous reports elevated detection limits have been presented. These detection limits are at or above their (potential) corresponding screening levels. Examples include (but are not limited to): benzene, cadmium, ethylbenzene, selenium, and toluene.

b. If a risk assessment is to be performed, the usability of this data will need to be demonstrated in accordance with US EPA Guidance.

c. KM is requested to review this issue with their laboratories to determine the reasoning behind these elevated detection limits.

d. KM is requested to review these issues and the remaining part of the quality assurance program (in accordance with Section VIII of the Phase II Consent Agreement) and submit a formalized response to NDEP.

11. **Action Levels**

a. The NDEP has repeatedly stressed the importance of comparing data to appropriate action levels including letters dated June 10, 1998 and December 17, 1998.

b. Please note that if a chemical is present, but below an established action level, it will not necessarily be removed from consideration or future analysis. This chemical may need to be carried through as a contributor to cumulative risk.

c. Action levels should be protective of human health and the environment. Standards or criteria that can be used to evaluate human health or ecological risks include Maximum Contaminant Levels (MCLs), USEPA soil screening levels (SSLs), USEPA Ambient Water Quality Criteria (AWQC), ATSDR criteria, site-specific background levels, and USEPA Region IX Preliminary Remediation Goals (if used correctly, see below

for additional details). KM should present a detailed evaluation of the derivation of the action levels to be used for this project.

d. Please note that although NAC 445A.2272 does allow the use of TCLP maximum concentrations as action levels where the exposure pathway is to surface water or groundwater, TCLP maximum concentrations were established Federally to classify hazardous waste for disposal purposes; they were not established to evaluate human health and ecological risk. Further, there is no basis in regulations to extrapolate these concentrations for use as human health and ecological risk criteria for soil exposure. According to NAC 445A.2272, the most restrictive action level must be used, and at an appropriate level of concentration that is based on the protection of human health and safety and of the environment. Contaminant concentrations associated with human health and ecological risk criteria are generally much lower than TCLP criteria, especially when multiple chemicals are being evaluated. Human health risk criteria, and potentially ecological risk criteria, must be addressed prior to site closure if contaminated media (above applicable target risk levels) are not removed from the site.

e. USEPA Preliminary Remediation Goals (PRGs) can be used to determine action levels if the analysis is completed correctly. If more than one contaminant exists at a site, then the use of PRGs may not be appropriate.

f. It is critical that background concentrations be appropriately evaluated. Background concentrations need to be evaluated by collecting soil samples in an area that is not impacted by site operations. Use of ASTM or USGS background levels for wide geographic areas is not acceptable per the June 10, 1998 NDEP letter to KM. A separate work plan should be submitted that describes where background samples will be collected and how background concentrations will be evaluated. It is highly recommended that an appropriate background study be completed prior to additional site characterization sampling. The development of a Remedial Alternatives Study (RAS) after site characterization is completed will depend heavily on comparisons of background concentrations to contaminant concentrations detected at the facility. The NDEP suggests that KM review the guidance documents listed below.

    i. U.S. Environmental Protection Agency, Guidance for Characterizing Background Chemicals in Soil at Superfund Sites, OSWER 9285.7-41 (EPA 540-R-01-003), June 2001.

    ii. U.S. Environmental Protection Agency, Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites, EPA/540/s-96/500, December 1995.

g. Due to the number of contaminants present at the facility, the lack of acceptable chemical-specific action levels or PRGs for many of the contaminants, and the potential that removal activities may not be cost-effective as a remedial option, KM should consider that a deterministic risk assessment might be required for site closure. A probabilistic risk assessment will not be accepted until after a deterministic risk assessment

is completed and it is determined that a probabilistic risk assessment is warranted. Risk assessment, if performed, shall be completed in accordance with USEPA guidance (see references below). Tentative cleanup goals for risk assessment are listed below.

i. Non-carcinogens: Hazard Index = 1
ii. Chemical carcinogens: Target Risk = $1x10^{-6}$
iii. Radionuclides: Target Risk= $1x10^{-6}$

h. Prior to performing a risk assessment, the usability of the data must be demonstrated in accordance with USEPA guidance (see reference below).

i. It is not clear what the objectives of the investigation to date are. Decision rules to guide the characterization process are not clearly laid out. Also, it is not clear how KM will sufficiently evaluate the facility to justify closure. It is highly recommended that data quality objectives (DQOs) be completed in accordance with the reference below. Ideally, DQOs should have been completed prior to any site characterization work to streamline the data collection process. A brief discussion on data quality assessment (DQA) may also be warranted (see reference below). In summary, the NDEP needs to have a better understanding of how KM proposes to close the site and recommends that KM discus the proposed DQOs with NDEP prior to submittal. Additionally, NDEP recommends submittal of DQOs as a separate, stand-alone document. It should be anticipated that these DQOs will be adjusted as the project proceeds.

j. References

i. U.S. Environmental Protection Agency, Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, December 1989.
ii. U.S. Environmental Protection Agency, Guidance for Data Usability in Risk Assessment, April 1992.
iii. U.S. Environmental Protection Agency, Guidance for the Data Quality Objectives Process, August 2000.
iv. U.S. Environmental Protection Agency, Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, July 2000.

12. **Conceptual Site Model**

a. The NDEP has repeatedly stressed the importance of the development of a conceptual site model (CSM) including in letters dated June 10, 1998 and December 17, 1998.

b. Kerr-McGee has completed a significant amount of hydro-geologic investigative work for the perchlorate remediation project. This information should prove to be very helpful in the development of a CSM.

c. It is suggested that the CSM be submitted under separate cover as soon as possible. For your information, all of the BMI Companies are preparing CSMs. It is suggested that the CSM include, but not be limited to, the following elements:

i. A list of site-related chemicals for soil and groundwater should be developed in accordance with USEPA guidance (see also comment

10). This list should identify chemicals that may have been disposed of but were not analyzed for during recent investigations. This list should also present risk-based criteria, such as USEPA Region IX PRGs, soil screening levels (SSLs), MCLs, and other criteria where appropriate. See also comment 11.

ii. A discussion pertaining to the potential for contaminants in soil to leach to groundwater should be provided. Contaminant concentrations in soil should be compared to migration to groundwater SSLs developed by the USEPA at the DAF of 1 or site-specific SSLs could be developed.

iii. Preferential migration pathways, such as paleochannels on top of the Muddy Creek Formation; the fine grained facies of the Muddy Creek Formation (e.g. channel sands); and the coarse grained facies of the Muddy Creek Formation also should be evaluated. Kerr-McGee has already completed significant work on this for the perchlorate remediation project.

iv. Cross sections showing the shallow alluvial aquifer and the next deeper water-bearing zone should also be presented.

v. It does not appear that the nature and extent of the contaminant plumes are well understood. Iso-concentration drawings for contaminant plumes in soil and groundwater (including the vertical extent of contamination) that show the entire extent of the plume (including off site data) should be provided. See also comment 8.

vi. The conceptual site model should discuss surface drainage patterns, surface migration of contaminants, and contaminant migration pathways within the vadose zone and groundwater.

vii. The CSM should discuss exposure pathways for current and future receptors, including ecological receptors.

viii. Data gaps should be identified and additional investigation work to close the data gaps should be proposed.

ix. Unqualified data may be presented, however, KM must ensure that the data are presented in a manner that allows the NDEP to differentiate between qualified and unqualified data.

13. **Soil Sampling**

a. In general, the soil sampling that has been conducted has been in the surface and near-surface. The limited sampling that was conducted is not sufficient to evaluate potential sources that may exist within the vadose zone. Soil samples need to be collected throughout the vadose zone to fully evaluate the extent of contamination in three dimensions and potential impacts to groundwater.

14. **Section 1.0, page 1-1**

a. Second paragraph – Please correct the date for NDEP's conditional approval of the Phase II Supplemental Work Plan from "*December 17, 1999*" to the correct date of December 17, 1998.

15. **Section 2.2.2, page 2-3**

a. First paragraph – In the statement "*The spacing of seven successfully drilled perimeter borings comprises a nearby equidistant...*" replace the word "*nearby*" with the word "nearly".

16. **Section 3.1, page 3-1**

a. Total chromium results for soil were compared to a 100 mg/kg level. This is not an appropriate action level or screening level. For example, the USEPA SSL (DAF 1) is 2.0 mg/kg and the USEPA TCLP is 5.0 mg/kg. Background levels may be more conservative. Using either of the above concentrations, all soil samples are grossly elevated. It appears that the depth and breadth of chromium contamination has not been properly evaluated. Please note that the NDEP is using these SSLs for discussion purposes only. KM should calculate their own SSLs or verify that the model used by the USEPA to calculate the published SSLs fits the model for the KM site. A DAF of 1 is being used for discussion purposes, assuming that there is little or no dilution or attenuation of soil leachate at the site (due to the shallow water table and the large source size).

b. The NDEP's December 17, 1998 letter to KM required comparison of sample results to actual Nevada cleanup standards and background values.

c. Soil samples also appear to indicate that there are elevated pH levels in a number of the locations and depths. Background levels for pH should be delineated in accordance with USEPA guidance (see also comment #11.f).

d. The data presented do not delineate the valences of the chromium present in soil. KM states "*elevated pH values tend to retard the mobility of chromium, especially trivalent chromium Cr(III) (Allen 1993). This implies that the mobility of chromium in soil beneath Old P-2 and P-3 Ponds is retarded, thus limiting or eliminating the ponds as an existing or future source of chromium to groundwater.*" The NDEP does not agree with this assessment. There are very high concentrations of chromium in groundwater in the vicinity of the P-2 and P-3 ponds. Data presented by KM indicates that a majority of this chromium may be hexavalent. Please provide further justification for the above statement.

17. **Section 3.2.1, page 3-11**

a. The detection limits presented in Table 3-2 and discussed in this section appear to be elevated. Potential screening levels for benzene, toluene and ethylbenzene in soil are at least an order of magnitude lower than the detection limits presented in table 3-2. For example, the USEPA SSL DAF 1 for benzene is 0.002 mg/kg, for toluene is 0.6 mg/kg, and for ethylbenzene is 0.7 mg/kg. KM needs to derive appropriate action levels and re-evaluate the need for additional sampling in this area.

b. For soil samples SB5-4 and SB5-5, the highest concentrations of "TEPH" are at the greatest depth. The NDEP believes that the depth and volume of soil contamination has not been appropriately evaluated. Additional deeper samples should be proposed in the next workplan.

c. It is suggested that future groundwater samples be analyzed for BTEX. Revised sampling procedures may need to be investigated due to the reported low flow conditions.

18. **Section 3.2.2, page 3-11**

a. The NDEP does not concur with the assessment that no further investigation is recommended or warranted for the former diesel fuel tank storage area.

LEO DROZDOFF, *Administrator*

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Administration
Facsimile 687-5856

Water Quality Planning
Water Pollution Control
Facsimile 687-4684

Mining Regulations and Reclamation
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STATE OF NEVADA
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DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
Las Vegas Office
1771 East Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837

May 6, 2005

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Background Investigation Work Plan dated March 29, 2005

Dear Ms. Crowley,

The NDEP has received and reviewed KM's correspondence identified above and provides comments in Attachment A. The NDEP requests that KM address the issues outlined herein no later than **June 22, 2005.**

If there is anything further or if there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Remediation and LUST Branch
Bureau of Corrective Actions
NDEP-Las Vegas Office

CC: Jim Najima, NDEP, BCA, Carson City
Jennifer Carr, NDEP, BCA, Carson City
Jeff Johnson, NDEP, BCA, Carson City
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlmann, City of Henderson, 240 Water Street, Suite 210, Henderson, NV 89015
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Carrie Stowers, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BEC, 875 West Warm Springs Road, Henderson, Nevada 89015
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
Mr. George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Mr. Lee Erickson, Stauffer Management Company, 1800 Concord Pike, Hanby 1, Wilmington, DE 19850-5437
Mr. Chris Sylvia, Pioneer Americas LLC, 8000 Lake Mead Parkway, Henderson, Nevada 89015
Mr. Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110

ATTACHMENT A

1. General comment, CEM Jurat, the jurat should clarify who is the responsible CEM for this project. There are three signatures on the page and one of the signatures is by a non-CEM. Please revise.
2. General comment, this report does not discuss the statistical methods that will be used to evaluate the background data once it is collected. It is suggested that KM describe the statistical methods that will be used to evaluate the background data in the revised version of this report.
3. General comment, KM should discuss how the proposed background data set will be evaluated versus background data sets collected by others (i.e., the City of Henderson, TIMET and BRC). It may be necessary for KM to consider these other background data sets in the development of the KM background data set. If the background data collected by KM differs from the data collected by others in the same geologic formation KM may need to discuss and justify the differences.
4. General comment, KM should discuss what types of background are proposed to be evaluated. For example, surface soil, sub-surface soil, sub-surface alluvium, sub-surface Muddy Creek formation (and different intervals?), ground water in the water table aquifer, ground water in deeper aquifers, etc.
5. Section 1.0, page 1-1, KM references a meeting that was held on April 1, 2005. This meeting did not occur. Please revise.
6. Section 1.2, page 1-4, KM states "In February 2004, the NDEP provided a response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that yet additional work would be required including..." The NDEP believes that the tone of this statement is inappropriate and has not been presented with data to not require "additional work". If KM believes that the scope of work that the NDEP is requiring is too onerous, then KM should develop an opinion paper and submit this document to the NDEP prior to the development of any additional reports.
7. Section 2.5, page 2-3, KM describes the water within the Muddy Creek formation as being of "generally good quality" and describes the water from the deeper coarse grained Muddy Creek Formation as containing "55 mg/l calcium, 180 mg/l chloride, 180 mg/l sodium and 250 mg/l sulfate". It would be helpful if this data was compared to site data that is impacted and off-site data that is not impacted. This data has limited meaning when it is not compared to other data sets. KM should substantiate statements in reports with data or references.
8. Section 3.0, page 3-1, it is requested that KM provide additional explanation on how the data that is collected for VOCs and TPH will be used. Ideally, background locations would be selected that are not impacted by anthropogenic activities. Also, please explain how KM will differentiate between site-related impacts from VOCs and TPH given the following:
   a. KM has documented releases of TPH on-site and elevated levels of TPH on-site and in the Western Area Power Administration (WAPA) easement.
   b. KM has a number of VOCs that are site-related chemicals.
   c. KM has collected limited groundwater data to determine the breadth and depth of contamination with regards to TPH and VOCs.
9. Section 3.2, pages 3-1 and 3-2, the NDEP has the following comments:

a. General comment, it may not be necessary to complete DQOs in order to develop a background data set. If KM chooses to develop a set of DQOs it is necessary to complete these DQOs in accordance with USEPA guidance. The NDEP believes that it is necessary to complete as many steps of the DQOs as possible in order to make sound decisions about site issues. KM has chosen to present an abbreviated implementation of the DQOs and the NDEP believes that this has limited value. Specific comments and examples are provided below.
b. Step 1, State the Problem, the NDEP has the following comments:
    i. The NDEP believes that the word "alluvium" in this sentence is extraneous. If KM disagrees, please explain how samples will be collected in the "alluvium" that are different than the soil and groundwater samples that are proposed. This comment applies to other steps in the DQOs as well.
    ii. KM has not identified the planning team and decision makers.
    iii. KM has not identified available resources, constraints and deadlines.
    iv. The NDEP believes that a reference to the CSM should be included in this step.
c. Step 2, Identify the Decision, the NDEP has the following comment:
    i. KM has not identified the principal study question, the alternative actions, or organized multiple decisions (if necessary).
d. Step 3, Identify Inputs to the Decision, the NDEP has the following comment:
    i. The NDEP believes that additional inputs may include: results of field screening of soil and groundwater; results of geological data collected; and the results of physical data of the soil. An additional input that should be discussed are the parameters that KM will compare the background data set to in order to determine if the data set is representative of background conditions.
e. Step 4, Study Area Boundaries, the NDEP has the following comments:
    i. KM should also state the depth-related boundary, and the time-related boundary for this study. In addition, it would be helpful if the areal boundaries were correlated to a figure.
    ii. Populations of interest should be defined. Including but not limited to the following examples: surface soil, subsurface soil (and possibly the different geologic formations), and groundwater (and possibly groundwater derived from different geologic formations).
    iii. The scale of decision making and practical constraints have not been discussed.
f. Step 5, Develop a Decision Rule, the NDEP has the following comments:
    i. KM has not specified the statistical parameter(s) that will characterize the population(s) of interest; or the action level that will be the basis for the decision; or combined the statistical parameter, the scale of decision making and the action level into a decision statement.
    ii. The decision statement should be presented in an if-then format to comply with the USEPA guidance.

g. Step 6, Specify Limits on Decision Error, and Step 7, Optimize the Design, the NDEP has the following comments:
   i. KM has not specified the limits on decision errors for step 6. KM should also discuss the project goals for power and significance. In addition, the null hypothesis has not been stated.
   ii. Step 7 has not been completed in accordance with the USEPA guidance.
   iii. It may not be necessary to complete Steps 6 and 7 of the DQOs. KM is asked to review the USEPA guidance and contemplate if it is necessary to complete Step 6 and 7 of the DQOs.

10. Section 4.1, pages 4-1 and 4-2, KM discusses the analytical data for perchlorate associated with existing well M-10, however, the analytical data for other analytes and other existing locations is not discussed. It is suggested that KM review and discuss the existing data for wells and soil borings in the vicinity of the proposed background locations. Please see additional comments below regarding the proposed background locations.
11. Section 4.1, pages 4-1 and 4-2, KM has proposed to sample soil and groundwater in a number of different geologic formations, however, KM does not discuss how this data will be applied in the future. KM should clarify the purpose of the work plan and identify if this background data set is intended to be applied to soils in the alluvium and the Muddy Creek Formation. In addition, a reference to the applicable tables would be helpful.
12. Section 4.3.1, page 4-3, please explain the methodology by which KM will obtain PID readings. Sonic drilling tends to produce heat which in turn accelerates volatization. PID readings on the outer surface of a soil boring may not be representative of sub-surface conditions.
13. Section 4.3.5, page 4-5, KM indicated that water generated from well development activities will be containerized and temporarily stored on site. Please explain what the final means of disposition and characterization will be for this material.
14. Section 4.3.6.2, pages 4-6 and 4-7, the NDEP has the following comments:
    a. Please include a discussion on well equilibration.
    b. Per USEPA guidance (*Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996), please limit the variance for electrical conductivity to 3%.
    c. Please clarify the criteria for low-flow purging versus traditional purging methodologies. It is likely that low-flow purging may produce variances in analytical results. KM should consider the implementation of either low-flow purging or traditional methodologies and implement this method uniformly.
    d. KM should consider implementing low-flow purging for wells that are located in low yield formations. Please note that TIMET has successfully implemented a low –flow purging and sampling program with some wells yielding as little as 40 mL/minute.
15. Section 4.3.6.3, pages 4-7 and 4-8, please note that USEPA guidance recommends against the use of a bailer for sample collection (*Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, May 2002).

16. Section 5.2, page 5-1, this section does not indicate that the analytical results will be statistically evaluated; see also general comment above on statistical methods. KM should describe how the background data will be evaluated if statistics are not proposed to be used.
17. Section 6.0, page 6-1, please note that the NDEP project manager for this case is Brian Rakvica not "Brian Ratvecka". Mr. Rakvica has been the project manager for this case for nearly two years and this type of error speaks to the lingering quality problems that KM continues to have.
18. Section 6.0, page 6-2, the Project Management Plan does not identify any personnel that perform QA/QC verification of documents prior to and after production. Based on the quality issues that KM has had in the past and continues to have, it is suggested that KM consider a more rigorous internal QA/QC program.
19. Section 7.0, pages 7-1 and 7-2, it would be helpful if KM listed the specific USEPA guidance that this document was prepared to be in compliance with.
20. Table 1, the NDEP has the following comments:
    a. Wells H-11, TR-8, TR-9, TR-10, and M-103 all appear to be impacted by site operations due to elevated concentrations of perchlorate. These elevated levels of this site-related chemical would disqualify these locations as viable background sample locations. The concentrations of perchlorate in these wells range from 47 – 1,000 ppb. If KM believes that these perchlorate concentrations are representative of background conditions the NDEP will require additional documentation to support this opinion.
    b. The NDEP requests that KM include a summary of the historic data from all of the existing wells that are proposed to be used for background. This data summary should include relevant data from the Montrose, Pioneer and Stauffer Corporations.
    c. KM states that there is an upward hydraulic gradient from the Muddy Creek formation to the alluvial aquifer, however, well TR-9 contains 55 ppb perchlorate at 250' bgs. Please explain the mechanism by which perchlorate impacted this well at this depth.
    d. Well H-11 is located south of the Montrose site and downgradient of an impacted site (the Fiesta Casino and adjacent properties). The properties upgradient of well H-11 that are impacted were historically used to stage ore materials and were also used as a historic dump by the BMI Companies. The NDEP explained this to KM in our meeting on March 16, 2005. It is suggested that KM review and present the historic data associated with well H-11. In addition, KM should present additional information to substantiate any opinion that the upgradient properties do not impact well H-11.
    e. Screened intervals, the NDEP has the following comments:
        i. Existing wells H-11, TR-7, TR-8, TR-9, and TR-10 are all screened well below the water table elevation as depicted on Figures 3, 4, and 5. Some wells are at greater than 200' below the existing water table elevation and are screened in a different geologic formation. KM should use existing wells or install new wells that are installed in the geologic formation that is closest to the alluvial aquifer and represents the "same water" that is found in the alluvial aquifer. It is not obvious

that the water located in the second coarse grained facies of the Muddy Creek Formation (MCF) is analogous to the water located in the alluvial aquifer.

ii. It is not clear why new wells are being proposed to be screened nearly 100' below the water table elevation and in a different geologic formation. It is suggested that the wells be screened in the geologic formation that contains the water table aquifer. For example, proposed well M-118 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table elevation is at approximately 50-60' bgs in the first coarse grained facies of the MCF. The NDEP does not understand the justification for such a proposal. Another example is proposed well M-117 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table is at approximately 70' bgs in the first coarse grained facies of the MCF.

21. Table 2, the NDEP has the following comments:
    a. KM has proposed varying sample depths on a location by location basis. This will provide a limited data set for soils below 50' bgs. KM should discuss if two soil samples from depths of 60-120' bgs will be sufficient to evaluate background. Also, it is not clear that the number of samples proposed for the 0-50' bgs depth increment is sufficient. It is the belief of the NDEP that KM will likely need more soil samples from the various depth intervals to appropriately assess background conditions.
    b. Please discuss how the sampling program was developed. All analytes are not proposed to be analyzed at all depths. Further justification for the analyses in the selected depth intervals is required.
    c. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded. The following metals appear to be omitted: calcium, magnesium, platinum, phosphorous, potassium, sodium, strontium, and tin. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, radon 222, and isotopic uranium. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.
    d. KM should list which VOCs are proposed for analysis.
22. Table 3, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. The method listed for perchlorate is EPA 350.1. This is the method for ammonia analysis. Please revise.
    c. It would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.

d. The method listed for total uranium is EML ASTM D5174. This appears to be the method for uranium analysis in water. Please clarify and revise if necessary.
e. KM states that radon-222 is not proposed for analysis because there is "no test – too volatile". The NDEP requests that this statement be clarified. There are analytical methods available to detect radon in soil. It appears that method DOE A-01-R (HASL 300) could be used for this purpose.
f. KM references "EML HASL 300" as the method for a majority of the radionuclides. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics, organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used. For example, method EML GA-01-R MOD is applicable to Lead-210, Lead-212, Lead-214, Bismuth-212, Bismuth-214, Actinium-228, Potassium-40, and Thallium-208.

23. Table 4, the NDEP has the following comments:
    a. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded. The following metals appear to be omitted: platinum, phosphorous, strontium and tin. In addition, hexavalent chromium is not specifically identified. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, and radon 222. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.
24. Table 5, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. Two methods are listed for cyanide. One method measures total cyanide and the other measures cyanide available to chlorination. Please discuss if KM plans to analyze by both methods or one of the methods. If KM is choosing to analyze using one of the indicated methods please delete the extraneous reference and explain why that method was chosen. The NDEP suggests that the analysis for total cyanide be used if KM is going to use one of the methods.
    c. Perchlorate is listed twice. Please remove the duplicate reference.
    d. As stated previously, it would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.
    e. Similar to the comment for cyanide, please specify what is intended for phosphate, sulfate, and radon analysis.
    f. KM references "EML HASL 300" as the method for uranium and thorium. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics,

organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used.

25. Figures 3, 4, and 5, it is suggested that these cross-sections be extended to present the data that shows that the water located in the MCF surfaces into the alluvial aquifer.

KERR-McGEE CHEMICAL LLC

Susan Crowley
Staff Environmental Specialist

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Fax (405) 228-6882
scrowley@kmg.com

July 20, 2005

Mr. Brian Rakvica, P.E.
Nevada Division of Environmental Protection
1771 East Flamingo, Suite 121-A
Las Vegas, NV 89119-0837

Subject: NDEP Facility ID H-000539 – Kerr-McGee ECA – *Background Study Work Plan – Groundwater and Soils* - Kerr-McGee Response to NDEP May 6, 2005 Comments

Dear Mr. Rakvica:

Kerr-McGee Chemical LLC (Kerr-McGee) has undertaken an Environmental Conditions Assessment (ECA) as directed by Nevada Division of Environmental Protection (NDEP). Integral to that investigation is understanding background conditions associated with the site. In late March 2005, Kerr-McGee submitted a *Background Study Work Plan – Groundwater and Soils* (Work Plan), which once executed is intended to provide information associated with background site conditions. NDEP provided comments regarding the Work Plan on May 6, 2005 and this correspondence provides responses to those comments. Our Work Plan has been revised to reflect the responses provided here but after discussion with your office we will hold on re-submittal of the revised Work Plan until you have reviewed the Attachment A enclosed.

Feel free to call me at (702) 651-2234 if you have any questions regarding this correspondence. Thank you.

Sincerely,

Susan Crowley
Staff Environmental Specialist, CEM 1428

Overnight Mail

Cc: Public Repository
Jeff Johnson, NDEP
Jennifer Carr, NDEP
Todd Croft, NDEP
Mitch Kaplan, EPA Region IX
Val King, NDEP
Jim Najima, NDEP
Jon Palm, NDEP

Brenda Pohlmann, COH
Barry Conaty, COH
Ron Sahu, BMI
Carrie Stowers, CCCP
Paul Sunberg, Montrose
Al Tinney, NDEP
Craig Wilkinson, TIMET
Keith Bailey, Kerr-McGee
Sally Bilodeau, ENSR
Pat Corbett, Kerr-McGee
John Dixon, Kerr-McGee
Dave Gerry, ENSR
Ed Krish, ENSR
Tom Reed, Kerr-McGee
Don Shandy, Kerr-McGee
Rick Stater, Kerr-McGee

Attachment

Attachment A
Kerr-McGee response to NDEP
Comments on the Background Investigation Work Plan
dated March 29, 2005 – Letter Dated May 6, 2005
Henderson, Nevada

NDEP Comment 1:

1. General comment, CEM Jurat, the jurat should clarify who is the responsible CEM for this project. There are three signatures on the page and one of the signatures is by a non-CEM. Please revise.

Response:

The signature page has been revised.

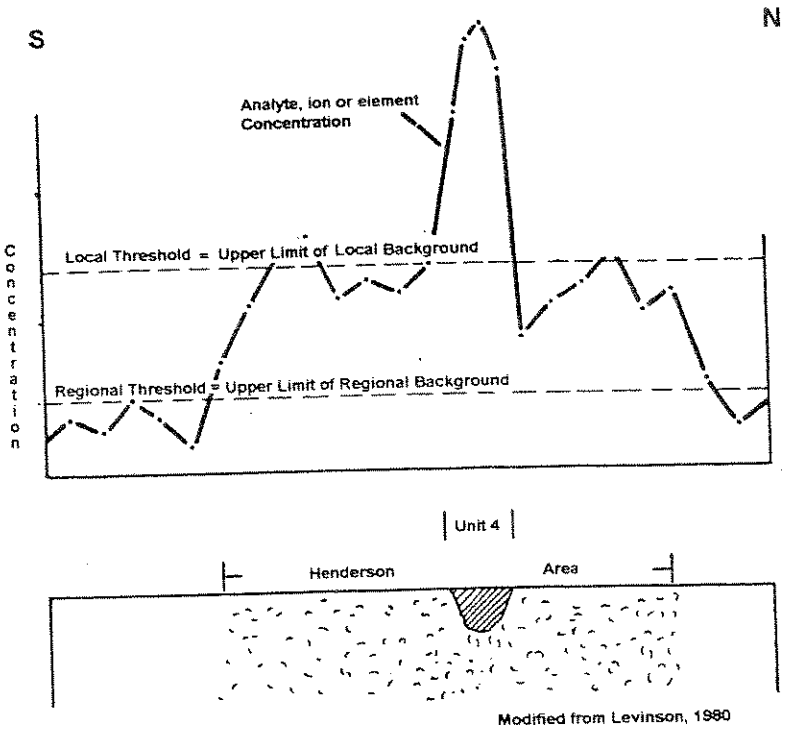
NDEP Comment 2:

2. General comment, this report does not discuss the statistical methods that will be used to evaluate the background data once it is collected. It is suggested that KM describe the statistical methods that will be used to evaluate the background data in the revised version of this report.

Response:

In interpreting the various chemical trends in the area of the Site, it is important to understand the concept of regional versus local background and threshold. As defined in the literature (Levinson, 1980), background is the normal range of concentrations, centered around some most likely value (the median), for an analyte, ion or element in an area. It is essential to understand that background is a range, and that normal backgrounds are established in unimpacted areas. The upper limit of background value, above which samples are considered anomalous, is defined as the threshold. The threshold is the highest background concentration.

Threshold concentrations, like median background concentrations, will vary for each analyte, ion or element, in each formation type and in each area. Concentrations higher than the threshold are considered anomalous and worthy of further evaluation. Statistical analyses of the sampled data allow a threshold to be defined. In most impacted areas there are usually two background values and two threshold values. These are called regional threshold, which is based on the normal (regional) background and the local threshold, based on a local (upgradient) background. The local (upgradient) background gives higher values and is generally in the vicinity of an impacted area. This concept is illustrated in the figure below, modified from Levinson (1980).



From this figure it can be seen that the regional upper limit of background (the regional threshold) can be considered a "plain" whereas the local upper limit of background (the local threshold) can be considered a "plateau" and the anomalies are represented as peaks. The definition of local backgrounds and thresholds, and the distinction between local and regional backgrounds and thresholds, are of great importance in the interpretation of chemical data.

By way of example, the bottom of the figure shows a theoretical cross section from the Black Mtns. on the south, through the Henderson and the BMI Complex areas, to Frenchman's Mtn on the north. This clearly illustrates the relationship of the higher local Henderson area background to the lower background of the surrounding region and the higher anomalous background in the Unit 4 area to the lower relative background of the Henderson area.

Without the benefit of a detailed geochemical orientation survey, the best way to determine regional and local background and threshold values is by using statistical methods. The conventional method, of taking the threshold as the mean plus two standard deviations, presents problems when dealing with geochemical data. Firstly, this method is designed for single population samples distributed symmetrically (either normal or lognormal). In geochemical surveys, sampling usually includes many individual populations related to bedrock type, environmental phenomena and contamination and therefore precludes the gathering of the requisite single population. Thus this situation really fits a case where the "statistical distribution is irregular" as defined by Hawkes and Webb (1962). Secondly, in areas containing contamination, the

inclusion of erratic high values renders the population asymmetrically distributed and biases the statistics toward the high end. For these kinds of "irregular" distributions the threshold can only be considered an "inspection level" and no true threshold can be determined (Garrett, 1989).

The preferred method used for determining the median background and upper limit of background (regional and local threshold) is described by Hawkes and Webb (1962). In this method the geochemical data are ordered (ranked) from lowest to highest, as one would do in preparing a cumulative frequency plot, and any erratic high values are set aside and some top percentage of the data are selected for further evaluation. According to these authors, when the statistical distribution is irregular, as it probably is in the Henderson area, "probably the best approximation is to estimate threshold (upper limit of background) as that value which is exceeded by no more than 2.5 percent of the total number of observations, excluding markedly high erratic values". Erratic values are defined as those lacking regularity. They are valid data, collected using approved industry methods and analyzed by reputable geochemical laboratories using approved analytical techniques. The only difference is that the erratic values have a markedly higher analyte content due to the sampling of scattered local anomalous phenomenon.

References:

Garrett, R. G. 1989. A Cry from the Heart. in Explore, Association of Exploration Geochemists Newsletter, Number 66, June 1989, Pg. 18-19.

Hawkes, H.E. and Webb, J.S. 1962. Geochemistry in Mineral Exploration, First edition: Harper and Row, New York, 415p.

Levinson, A.A. 1980. Introduction to Exploration Geochemistry. Second Edition: Applied Publishing, Calgary, 924p.

NDEP Comment 3:

3. General comment, KM should discuss how the proposed background data set will be evaluated versus background data sets collected by others (i.e., the City of Henderson, TIMET and BRC). It may be necessary for KM to consider these other background data sets in the development of the KM background data set. If the background data collected by KM differs from the data collected by others in the same geologic formation KM may need to discuss and justify the differences.

Response:

Kerr-McGee will compare this data set with data sets collected by others as appropriate for data sets collected from different physical locations and different geologic units. Background soil sampling by the City of Henderson, TIMET and BRC will probably suffice to establish the regional background and threshold. Also see the response for NDEP Comment 2.

NDEP Comment 4:

4. General comment, KM should discuss what types of background are proposed to be evaluated. For example, surface soil, sub-surface soil, sub-surface alluvium, sub-surface Muddy Creek formation (and different intervals?), ground water in the water table aquifer, ground water in deeper aquifers, etc.

Response:

Soil samples will be collected from 0.5 feet below ground surface (bgs), subsurface soil/alluvium samples will be collected from depths of 5, 10, 20, 30, 40 feet bgs (i.e. at 10 foot intervals until the Muddy Creek Formation is reached) and Muddy Creek formation samples will be collected at 10 foot intervals to the total depth of each borehole (currently estimated to be 140 feet in M-117 and M-118). Groundwater samples will be collected from the Muddy Creek coarse grained facies 1 and 2 (MCfg 1 and 2) and the Muddy Creek fine grained facies 2. These sample intervals are summarized in Tables 1 and 2 of the Workplan.

NDEP Comment 5:

5. Section 1.0, page 1-1, KM references a meeting that was held on April 1, 2005. This meeting did not occur. Please revise.

Response:

The meeting date has been changed to March 16, 2005.

NDEP Comment 6:

6. Section 1.2, page 1-4, KM states "In February 2004, the NDEP provided a response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that yet additional work would be required including..." The NDEP believes that the tone of this statement is inappropriate and has not been presented with data to not require "additional work". If KM believes that the scope of work that the NDEP is requiring is too onerous, then KM should develop an opinion paper and submit this document to the NDEP prior to the development of any additional reports.

Response:

Kerr-McGee did not intend to offend the NDEP and has removed the "yet" from the sentence.

NDEP Comment 7:

7. Section 2.5, page 2-3, KM describes the water within the Muddy Creek formation as being of "generally good quality" and describes the water from the deeper coarse grained Muddy Creek Formation as containing "55 mg/l calcium, 180 mg/l chloride, 180

mg/l sodium and 250 mg/l sulfate". It would be helpful if this data was compared to site data that is impacted and off-site data that is not impacted. This data has limited meaning when it is not compared to other data sets. KM should substantiate statements in reports with data or references.

Response:

The sentence discussing the data has been removed.

NDEP Comment 8

8. Section 3.0, page 3-1, it is requested that KM provide additional explanation on how the data that is collected for VOCs and TPH will be used. Ideally, background locations would be selected that are not impacted by anthropogenic activities. Also, please explain how KM will differentiate between site-related impacts from VOCs and TPH given the following:
    a. KM has documented releases of TPH on-site and elevated levels of TPH on-site and in the Western Area Power Administration (WAPA) easement.
    b. KM has a number of VOCs that are site-related chemicals.
    c. KM has collected limited groundwater data to determine the breadth and depth of contamination with regards to TPH and VOCs.

Response:

It is acknowledged that if TPH or VOC impacts are detected, additional analysis may be required to determine the extent and/or source of impact. Such analysis could include but not necessarily be limited to fuel fingerprinting.

NDEP Comment 9:

9. Section 3.2, pages 3-1 and 3-2, the NDEP has the following comments:
    a. General comment, it may not be necessary to complete DQOs in order to develop a background data set. If KM chooses to develop a set of DQOs it is necessary to complete these DQOs in accordance with USEPA guidance. The NDEP believes that it is necessary to complete as many steps of the DQOs as possible in order to make sound decisions about site issues. KM has chosen to present an abbreviated implementation of the DQOs and the NDEP believes that this has limited value. Specific comments and examples are provided below.
    b. Step 1, State the Problem, the NDEP has the following comments:
        i. The NDEP believes that the word "alluvium" in this sentence is extraneous. If KM disagrees, please explain how samples will be collected in the "alluvium" that are different than the soil and groundwater samples that are proposed. This comment applies to other steps in the DQOs as well.
        ii. KM has not identified the planning team and decision makers.
        iii. KM has not identified available resources, constraints and deadlines.
        iv. The NDEP believes that a reference to the CSM should be included in this step.

c. Step 2, Identify the Decision, the NDEP has the following comment:
    i. KM has not identified the principal study question, the alternative actions, or organized multiple decisions (if necessary).
d. Step 3, Identify Inputs to the Decision, the NDEP has the following comment:
    i. The NDEP believes that additional inputs may include: results of field screening of soil and groundwater; results of geological data collected; and the results of physical data of the soil. An additional input that should be discussed are the parameters that KM will compare the background data set to in order to determine if the data set is representative of background conditions.
e. Step 4, Study Area Boundaries, the NDEP has the following comments:
    i. KM should also state the depth-related boundary, and the time-related boundary for this study. In addition, it would be helpful if the areal boundaries were correlated to a figure.
    ii. Populations of interest should be defined. Including but not limited to the following examples: surface soil, subsurface soil (and possibly the different geologic formations), and groundwater (and possibly groundwater derived from different geologic formations).
    iii. The scale of decision making and practical constraints have not been discussed.
f. Step 5, Develop a Decision Rule, the NDEP has the following comments:
    i. KM has not specified the statistical parameter(s) that will characterize the population(s) of interest; or the action level that will be the basis for the decision; or combined the statistical parameter, the scale of decision making and the action level into a decision statement.
    ii. The decision statement should be presented in an if-then format to comply with the USEPA guidance.
g. Step 6, Specify Limits on Decision Error, and Step 7, Optimize the Design, the NDEP has the following comments:
    i. KM has not specified the limits on decision errors for step 6. KM should also discuss the project goals for power and significance. In addition, the null hypothesis has not been stated.
    ii. Step 7 has not been completed in accordance with the USEPA guidance.
    iii. It may not be necessary to complete Steps 6 and 7 of the DQOs. KM is asked to review the USEPA guidance and contemplate if it is necessary to complete Step 6 and 7 of the DQOs.

Response:

The DQOs have been removed.

NDEP Comment 10:

10. Section 4.1, pages 4-1 and 4-2, KM discusses the analytical data for perchlorate associated with existing well M-10, however, the analytical data for other analytes and other existing locations is not discussed. It is suggested that KM review and discuss the existing data for wells and soil borings in the vicinity of the proposed background

locations. Please see additional comments below regarding the proposed background locations.

Response:

A table will be added to section 4.1 that will list all of the available recent chemistry for the other existing upgradient wells in the vicinity of the proposed background locations. The contents of the table will be discussed in the text.

NDEP Comment 11:

11. Section 4.1, pages 4-1 and 4-2, KM has proposed to sample soil and groundwater in a number of different geologic formations, however, KM does not discuss how this data will be applied in the future. KM should clarify the purpose of the work plan and identify if this background data set is intended to be applied to soils in the alluvium and the Muddy Creek Formation. In addition, a reference to the applicable tables would be helpful.

Response:

The purpose of this work plan is to characterize the local background geochemistry of the sediments in the different upgradient formations as well as to characterize the local background chemistry of the groundwater that moves through them. It is anticipated that background soil sampling by the City of Henderson, TIMET and BRC will be sufficient to establish the regional background and threshold.

Chemical data generated in the sampling of soil from the different geologic formations will be used to establish a local baseline case showing the present chemical character of these formations at the upgradient edge of the Site. Chemical data generated in the sampling of groundwater from the different geologic formations will also be used to establish a local baseline case showing the present chemical character of these formation waters at the upgradient edge of the Site. These wells will be monitored annually for changes to this baseline. Refer also to the response to comment 2.

NDEP Comment 12:

12. Section 4.3.1, page 4-3, please explain the methodology by which KM will obtain PID readings. Sonic drilling tends to produce heat which in turn accelerates volatization. PID readings on the outer surface of a soil boring may not be representative of sub-surface conditions.

Response:

The following has been added to the workplan. "Approximately 200 grams of soil will be removed from the sampling tube and placed in a zip lock plastic bag. In general soil from the middle sleeve of the sampling tube is used for the PID analysis. Once sealed in the bag the soil will be broken apart and allowed to equilibrate for about 20 minutes. The probe tip of the PID will be inserted into the plastic bag and a reading obtained.

These organic vapor readings will be recorded on boring logs prepared by the field geologist during drilling activities. The PID will be calibrated to 100 ppm isobutylene each day prior to its use."

In response to the heat from sonic drilling, please note that the drill string is removed from the borehole and the split spoon sampler is advanced into "undisturbed" soil, so heat transference from the sonic drill bit to the portion of the soil column that is sampled will be minimal.

NDEP Comment 13:

13. Section 4.3.5, page 4-5, KM indicated that will be containerized and temporarily stored on site. Please explain what the end characterization will be for this material.

Response:

The water generated from well development activities will stored in the GW-11 pond and treated on site.

NDEP Comment 14:

14. Section 4.3.6.2, pages 4-6 and 4-7, the NDEP has the following comments:
    a. Please include a discussion on well equilibration.
    b. Per USEPA guidance (*Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996), please limit the variance for electrical conductivity to 3%.
    c. Please clarify the criteria for low-flow purging versus traditional purging methodologies. It is likely that low-flow purging may produce variances in analytical results. KM should consider the implementation of either low-flow purging or traditional methodologies and implement this method uniformly.
    d. KM should consider implementing low-flow purging for wells that are located in low yield formations. Please note that TIMET has successfully implemented a low –flow purging and sampling program with some wells yielding as little as 40 mL/minute.

Response:

a. *The text has been revised to state, "The well casing will have a vent hole so equilibration of the water level prior to purging and sampling should be achieved. Water levels will be monitored during purging and sampling and, if possible, drawdown will be limited to less than 10 percent of the distance between the initial water level and pump intake."*
b. *Historical data indicate that electrical conductivity varies 5% due to the chemistry of the local aquifer so that site specific value will be applied.*
c. *Kerr-McGee is still in the process of evaluating the purge and sampling methods to apply to the site. It is anticipated that some comparative tests may be proposed to resolve this issue. Kerr-McGee will work closely with NDEP to identify and implement sampling methods that are acceptable to both parties.*

d. *Kerr-McGee is still in the process of evaluating the purge and sampling methods to apply to the site. It is anticipated that some comparative tests may be proposed to resolve this issue. Kerr-McGee will work closely with NDEP to identify and implement sampling methods that are acceptable to both parties.*

NDEP Comment 15:

15. Section 4.3.6.3, pages 4-7 and 4-8, please note that USEPA guidance recommends against the use of a bailer for sample collection (*Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, May 2002).

Response:

Comment noted. See response to 14 c and d above.

NDEP Comment 16:

16. Section 5.2, page 5-1, this section does not indicate that the analytical results will be statistically evaluated; see also general comment above on statistical methods. KM should describe how the background data will be evaluated if statistics are not proposed to be used.

Response:

As described in the response for NDEP Comment 2, Kerr-McGee plans to identify a local threshold (upper limit of background) as that value that is not exceeded by 2.5 percent of the total number of observations, excluding markedly high erratic values.

NDEP Comment 17:

17. Section 6.0, page 6-1, please note that the NDEP project manager for this case is Brian Rakvica not "Brian Ratvecka". Mr. Rakvica has been the project manager for this case for nearly two years and this type of error speaks to the lingering quality problems that KM continues to have.

Response:

Comment noted.

NDEP Comment 18:

18. Section 6.0, page 6-2, the Project Management Plan does not identify any personnel that perform QA/QC verification of documents prior to and after production. Based on the quality issues that KM has had in the past and continues to have, it is suggested that KM consider a more rigorous internal QA/QC program.

Response:

A QA/QC verification of documents team has been designated.

NDEP Comment 19:

19. Section 7.0, pages 7-1 and 7-2, it would be helpful if KM listed the specific USEPA guidance that this document was prepared to be in compliance with.

Response:

The references section has been expanded to include USEPA guidance documents.

NDEP Comment 20:

20. Table 1, the NDEP has the following comments:
    a. Wells H-11, TR-8, TR-9, TR-10, and M-103 all appear to be impacted by site operations due to elevated concentrations of perchlorate. These elevated levels of this site-related chemical would disqualify these locations as viable background sample locations. The concentrations of perchlorate in these wells range from 47 – 1,000 ppb. If KM believes that these perchlorate concentrations are representative of background conditions the NDEP will require additional documentation to support this opinion.
    b. The NDEP requests that KM include a summary of the historic data from all of the existing wells that are proposed to be used for background. This data summary should include relevant data from the Montrose, Pioneer and Stauffer Corporations.
    c. KM states that there is an upward hydraulic gradient from the Muddy Creek formation to the alluvial aquifer; however, well TR-9 contains 55 ppb perchlorate at 250' bgs. Please explain the mechanism by which perchlorate impacted this well at this depth.
    d. Well H-11 is located south of the Montrose site and downgradient of an impacted site (the Fiesta Casino and adjacent properties). The properties upgradient of well H-11 that are impacted were historically used to stage ore materials and were also used as a historic dump by the BMI Companies. The NDEP explained this to KM in our meeting on March 16, 2005. It is suggested that KM review and present the historic data associated with well H-11. In addition, KM should present additional information to substantiate any opinion that the upgradient properties do not impact well H-11.
    e. Screened intervals, the NDEP has the following comments:
        i. Existing wells H-11, TR-7, TR-8, TR-9, and TR-10 are all screened well below the water table elevation as depicted on Figures 3, 4, and 5. Some wells are at greater than 200' below the existing water table elevation and are screened in a different geologic formation. KM should use existing wells or install new wells that are installed in the geologic formation that is closest to the alluvial aquifer and represents the "same water" that is found in the alluvial aquifer. It is not obvious that the water located in the second coarse grained facies of the Muddy Creek Formation (MCF) is analogous to the water located in the alluvial aquifer.
        ii. It is not clear why new wells are being proposed to be screened nearly 100' below the water table elevation and in a different geologic formation.

It is suggested that the wells be screened in the geologic formation that contains the water table aquifer. For example, proposed well M-118 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table elevation is at approximately 50-60' bgs in the first coarse grained facies of the MCF. The NDEP does not understand the justification for such a proposal. Another example is proposed well M-117 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table is at approximately 70' bgs in the first coarse grained facies of the MCF.

Response:

a. *In the response to NDEP Comment 2, the concept of regional versus local background and threshold was described and illustrated in a figure. It was stressed that background is a range of values centered around a median concentration and that the threshold is the upper limit of background above which concentrations are anomalous. This concept requires that there will be two backgrounds and two thresholds – a lower regional one and a higher local one. Henderson, by its very nature as a residential/commercial/industrial city, appears to have made its background and threshold the higher local variety. In essence, Henderson, in its 70+ years of existence, has impacted some soil and groundwater. Chemical impacts upgradient of the Kerr-McGee Site contribute to the higher local background and threshold conditions which, in turn, directly impact the Kerr-McGee Site.*

   The NDEP observation of 1000 ug/l perchlorate in well TR-10 has been noted. However the recently discovered 510 and 390 ug/l perchlorate concentrations in groundwater along Lake Mead Parkway, south of TIMET and downgradient of downtown Henderson, appears to indicate other upgradient off-site impacts

   In response to NDEP's concerns, Kerr-McGee has relocated wells M-117 and M-118 to the extreme south end of the property approximately 50 feet north of Lake Mead Parkway. In addition two wells will be constructed in the same area to monitor the first encountered water bearing zone.

b. *A summary table of historic chemical data, of known data quality, will be provided for the existing wells that are proposed to be used for background.*

c. *Potential mechanisms will be discussed.*

d. *The historic data from well H-11, of known data quality, will be presented and the difference between regional background and local (upgradient) background and threshold will be discussed.*

e.i *The TR-series wells were installed in 1999 to specifically look for the deep AMPAC perchlorate plume in the first and second coarse-grained facies of the Muddy Creek formation beneath the Kerr-McGee Site. At that time the eastern most expression of this plume was in the Thatcher well, 3000 feet to the west and possibly in H-11 located 300 feet west of the Kerr-McGee property boundary.*

Kerr-McGee has sought to monitor and understand what upgradient off-Site chemical constituents are flowing toward the Site. The rational for completing proposed wells M-117 and M-118 in the MCfg2 unit is because there are not wells completed in that unit. As mentioned above, the locations for the two new wells have been relocated to the south and two additional wells to monitor the first encountered water bearing zone will also be constructed. Comment noted.

e.ii *In order to be further away and upgradient from historic industrial land uses, Kerr-McGee has relocated wells M-117 and M-118 to the extreme south end of the property just north of the drainage ditch that parallels Lake Mead Parkway. In addition two wells will be constructed in the same area to monitor the first encountered water bearing zone. The map and cross sections will be updated to reflect this change. Comment noted.*

NDEP Comment 21:

21. Table 2, the NDEP has the following comments:
    a. KM has proposed varying sample depths on a location by location basis. This will provide a limited data set for soils below 50' bgs. KM should discuss if two soil samples from depths of 60-120' bgs will be sufficient to evaluate background. Also, it is not clear that the number of samples proposed for the 0-50' bgs depth increment is sufficient. It is the belief of the NDEP that KM will likely need more soil samples from the various depth intervals to appropriately assess background conditions.
    b. Please discuss how the sampling program was developed. All analytes are not proposed to be analyzed at all depths. Further justification for the analyses in the selected depth intervals is required.
    c. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded. The following metals appear to be omitted: calcium, magnesium, platinum, phosphorous, potassium, sodium, strontium, and tin. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, radon 222, and isotopic uranium. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.
    d. KM should list which VOCs are proposed for analysis.

Response:

a. Kerr-McGee will discuss the need for additional background samples following analysis of the samples proposed.
b. Justification for the analysis selected for the depth intervals has been included.
c. Justification for the selected metals and radionuclides has been included.
d. The VOCs proposed for analyses are listed at the end of this document and at the bottom of Table 3.

NDEP Comment 22:

22. Table 3, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. The method listed for perchlorate is EPA 350.1. This is the method for ammonia analysis. Please revise.
    c. It would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.
    d. The method listed for total uranium is EML ASTM D5174. This appears to be the method for uranium analysis in water. Please clarify and revise if necessary.
    e. KM states that radon-222 is not proposed for analysis because there is "no test – too volatile". The NDEP requests that this statement be clarified. There are analytical methods available to detect radon in soil. It appears that method DOE A-01-R (HASL 300) could be used for this purpose.
    f. KM references "EML HASL 300" as the method for a majority of the radionuclides. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics, organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used. For example, method EML GA-01-R MOD is applicable to Lead-210, Lead-212, Lead-214, Bismuth-212, Bismuth-214, Actinium-228, Potassium-40, and Thallium-208.

Response:

a. *Comment noted.*
b. *Comment noted. The method for Perchlorate in soil to be used is EPA 314.0 using preparation method 1:10 DI-leach.*
c. *The VOCs proposed for analyses are listed at the end of this document and on Table 3.*
d. *The method to be used for analysis of total Uranium is DOE U-02 using Alpha Spectroscopy.*
e. *According to the contracted Nevada Certified lab for radionuclide analyses (both soil and water) Radon-222 analyses are not performed on soil, in groundwater the analyses is by Liquid Scintillation SM 7500-RN-B. However, Nevada does not certify a method for Radon-222 in either water or soil.*
f. *Table 3 has been revised with specific methods.*

NDEP Comment 23:

23. Table 4, the NDEP has the following comments:
    a. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded.

The following metals appear to be omitted: platinum, phosphorous, strontium and tin. In addition, hexavalent chromium is not specifically identified. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, and radon 222. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.

Response:

Justification for the selected metals and radionuclides has been included.

NDEP Comment 24:

24. Table 5, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. Two methods are listed for cyanide. One method measures total cyanide and the other measures cyanide available to chlorination. Please discuss if KM plans to analyze by both methods or one of the methods. If KM is choosing to analyze using one of the indicated methods please delete the extraneous reference and explain why that method was chosen. The NDEP suggests that the analysis for total cyanide be used if KM is going to use one of the methods.
    c. Perchlorate is listed twice. Please remove the duplicate reference.
    d. As stated previously, it would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.
    e. Similar to the comment for cyanide, please specify what is intended for phosphate, sulfate, and radon analysis.
    f. KM references "EML HASL 300" as the method for uranium and thorium. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics, organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used.

Response:

a. *Comment noted.*
b. *The analysis for Total Cyanide will be used (EPA Method 335.2) as it is a better measure of occurrence that will detect free Cyanide and metal associated Cyanides.*
c. *Comment noted, the duplicate reference has been removed.*
d. *The list of VOCs to be analyzed is attached in Kerr-McGee's response to comment 25. No fuel alcohols will be analyzed due to the difficulty in analyzing for ethanol and methanol, also methanol is the solvent for the internal standard used in the laboratory making analysis for this analyte virtually impossible.*

e. *The analysis for phosphate will be the colorimetric method EPA 365.1, which is more sensitive than EPA 300.0. The analysis for sulfate will be EPA 300, which is more precise than EPA 375.4. The analysis for radon will be Standard Methods 7500-RN-B, which is the method proposed by EPA for the Radon Rule and is more precise than EPA 913.0.*

f. *Total Uranium will be analyzed by DOE U-02 (Alpha Spectroscopy). Isotopic Thorium will be analyzed by ACW-03 (Alpha Spectroscopy), however Nevada does not certified any analysis for Thorium.*

NDEP Comment 25:

25. Figures 3, 4, and 5, it is suggested that these cross-sections be extended to present the data that shows that the water located in the MCF surfaces into the alluvial aquifer.

Response:

A north-south cross section (PLATE 4d) that shows the water located in the Muddy Creek formation surfaces into the alluvial aquifer is part of the Conceptual Site Model document dated February 28, 2005. Readers will be referred to that cross section.

24d. List of VOCs to be analyzed in Groundwater and Soil. In groundwater no fuel alcohols will be analyzed due to difficulty in analyzing for ethanol and methanol is the solvent for the internal standard used in the laboratory.

1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane (1,1,2-T
1,1-Dichloroethane
1,1-Dichloroethylene (1,1DCE)
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichloropropane
2,2-Dichloropropane
2-Butanone (MEK)
2-Chloroethylvinyl ether
2-Hexanone
4-Methyl-2-Pentanone (MIBK)
Acetone
Acrylonitrile
Benzene
Bromobenzene
Bromochloromethane
Bromoform
Carbon disulfide
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Dibromomethane
Dichlorobromomethane
Dichlorodifluoromethane
Ethyl benzene
Freon 113
Hexachlorobutadiene
Iodomethane
Isopropylbenzene
m-Dichlorobenzene (1,3-DCB)
Methyl Bromide
Methyl Chloride
*methyl isobutyl ketone**
methyl tert-butyl ether
Methylene Chloride
Naphthalene

n-Butylbenzene
n-Propylbenzene
o-Chlorotoluene
o-Dichlorobenzene (1,2-DCB)
p-Chlorotoluene
p-Dichlorobenzene (1,4-DCB)
p-Isopropyltoluene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene (PCE)
Toluene
Total Trihalomethanes
Total Xylenes
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethylene (TCE)
Trichlorofluoromethane
Vinyl Acetate
Vinyl Chloride (VC)

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AUG - 1 2005

July 28, 2005

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Background Study Workplan – Groundwater and Soils – Kerr-McGee Response to NDEP May 6, 2005 Comments dated July 20, 2005

Dear Ms. Crowley,

The NDEP has received and reviewed KM's correspondence identified above and provides comments in Attachment A. Please address these comments in the revised workplan, if there are questions it is suggested that these issue be discussed in our next monthly meeting.

If there is anything further or if there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Remediation and LUST Branch
Bureau of Corrective Actions
NDEP-Las Vegas Office

CC: Jim Najima, NDEP, BCA, Carson City
Jeff Johnson, NDEP, BCA, Carson City
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Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
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Mr. Chris Sylvia, Pioneer Americas LLC, PO Box 86, Henderson, Nevada 89009
Mr. Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110

Attachment A

1. General comment, in a number of instances KM notes that the response is provided in the revised workplan. The NDEP will review the appropriateness of these revisions once the revised workplan in received.
2. Response #2, the NDEP has the following comments:
    a. The NDEP recommends the use of the following statistical tests: Gehan Modification of the Wilcoxon Rank Sum Test; Quantile Test; Slippage Test; and side-by-side plots. The NDEP can provide additional information on these tests and a reference to a website that may assist Kerr-McGee with completing these tests. The derivation of background is an issue that requires rigorous analysis by KM and concurrence by the NDEP.
    b. KM should reference the applicable USEPA guidance on the calculation of the range of background concentrations. Geochemistry textbooks are not an appropriate reference. Please review the applicable USEPA guidance and the KM response.
    c. The NDEP understands and appreciates the importance of establishing upgradient conditions and requests that the terminology of upgradient be used in place of "local background".
    d. KM should note that the range of background concentrations will not necessarily be centered around the median.
3. Response #3, KM should note that the BRC/TIMET evaluation of background includes the evaluation of alluvial soils derived from the River Mountains and McCullough range. This evaluation will also determine if the soils from these two ranges are geologically and chemically similar. KM is located on soils derived from the McCullough Range. Please describe what "different geologic unit" is being referenced by KM in their response. It appears that KM may be referring to soils derived from the Muddy Creek Formation. Please clarify.
4. Response #8, KM should note that the nature and extent of contamination associated with the southern drainage ditch has not been determined and that it is likely that this ditch is a source of perchlorate, TPH, and other contaminants.
5. Response #14a, depending on the methodology used, the drawdown discussed by KM may not be appropriate. If low-flow sampling is performed the drawdown should be limited to less than 0.3 feet at the maximum purge rate. Additionally, it is recommended (for low-flow sampling) that the well equilibration be verified. The well should be opened and a depth to water measurement should be taken. This depth to water measurement should be taken periodically until two consecutive readings within 0.01 feet of each other are recorded. It is recommended that KM discuss the appropriate sampling techniques with a qualified vendor or TIMET personnel.
6. Response #14b, please note that the historical data is not based upon low-flow sampling. Low-flow sampling may allow KM to achieve the less than 3% variance that is requested. The remaining parameters should stabilize prior to sampling of the well. Once KM has selected a sampling method, NDEP will work with KM to determine an appropriate operating procedure. Also, please note that the revised

workplan cannot be approved until a sampling procedure is decided upon and discussed with the NDEP.

7. Response #16, please see NDEP comment above regarding Response #2.
8. Response #20a, KM should note that it is likely that the drainage ditch along the southern property boundary is a likely source of contamination. See also comment #3 above. KM should note that it is possible that the proposed wells may serve as a good indication of upgradient conditions but may not be appropriate for the evaluation of background conditions. As NDEP has discussed with KM previously, it is preferable to locate background locations off-site and upgradient of impacts from the site.
9. Response #24d, it is expected that the revised workplan will provide a discussion on how the VOCs in this list were selected and how they compare to the site-related chemical list.

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October 6, 2005

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Upgradient Investigation Work Plan
dated September 29, 2005

Dear Ms. Crowley,

The NDEP has received and reviewed KM's letter identified above and provides comments in Attachment A. The remaining issues outlined below should be addressed through a conference call and/or errata sheet prior to the initiation of field work.

If there is anything further or if there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Bureau of Corrective Actions
NDEP-Las Vegas Office

CC: Jim Najima, NDEP, BCA, Carson City
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Attachment A

1. Section 3.2, page 3-2, after the completion of field activties, in the investigation report, and please include a discussion regarding the relationship between the various lithologies. For example, how does the groundwater encountered in the alluvial aquifer in the central portions of site relate to the MCfg1 and MCcg1 formations on the southern portion of the site? Also, are any chemical differences in groundwater attributable to the difference in lithology?
2. Section 3.3, pages 3-3 and 3-4, please consider including the following chemicals in the soil and groundwater analyses: cyanide – reportedly was historically associated with State Industries operations; chlorate – historically associated with Site operations; platinum – historically associated with Site operations and potentially useful for delineating upgradient versus Site-related. The presence of platinum is unclear at this time based on the limited amount of historic data on platinum.
3. Section 3.3, page 3-3, it is suggested that perchlorate analysis be completed in the same intervals as the remaining metals and ions. Also, this section does not address the NDEP comment 9 in the July 28, 2005 letter to KM regarding VOCs. Please provide a discussion or table that addresses this issue.
4. Section 4.2.6.2, page 4-6, in the errata submitted on September 5, 2005 KM changed the variance to 3% for electrical conductivity, turbidity and dissolved oxygen. The NDEP's requested change was for electrical conductivity only. Please note the appropriate correction in the field sampling protocol.
5. Table 2, the NDEP has the following comments:
    a. The proposed sampling frequency for metals does not coincide with the text on page 3-3. The text on page 3-3 indicates that samples will be collected every 10' to the bottom of the boring. Table 2 skips the collection of samples in select intervals. Please correct the text or table.
    b. The proposed sampling frequency for location M-121 for hexavalent chromium does not appear to be consistent with the remainder of the locations or with the text. Please delete the 5' depth interval for consistency.
    c. The proposed sampling frequency for location M-121 for radionuclides is not consistent with the remainder of the locations. Please include a sample at the 5' depth interval and hold the samples in the 10' depth interval for consistency.
6. Figure 2, KM should consider soil sampling in the storm water ditch (and vicinity) to delineate the depth and extents of contamination associated with this ditch
7. Please note that the NDEP's review of this document does not include a comprehensive review of detection limits in Appendix D; appropriateness of containers or holding times for laboratory analyses; or QA/QC procedures relating to field procedures or laboratory analyses. These issues are the responsibility of KM to insure that data collected is of sufficient quality to support future decision making. The NDEP will review these issues in an exhaustive manner as part of future data validation; risk assessments; and risk-based decisions. The NDEP has performed "spot checks" of this information and has included comments as necessary. Also, the

TRONOX

Susan Crowley
Staff Environmental Specialist

(702) 651-2234
Fax (405) 228-6882
scrowley@kmg.com

February 20, 2006

Brian Rakvica, P.E.
Nevada Division of Environmental Protection
1771 East Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119

Subject: NDEP Facility ID H-000539 – Tronox ECA – *Upgradient Investigation Workplan* – Tronox response to NDEP October 6, 2005 comments

Dear Mr. Rakvica:

Tronox LLC (Tronox), formerly Kerr-McGee Chemical LLC (Kerr-McGee), has undertaken an Environmental Conditions Assessment (ECA) as directed by the Nevada Division of Environmental Protection (NDEP). Integral to that investigation is understanding upgradient / background conditions associated with the site. In late March 2005, Tronox submitted a *Background Study Workplan*. NDEP provided comments May 6, 2005 and Tronox provided a response to NDEP's comments July 20, 2005. NDEP provided further comment on July 28, 2005 and Tronox submitted the *Upgradient Investigation Workplan* September 29, 2005. October 6, 2005 the NDEP provided additional comments and October 14, 2005 errata sheets and a revised CD were provided by Tronox. The enclosed *Attachement A* has been prepared to document Tronox responses to the NDEP October 6, 2005 comments.

Please feel free to contact me at (702) 651-2234, if you have any questions related to this information. Thank you.

Sincerely,

Susan M. Crowley
Staff Environmental Specialist

Overnight Mail

cc: Public Repository
Jeff Johnson, NDEP
Keith Bailey Tronox
Tom Reed, Tronox
Ed Krish, ENSR
Sally Bilodeau, ENSR

Todd Croft, NDEP
Val King, NDEP
Jim Najima, NDEP
Jon Palm, NDEP
Brenda Pohlmann, COH
Barry Conaty, COH
Rob Mrowka, CCCP
Mitch Kaplan, EPA Region IX
Ron Sahu, BMI
Paul Sundberg, Montrose
Al Tinney, NDEP
Craig Wilkinson, TIMET
Dave Gerry, ENSR
Pat Corbett, Tronox
Dana Elmer, Tronox
John Hatmaker, Tronox
Don Shandy, Tronox
Rick Stater, Tronox
Brad Dougherty, AIG
Tim Wolf, Malcom Pirne
Tracy Hemmerling

Attachment

J:\2006 Projects\
04020 - KerrMcGee\0

Attachment A
Tronox response to
October 6, 2005 NDEP comments on the
Upgradient Investigation Workplan
dated September 29, 2005

NDEP Comment 1

1. Section 3.2, page 3-2, after the completion of field activties, in the investigation report, and please include a discussion regarding the relationship between the various lithologies. For example, how does the groundwater encountered in the alluvial aquifer in the central portions of site relate to the MCfg1 and MCcg1 formations on the southern portion of the site? Also, are any chemical differences in groundwater attributable to the difference in lithology?

Response: *The data will be evaluated to see if differences in groundwater chemistry may be attributable to differences in lithology.*

NDEP Comment 2

2. Section 3.3, pages 3-3 and 3-4, please consider including the following chemicals in the soil and groundwater analyses: cyanide – reportedly was historically associated with State Industries operations; chlorate – historically associated with Site operations; platinum – historically associated with Site operations and potentially useful for delineating upgradient versus Site-related. The presence of platinum is unclear at this time based on the limited amount of historic data on platinum.

Response: *Cyanide, platinum and chlorate have been added to the soil and groundwater analyte lists.*

NDEP Comment 3

3. Section 3.3, page 3-3, it is suggested that perchlorate analysis be completed in the same intervals as the remaining metals and ions. Also, this section does not address the NDEP comment 9 in the July 28, 2005 letter to KM regarding VOCs. Please provide a discussion or table that addresses this issue.

Response: *Table 2 has been modified to indicate that Perchlorate will be analyzed at the same intervals as metals and ions. The suite of VOCs that will be included in the soil and water analysis is shown on Table 8. The VOCs proposed for analysis include those that the selected lab routinely performs through this analyes. This is a broader suite of VOCs than those specifically identified on the Site Related Chemicals List (SRC). The broader suite of VOCs was selected because it is available at no additional cost and the additional information may identify chemicals that are present but that are not currently on the SRC list.*

NDEP Comment 4

4. Section 4.2.6.2, page 4-6, in the errata submitted on September 5, 2005 KM changed the variance to 3% for electrical conductivity, turbidity and dissolved

oxygen. The NDEP's requested change was for electrical conductivity only. Please note the appropriate correction in the field sampling protocol.

Response: *The text has been modified to state, "Stabilization of water quality parameters is indicated when the following criteria are met in the final three consecutive readings: the pH is within 0.1 unit, temperature is within 1 degree Celsius, electrical conductivity is within 3 percent and the dissolved oxygen and turbidity are within 5 percent."*

NDEP Comment 5

5. Table 2, the NDEP has the following comments:
    a. The proposed sampling frequency for metals does not coincide with the text on page 3-3. The text on page 3-3 indicates that samples will be collected every 10' to the bottom of the boring. Table 2 skips the collection of samples in select intervals. Please correct the text or table.
    b. The proposed sampling frequency for location M-121 for hexavalent chromium does not appear to be consistent with the remainder of the locations or with the text. Please delete the 5' depth interval for consistency.
    c. The proposed sampling frequency for location M-121 for radionuclides is not consistent with the remainder of the locations. Please include a sample at the 5' depth interval and hold the samples in the 10' depth interval for consistency.

Response: *The tables and text have been corrected.*

NDEP Comment 6

6. Figure 2, KM should consider soil sampling in the storm water ditch (and vicinity) to delineate the depth and extents of contamination associated with this ditch.

Response: *Tronox is not proposing to sample the storm water ditch at this time but will evaluate sampling following evaluation of the soil and groundwater data generated by the upgradient investigation.*

NDEP Comment 7

7. Please note that the NDEP's review of this document does not include a comprehensive review of detection limits in Appendix D; appropriateness of containers or holding times for laboratory analyses; or QA/QC procedures relating to field procedures or laboratory analyses. These issues are the responsibility of KM to insure that data collected is of sufficient quality to support future decision making. The NDEP will review these issues in an exhaustive manner as part of future data validation; risk assessments; and risk-based decisions. The NDEP has performed "spot checks" of this information and has included comments as necessary. Also, the NDEP does not have the regulatory authority to review or approve Health and Safety plans but appreciates the inclusion of these documents as part of the work plan.

Response: *Comment noted.*

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NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Kenny C. Guinn, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

February 23, 2006

Ms. Susan Crowley
Tronox LLC
PO Box 55
Henderson, Nevada 89009

Re: **Tronox LLC (Trx)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Upgradient Investigation Work Plan
dated February 2006

Dear Ms. Crowley,

The NDEP has received and reviewed Trx's letter identified above and provides comments below.

1. Table 2, it is suggested that hexavalent chromium be analyzed from the same depth increments as the remaining metals.
2. Table 8, please include xylenes in the VOC analysis.

These comments should be addressed as part of the work plan implementation. If there is anything further or if there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions
NDEP-Las Vegas Office

CC: Jim Najima, NDEP, BCA, Carson City
Jeff Johnson, NDEP, BCA, Carson City
Shannon Harbour, NDEP, Las Vegas
Todd Croft, NDEP, Las Vegas
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Rob Mrowka, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BEC, 311 North Story Place, Alhambra, CA 91801
Keith Bailey, Tronox, PO Box 268859, Oklahoma City, Oklahoma 73126-8859
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
Mr. George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Mr. Lee Erickson, Stauffer Management Company, 1800 Concord Pike, Hanby 1, Wilmington, DE 19850-5437
Mr. Chris Sylvia, Pioneer Americas LLC, PO Box 86, Henderson, Nevada 89009
Mr. Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110

TRONOX

Susan Crowley
Staff Environmental Specialist

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July 20, 2006

Mr. Brian Rakvica, P.E.
Nevada Division of Environmental Protection
1771 East Flamingo, Suite 121-A
Las Vegas, NV 89119-0837

Subject: NDEP Facility ID H-000539 – Tronox ECA – *Upgradient Study Report*

Dear Mr. Rakvica:

Tronox LLC (Tronox) has undertaken an Environmental Conditions Assessment (ECA) as directed by Nevada Division of Environmental Protection (NDEP). An element of this ECA is the development of an understanding of upgradient soil and groundwater conditions. This information can in turn assist in understanding the background conditions for the site, within which the studied facility sits. A work plan was prepared and approved by NDEP for upgradient soil and groundwater sampling which anticipated a report preparation time of 120 following field sampling. The field sampling was completed earlier this year; however the long delivery time for the analytical results has delayed several key elements for the report preparation, data validation being the first. The validation is underway and moving with all speed. Even with this, the report will not be available for issue until October 31, 2006.

Feel free to call me at (702) 651-2234 if you have any questions regarding this correspondence. Thank you.

Sincerely,

Susan Crowley
Staff Environmental Specialist, CEM 1428 exp 3-8-07

Overnight

CC: Please see attached distribution list

smc/Trx to NDEP - Delivery of Source Area Phase A Work Plan - 10-21-05.doc

Tronox Document Distribution List Updated: 20-Apr-06

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Reed	Tom	Tronox	X	X	
Shandy	Don	Tronox Counsel		X	
Stater	Rick	Tronox		X	
Crowley	Susan	Tronox	2	X	
			& Hard Data		
Krish	Ed	ENSR	X	X	
Bilodeau	Sally	ENSR	X	X	
Gerry	Dave	ENSR		X	
Lambeth	Jeff	Veolia			
Smart	Gerald	Veolia			
Cheung	Mary	Veolia			
Guerriero	Joe	AIG		X	
Wolf	Tim	Malcolm Pimie		X	
Hemmerling	Tracy	Malcolm Pimie		X	
Stowers	Kirk	Broadbent			
Quillian	Jill	ERM			
Sahu	Rahnijit	BMI		X	
Crouse	George	Syngenta		X	
Erickson	Lee	Stauffer		X	
Kelly	Joe	Montrose			
Sundberg	Paul	Montrose		X	
Gibson	Jeff	AmPac			
Sylvia	Chris	Pioneer		X	
Wilkinson	Craig	Timet		X	
Mack	Joel	Montrose Counsel			

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STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Jim Gibbons, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

March 23, 2007

Ms. Susan Crowley
Tronox LLC
PO Box 55
Henderson, Nevada 89009

Re: **Tronox LLC (TRX)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Upgradient Investigation Results
dated October 30, 2006

Dear Ms. Crowley,

The NDEP has received and reviewed Tronox's report identified above and provides comments in Attachment A. Once TRX has reviewed these comments it may be useful to have the NDEP's technical team discuss these matters with the TRX technical team. Please advise when a revised report can be expected.

If there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Bureau of Corrective Actions
Special Projects Branch
NDEP-Las Vegas Office

CC: Jim Najima, NDEP, BCA, Carson City
Shannon Harbour, NDEP, BCA, Las Vegas
Todd Croft, NDEP, BCA, Las Vegas
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
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Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
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Paul Duffy, Neptune and Company, Inc., 8550 West 14th Street, Suite 100, Lakewood, CO 80215

Attachment A

1. General comment, the NDEP provides the following general comments:
    a. There is inconsistency in the report with respect to the subject-verb agreement for the usage of the word "data". In some places it is treated as singular and in others it is treated (correctly) as a plural.
    b. When statistical tests are performed, it is preferable to present the *p*-values that correspond to the test as opposed to a binary indicator of whether the null hypothesis was rejected or not. Because the *p*-value quantifies the weight of evidence against the null hypothesis, the actual value is useful when hypothesis tests are used as part of the decision-making process, as opposed to the sole determinant of the decision-making process itself.
    c. Regarding data usability, it would be helpful if TRX followed the recent example from the BRC Borrow Pit Human Health Risk Assessment for the revised version of the Upgradient Report. Please note that the revised version of the BRC Borrow Pit Human Health Risk Assessment has not been published as of the date of this letter. In addition, the NDEP would be happy to review this issue with TRX. The TRX data usability is currently incomplete.
    d. The evaluation of Data Quality Indicators is also incomplete. In particular, comparability and representativeness are insufficiently addressed.
    e. Too much reliance is placed on statistical test results, and not enough on the weight of evidence. Summary statistics and exploratory data analysis are presented, but the statistical test results dominate conclusions. They should be considered in light of the plots and summary statistics, so that informed decisions are made. This approach might shed some light on why some of the statistical results are significant and others are not. Exploration and interpretation are key, and cannot be replaced by a flowchart approach to performing statistics in a vacuum. The data can tell a story; the data analysis should expose that story. In general, this is a case where it would be helpful if some more analysis and interpretation was given. Why do some of these tests fail? Which boreholes cause the failure? Is it because they have relatively high or low concentrations? Why are depth differences seen when geological differences are not? Why are depth and geologic differences both seen for some chemicals. It is important to use the data to understand what is going on, and not simply report statistical analysis results. It is not enough to simply state that statistical tests fail or do not fail. This is a general comment that applies to all of the analyses reported.
    f. In addition, the pieces should be used to build a picture of what is happening and then there should be a report on the big picture as well. However, the presentation of results is at the level of each chemical, without building a case for what these results mean collectively. For example, there are differences between the TRX and the City of Henderson (COH) and BMI/TIMET background. This would imply that

the background distributions are different, or that there are releases impacting the site. If the latter, then it is probably inappropriate to combine data for any of the chemicals considered. This analysis is at a detail level that does not help understand what is going on at the site. The bigger picture needs to be pulled together from the pieces.

2. Table of Contents, the page numbers in the table of contents appear to be incorrect.
3. Acronyms, page iv, ANOVA typically refers to general "analysis of variance" models and not just the "one-way analysis of variance" as stated on page vi.
4. Executive Summary, the NDEP has the following comments:
    a. Page ES-1, second paragraph, first sentence states, "The upgradient investigation successfully achieved the objective of gathering sufficient soil and groundwater chemistry data to characterize the local upgradient geochemistry of the sediments in the different upgradient formations as well as to characterize the groundwater that moves through the formations." Some description of sufficiency should be presented here.
    b. Page ES-1, 1st para after the bullets, last sentence. The sentence implies the existence of groundwater background data. The sentence should be revised to make it clear that background comparisons with the COH and BMI data are only applicable to soil data. The groundwater data have not been compared to other background data.
    c. Page ES-1, 2nd paragraph after the bullets, 2nd sentence, it is not clear why this RPD objective was used. This has no statistical basis for determining the importance of differences that are observed. See other comments below on the comparison of micro-purge and bailer results.
    d. Page ES-2, TRX states "Statistical comparisons between the Tronox and COH data sets indicate that all species, except arsenic and iron, represent different populations and should not be combined for subsequent analyses." Please note that the NDEP does not necessarily concur and believes that this issue should be discussed amongst statistical personnel.
    e. Page ES-2, TRX goes on to state "This is not surprising because the COH data were collected from alluvial materials approximately 2.4 to 3.4 miles to the east of the upgradient samples." Please note that the 2.4 to 3.4 mile distance has little to do with the comparability of these samples. This issue should be discussed in terms of geochemical similarities.
    f. Page ES-2, TRX goes on to discuss the BRC/TIMET data set in a similar manner as above. Again, the NDEP believes that this issue warrants further discussion between statistical personnel.
    g. Page ES-2, 1st full paragraph, 3rd sentence. It is not clear how samples were qualified based on "representativeness". This is a qualitative issue that refers to how the samples collected represent the populations they are meant to represent. Some clarification (or deletion) would help.
    h. Page ES-2, second full paragraph, second sentence states, "The upgradient data for metals and perchlorate in soil samples were statistically compared boring to boring, depth-to-depth (20 ft or less vs. 30 ft or more), and alluvium to Muddy Creek formations." It is not clear what this means.

Perhaps the sentence could be broken into bullets that describes each set of comparisons.

i. Page ES-2, 3rd full paragraph. This and the next paragraph indicate that some of the populations are different. It is important to know more about what this means. Are the TRX concentrations greater than or less than the background concentrations in these cases? Are the differences large or small (statistical but not practical perhaps)? This gets at the general concern that too much reliance is placed on statistical test results, and that more attention should be paid to interpreting the data from summary statistics, plots and test results (including professional judgement).
j. Page ES-2, 5th full paragraph. Similar concerns about the level of interpretation provided for the statistical results that have been presented. Its also not clear if the goal here is to merge datasets, or simply to note whether the TRX and background datasets are similar or not. The background data set is quite rich at this point, so inclusion of new data in the background dataset may not be needed. In addition, since several metals and radionculides do not exhibit site concentrations that are similar to the background data, this begs the question of the reasonableness of combining any of those data. The goal instead should be comparison of the TRX data with the background data, not with a view to combination of the data for some chemicals.
k. Page ES-3, 1st full paragraph. Perchlorate is detected again below 50 feet. It would be helpful if some indication of concentrations were provided.
l. Page ES-3, 1st full paragraph. A depth is not provided for the term "shallow groundwater". It would be helpful to know the depth of the shallow groundwater here.
m. Page ES-3, 2nd full paragraph. In the context of the Executive Summary, it is not clear why a paragraph is devoted to perchlorate. Some explanation is needed for why perchlorate is called out when this is not the case for any other chemicals (except Cr).
n. Page ES-3, 2nd full paragraph. In the context of the Executive Summary, it is not clear why a paragraph is devoted to Cr. Some explanation is needed for why Cr is called out when this is not the case for any other chemicals.

5. Section 1.2.3, page 1-4, TRX states "At the request of the NDEP, soil from one boring (M-120) was analyzed for the full list of SRCs." Please revise this statement as this was never requested by the NDEP. If TRX believes that the NDEP is in error, please provide the documentation to support the above statement.
6. Section 1.2.3, page 1-4, bullets at top of page. It might be helpful to present these items on a Figure.
7. Section 1.2.3, page 1-4, last paragraph of Section 1.2.3. The borings are shown on Figure 1-2 rather than Figure 1-1.
8. Section 2.5.2, page 2-4, please note that the background summary report is currently being revised in response to NDEP comments.
9. Section 2.5.3, page 2-5, TRX refers to the NDEP's consultant as "Neptune Company". Please note that the proper company name is "Neptune and Company, Inc.".

10. Section 2.5.3, 2nd paragraph, suggest rewording the back end of sentence that states "however, the elimination of these rejected data did not adversely affect the data set statistics used in this study. It is not clear what "data set statistics" means. Perhaps the term "statistical analyses" or "data analyses" would be more appropriate.
11. Section 2.5.3, 4th paragraph, last sentence. Suggest changing "comparable" to "similar" but in the context of the distributions of the concentrations. One problem with the term comparable here is that EPA uses that term for a different purpose as one of its Data Quality Indicators.
12. Section 2.5.3, 4th paragraph, 1st sentence. Sentence does not make sense as written. It includes a clause that background data for the River range were collected because the northern McCullough range is the primary source of material… Suggest rewriting the sentence.
13. Section 2.5.3, 5th paragraph, 1st sentence. Replace test with tests at the end of the sentence.
14. Section 2.5.3, page 2-6, 1st paragraph, last sentence. It is not clear that this sentence makes sense. It is not clear what is meant by the "BRC/TIMET data set incorporates the variability of the COH data set". Perhaps this should be explained in terms of the range of the data, but variability usually means variance or standard deviation, in which case the sentence does not make sense. Some clarification is needed.
15. Section 3. It appears that the data usability step has been missed. Data validation has been performed, data evaluation has been performed, but the intermediate step as part of EPA's quality system has not been performed. See also general comment above.
16. Section 3.1, page 3-1, TRX states "The boreholes were backfilled with the unused core material". Please note that this practice is forbidden by the Nevada Division of Water Resources and should not be repeated in the future. Please note that this comment applies to similar instances discussed in other sections of the report.
17. Section 3.1, page 3-1, TRX states that a Photovac PID was used. Please discuss the bulb that was used in this PID and how this bulb relates to the ionization potential of the chemicals that were being investigated.
18. Section 3.5, page 3-5, please clarify if the wells were sampled with the bailer or micro-purge technique first. Also, please discuss the time that elapsed between each event. In addition, please discuss the amount of time that elapsed between the installation of the micro-purge well and the sampling event.
19. Section 3.12, NDEP has the following comments:
    a. Page 3-10, second to last paragraph states, "When more than two sets of data were compared, such as when the concentrations of more than two soil borings were compared, the ANOVA and the Kruskal-Wallis tests were applied." It isn't clear to NDEP that this comparison makes sense. Is this approach looking for differences between boreholes? If so, some further explanation of why this is potentially useful is needed. Is the intent to search for spatial differences in the data, so it is basically an effort at exploratory data analysis. In addition, a downside of running as many tests as have been run on the same data is that the error rate being used of 0.05 is no longer supportable.
    b. Page 3-10. The Gehan test is a generalization of the Wilcoxon Rank Sum test. That is, if there are no censored data (non-detects) then they give

exactly the same results. All that the Gehan test does that is different is provide a different ranking system for the data when non-detects are involved. Otherwise the statistical tests (Gehan and WRS) are the same. This issue seems to be missed in the presentation and in the report.

c. Page 3-10. The value of running a t-test on log-transformed data is not totally clear. Log-transformations essentially smooth the data, especially lessening the effect of higher values. Consequently, running a test that says that the mean of the logs are similar (or not) is not conceptually appealing. EPA, in its Data Quality Assessment guidance (2006) does not require testing on transformed data, but instead suggests using non-parametric tests when the normality assumptions are sufficiently violated. We would prefer that TRX performs t-tests on the untransformed data, and the WRS test (along with the Quantile and Slippage tests – see below), when comparing two sets of data, especially when one set is meant to be background. This set of tests has been long approved by EPA, and are customarily run when comparison is needed between two sets of environmental data, especially when one of the sets is a background or reference set.

d. Page 3-10, last paragraph. The NDEP does not concur with the reasons given for not running the Quantile and Slippage tests. The objectives of the statistical analysis are, in general, to determine of different sets of data (distributions of concentrations) are similar. The reason that Gilbert introduced the Quantile and Slippage tests for environmental data was precisely because it is not unusual to see differences in the tails of such distributions, when the centers are similar. Background comparisons, among other comparisons, have been performed here, and use of these tail tests is relevant and should not be dismissed without some better justification.

20. Section 3.13.1, pages 3-11 through 3-12, it is not clear to the NDEP why TRX has included an extended discussion of the data validation process in this section. NDEP and TRX have mutually agreed to a process and this should not be repeated in the revised report. This process should be summarized via a reference to the documentation between NDEP and TRX.
21. Section 3.13.2, the NDEP has the following comments:
    a. Page 3-12, Section 3.13.2, 2nd bullet. It is noted that only a small number of radionuclide analyses were performed. Is this regarded as a data gap? Or, do more such data need to be collected to support hypothetical DQOs or data needs and requirements? We also note that the last sentence states, "(the comparisons for radionuclides was limited because only a small number of radionuclide analyses were conducted below the Quaternary Alluvium)." The word "was" should be changed to "were".
    b. Page 3-12, Section 3.13.2, 3rd bullet. Background comparisons will be performed, but it is not clear that there is justification in combining TRX and background data sets. See earlier comments. It would be up to NDEP to decide if the background dataset should be augmented, but the arguments provided are not sufficient to justify this as a goal or objective.

Background comparisons can be performed, but the purpose should be to determine if the TRX data are similar to background.

c. Page 3-12, paragraph after bullets. It is questionable that averaging field duplicates is standard statistical procedure. Field duplicates for soil samples often should be represented as separate samples, depending perhaps on the nature of the contamination. Most metals are sufficiently particulate that field duplicates serve very little purpose for QA because they do not account for small scale variability. If the duplicates are splits (splits of a homogenized sample), then there is some QA value in their collection. A further problem is that averaging violates some basic statistical assumptions. We agree that averaging is done, but and that the assumptions violation (of independent and identically distributed assumptions) is ignored. The preference these days is to treat them as separate samples unless there is any reason not to (e.g., because they are splits). Otherwise averaging is accepted. Other options include using the first sample because the second one was collected for a different reason. From the perspective of classical statistics this is also justifiable. There is an example in EPA's Data Quality Assessment guidance (G-9, 2006) that addresses this issue, and treats the field duplicates as separate samples. Also, when it should be stated how the detection status is determined for duplicates when one of the duplicates is detected and the other is not (e.g. Sb:sample id M117-20, perchlorate M118-20)

d. Page 3-12, 2nd last paragraph. The boxplots for the "all results" for each chemical are not particularly useful. There might be better choices for showing distributions like this, such as histograms, or density estimates, but the main purpose of this data analysis is comparison, for which the side-by-side boxplots are helpful.

e. Page 3-13, second paragraph, middle. It is stated that, for reasons given, the "average arsenic concentration .... is an approximation of the true mean". This is not a correct statistical statement. Despite the fact that many statisticians do not believe in the concept of a "true mean", the average is not an approximation, it is an estimate of the "true mean".

f. Page 3-13, second paragraph, last sentence states, "Instead, statistical tests can be applied to determine with reasonable confidence if the measured concentrations came from two separate formations, even if the mean arsenic concentrations are the same or similar." The phrase "are the same or" should be omitted. If the measured concentrations from two formations are the same than there can be no statistical difference between the two.

g. Page 3-13, 3rd paragraph, third sentence states, "An appropriate statistical test could be conducted to determine the probability that the null hypothesis is true." This is technically incorrect. Statistical hypothesis tests do not compute the probability that the null hypothesis is true. Hypothesis tests are performed to determine the probability of observing a result (this result is based on the statistic of interest, and the way the data are summarized with respect to the statistic of interest) outside of the

expected range of results that would be obtained when assuming that the null hypothesis is true. Basically, we assume the null hypothesis is true and then see how incongruous the data are with respect to that assumption. Perhaps the following statement could be used as a replacement: "An appropriate statistical test could be conducted to determine whether the null hypothesis should be rejected."

h. Page 3-13, fourth paragraph, last sentence states, "In contrast, nonparametric tests can be applied to any dataset regardless of the distributions." There are some distributional requirements for some non-parametric tests. For example, the Wilcoxon class of tests does technically require that the distribution be symmetric about a median. In general, non-parametric tests do not require that the distribution follow a form that can be parametrized (e.g. normal, gamma, etc).

i. Page 3-13, last paragraph, first sentence states, "If both subsets of data were assumed to follow normal distributions, the parametric F-test was conducted to evaluate if the standard deviations are equal." The F-test is performed using the variance and tests for the equality of variances. Even though the standard deviation is a function of the variance, since the test is performed on the variance, the results of the test should be interpreted in terms of the variance. An analog is that equality of the means does not imply equality of the logarithm of the means. This correction should be made in subsequent sentences as well. Additionally, it isn't clear if this test was one-sided or two-sided. This should be stated.

j. Page 3-14, first paragraph, first sentence states, "Differences among borings were evaluated using a parametric ANOVA to test the null hypothesis that the mean concentrations from all of the borings are the same and using a non-parametric Kruskal-Wallis test to test the null hypothesis that the median concentrations from all of the borings are the same." It isn't clear that this is an appropriate use of the ANOVA model. If a regular ANOVA model is run (i.e. fixed effects) then the interpretation is valid for only those borings where samples were taken. If, however, a random effects model were run, then this approach would allow for inferences among the collection of all possible boreholes.

22. Section 4.2 subsections. Please explain why comparisons have been performed with PRGs for some of the suites of chemicals and not for others.
23. Section 4.2.6, page 4-3, "Uranium (natural)" should be changed to "Uranium (elemental)."
24. Section 4.2.6, page 4-4, the summary of the radionuclide analysis presented here is fine. However, no backup is provided. These results need to be justified with the calculations that were performed. The calculations should involve some statistical analysis to demonstrate the similarities that are reported.
25. Section 4.3, page 4-5, first sentence. It is not clear that the data can lead to a conclusion about which approach leads to more representative samples. The data can lead to a conclusion that the two methods yield different results. Then a conclusion can perhaps be drawn that the micro-purge method produces more representative data, but only because there is a difference and it is believed that the micro-purge

approach is likely to give better data. That is the conclusion is based on what is expected, and then supported by the data, and not purely on the statistical evaluation. The statistics can only indicate if there is a difference.

26. Section 4.3, page 4-6, it is not clear why RPD was used for this comparison. This limits the comparison to a pair of data points at a time, does not adequately account for the direction of the differences, and the RPD provides no statistical basis for drawing conclusions. It is more appropriate, statistically, to perform a paired *t*-test (or non-parametric analog) on the paired data.
27. Section 4.3, page 4-6, paragraph in middle of page. It is stated that: "An RPD greater than 30% represents a statistically significant difference in duplicate water samples". This statement is not correct. There is no statistical significance associated with the RPD measure.
28. Section 4.5, general comment, please explain what it means that the intent is to examine potential issues related to matrix interferences? How is this done? What statistical methods are used? Is it based purely on chemistry data validation? These samples are hoped to be close to background, hence relatively unimpacted, so what is expected here? It is not clear how analysis of samples that probably will not have high concentrations of these chemicals will help when analyzing samples that have high concentrations of these analytes.
29. Section 4.5.1, the NDEP has the following comments:
    a. Page 4-7, 1st paragraph, 3rd sentence. This sentence requires some cleanup. Otherwise it seems as though silica was measured in 45 samples. Use of semi-colons to separate items might help.
    b. Page 4-7, 1st paragraph, 4th sentence. The way the sentence is worded makes it seem as though perchlorate is a metal. Perhaps the sentence can be reworded.
    c. Page 4-7, second paragraph, first sentence states "Box and whisker plots of the data for each metal and for perchlorate in the soil samples are presented in Figure 4-7." The legend in figure 4-7 states that the whiskers of the boxplot extend to the minimum and maximum value. This is incorrect. The third to last sentence in this paragraph correctly states "The whiskers extend to the largest and smallest values that are not more then 1.5 times the IQR range above or below the box." The same changes need to be made to the legends in Figures 4-8 through 4-15.
    d. Page 4-7, second paragraph, last sentence. Note that the box plots as presented show the mean concentration as well.
    e. Page 4-8, first sentence states, "Box and whisker plots for metals and perchlorate grouped by boring are presented in Figure 4-8." It isn't clear how or when multiple samples were collected from within each borehole. Please clarify if these samples from multiple depths within the same borehole.
    f. Page 4-8, 1st paragraph, in looking at some of the plots, some of the ANOVA results are "unexpected". This is a case where it would be helpful if some more analysis and interpretation was given. Why do some of these tests fail? Which boreholes cause the failure? Is it because they have relatively high or low concentrations? It is not enough to simply

state that statistical tests fail or do not fail. This is a general comment that applies to all of the analyses reported.

g. Page 4-8, second paragraph, first sentence states, "Box and whisker plots grouped by sample depth are presented in Figure 4-9." Why is only a subset of the analytes presented in Figure 4-9?

h. Page 4-8, second paragraph, last sentence states, "Based on the apparent differences in concentrations between these two depths, statistical tests were conducted to compare subsets of the data in these two depth ranges." There should be a reference to the table where the results of these statistical tests are presented. Additionally, is there a physical reason that these differences between data greater than 20ft and less than 20ft exist? It isn't clear that dividing the data based on observed differences and then running statistical tests to quantify these differences makes sense in the absence of a physical reason for differences that can be incorporated into the conceptual model.

i. Page 4-8, 3rd paragraph, if only 3 samples were collected from the fine-grained facies, did TRX also consider removing them from the analysis? Please consider if it would make any practical difference in the statistical results.

j. Page 4-8, bullets. This separation is curious. The separation by depth needs to compared to the separation by geology. That is, perhaps when both distinctions occur they are for the same basic reason. This should be investigated further in an attempt to simplify this process of separating data sets. When there are statistical differences in one case and not the other, is it because the difference is marginal statistically. Presumably the data are being split similarly for these 2 cases (depth and geology), at least there must be overlap, in which case it is worth exploring the data further to understand what the results of the statistical analyses are trying to say.

k. Page 4-8, fifth paragraph, first sentence states, "Differences were statistically significant by depth range but not by geological formation for two chemicals: tungsten, vanadium, and perchlorate." Tungsten should be removed.

l. Page 4-8, last bullet on the page states, "If differences were statistically significant by both depth range and geological formation, preference was given to the categorization (i.e., by depth range or by geological formation) that resulted in subsets of the data that followed either normal or lognormal distributions. This selection was made to provide subsets of the data that could be used in parametric statistical tests for future comparisons. If both categorizations led to subsets that followed normal or lognormal distributions, the data were categorized by geological formation. Similarly, if neither categorization led to subsets that followed normal or lognormal distributions, the data were also categorized by geological formation." The decision process for partitioning should account for a conceptual understanding of the site as opposed to convenience for statistical testing. For example, differences as a function of both depth and geology are not surprising since geology is a function of

depth. The existence of normal distributions for both subsets of data defined as a function of geology, provides some evidence that the differences are due to geology as opposed to anthropogenic contamination that is diluting as a function of depth and hydrogeology (e.g. perchlorate). However, the existence of normal distributions for both subsets of the arsenic and potassium data defined as a function of depth suggests that something is missing from the conceptual model. For example, is 20 ft the vertical extent of groundwater rise during anomalous precipitation events? Additionally, it seems odd that so many analytes have lognormal distributions for both subsets of the data defined as a function of depth (e.g. barium, chromium cobalt, magnesium, uranium, and vanadium).

m. Page 4-9, "Upgradient Data vs. Background Data" section. There should be some brief review of the relevant aspects of the COH and BRC/TIMET datasets here. Specifically, what are the depths for the COH and BRC/TIMET datasets and why is it meaningful to compare the TRX data to the COH and BRC/TIMET datasets?

n. Page 4-9, Section 4.5.1. Given the results that for many chemicals there are statistical differences between geologies or depths, and between TRX data and background, it is more reasonable, in a bigger picture sense, to conclude that TRX and background data sets should not be merged. It would be very difficult to justify merging for some chemicals and not others, when the differences that exist can be due to releases as well as to geology differences. If there are any releases in this area, then background conditions as a whole do not exist, and combination of TRX and background data sets may not make sense.

o. Please discuss if TRX considered comparing the upgradient data only to the McCullough Mountains data set from the BRC/TIMET/COH data set.

30. Section 4.5.2, page 4-9, earlier it was indicated that the radionuclides are in secular equilibrium. However, in this section some radionuclides are considered greater than background and others are not. Are there any further observations that can be made to clarify the interplay between the background comparisons and secular equilibrium?

31. Section 5.0, the NDEP has the following comments:

a. Page 5-1, Data Validation section, reference is made to data quality indicators, however, it is not clear how the issues of representativeness and comparability were dealt with or if there is any effect from them on the results and conclusions.

b. Page 5-1, statistical evaluation section, last sentence states, "For this reason, the data for these 15 metals and perchlorate from the specific geologic formation, alluvium, or Muddy Creek Formation, or from specific ranges of depth, 20 ft or less or 30 ft or more, should be used separately for future comparisons with downgradient data." Based on the previous two sentences, this statement does not make sense. Specifically, which 15 metals are referenced? Additionally, it is not clear how the results of the differences among borehole analysis are useful in a decision-making context.

c. Page 5-1, section "Statistical comparison with Off-Site Data Sets", second sentence states, "Statistical comparisons between the Tronox and COH data sets indicate that all species, except arsenic and iron and selenium represent different populations and should not be combined for subsequent analyses." This conclusion for Selenium needs to be supported by additional interpretation of results found on Page 4-9, section Upgradient Data vs. Background Data, paragraph 2. Note again, given this analysis a more reasonable conclusion is that the TRX and background datasets should not be combined.

d. Page 5-1, section "Statistical comparison with Off-Site Data Sets", last sentence states, "Because arsenic, iron and selenium concentrations did not exhibit statistically significant differences in their mean or median concentrations or standard deviations, those parameters, for the samples collected at depths of 20 ft or less, from the COH and Tronox datasets can be combined for subsequent analysis." The results for differences in standard deviation for subsets of the data have not been presented or discussed in the text.

e. Page 5-2, background comparisons in general. Comparability is a very important issue for comparing two different data sets. There should be some discussion of this issue.

f. Page 5-2, first sentence states, "Statistical comparisons between the Tronox and BRC/TIMET data sets indicate that all species, except calcium and lead, represent different populations and should not be combined for subsequent analyses." The reasoning for not combining any of the analytes except calcium or lead needs to be better explained either here or on Page 4-9, section "Upgradient Data vs. Background Data", third paragraph. Specifically, Page 4-9, section "Upgradient Data vs. Background Data", third paragraph, first sentence states " Differences between the means or medians of Tronox and BRC/TIMET data are not statistically significant for 11 of the 27 chemicals that were measured in both studies." However, 9 of the 11 chemicals (excluding lead and calcium) are not discussed.

g. Page 5-2, second paragraph, last sentence states, "Statistical comparisons between the Tronox and BRC/TIMET data sets indicated that data for thorium 230 and uranium 234 could probably be combined for subsequent analysis." This conclusion is made based on results presented in Page 4-10, section "Upgradient Data vs. Background Data" second paragraph, although this paragraph does not explicitly state which datasets are being compared to obtain these results. Previous more general comments about combining datasets apply, again.

h. Page 5-2, section "Groundwater Sampling Comparison", second paragraph, first sentence states, "In general, the less soluble constituents appear to be affected more than the highly soluble constituents." It should be mentioned in this statement that differences in measured concentrations between methods is a function of solubility.

i. Page 5-2, Evaluation for matrix effects section. Again, it is not clear exactly what the purpose is of this evaluation.

j. Page 5-2, Groundwater Sampling Comparison section, "Perchlorate", states "Below a depth of 20 ft bgs, perchlorate was not detected in soil samples until 50 ft bgs, which suggests that the perchlorate at this depth in soil is not related to vertical downward migration of shallow sources but is related to the perchlorate in the groundwater." Is it possible that the decreased concentrations observed above ground water but below 20 ft. are a consequence of fluctuations in the water table that "wash" the perchlorate out of the soil and into ground water? Also, the text indicates that perchlorate is present upgradient. Isn't there also an onsite source? Some clarification would help.

32. Figure 3-1. The diagram provides a flow path for statistical analysis steps. The first problem with this type of approach is that it takes professional judgement out of the decision making process. Exploratory data analysis and statistical test results are disjointed, which is also evident in the main report. In addition, many statistical tests are performed on the same subsets of data, in which case a different *p*-value should be used if an omnibus *p*-value of 0.05 is desired. Simplification is possible by not performing log –transforms ,which can only lead to conclusions in the log-space, so they are not very useful. The final conclusions are based on the test statistic results with a straight comparison to a *p*-value of 0.05. Apart from probably being the wrong *p*-value to use in the context of family-wise error rates, a straight comparison without revisiting the data implies a lack of interpretation of the entire statistical package that is offered. This is evident in the main report. Much more needs to be made of all of the statistical tools and analyses.
33. Figure 4-7 by itself is not very useful. Other ways of displaying single distributions could be used, such as histograms and density estimates, but the basic issue remains. Single plots of the combined TRONOX data are not very helpful.
34. Table 4-4. For Well IDs H-11 and M-117, the detection limit is 16 µg/L, which is four times greater than the detection limit for TR-07 and TR-09. Additionally, since the USEPA PRG is equal to 4 µg/L, the utility of these samples may be limited.
35. Appendix E, the NDEP has the following comments:
    a. General comment, the groundwater radionuclide data is not in secular equilibrium. Please discuss this matter in the main body of the report.
    b. The NDEP's review of this Appendix included a supplemental deliverable that was provided by TRX. Please include this information in the finalized report.
    c. Table E-6 contains a column labeled "Results." However, these are not actually the sample concentrations but the reporting limits in most cases. The Table should clarify this discrepancy.
    d. Section 3.3, page 7. The report states, "No data from the SW-846 601B analyses ..." Please revise "601B" to "6010B".
    e. Section 3.4 and General, regarding trip blanks, the report states, "No data required qualification due to trip blank contamination." However, there is confusion whether trip blanks were included with these samples. Section 3.8.1 of the main report indicates trip blanks were included in the field QA/QC. However, the data validation memos labeled "TH021voclms.rev" and "TH018voclms.rev" indicate that no trip blanks

were submitted. The data validation report should clarify if, or for which sample sets, trip blanks were included for the VOC analysis.

36. Appendix F, the NDEP has the following comments:
    a. Section 1.1, page 1-1, Item 1. Was the Gehan ranking scheme also used for the Kruskal-Wallis test when non-detects were involved?
    b. Section 1 subsections. There is a lot of redundancy in these subsections, suggesting that the subsections could be reorganized to reduce repetition.
    c. Other statistical comments have been made in the main text, but they apply equally here.
    d. Section 1.1, page 1-1, subsection 1, sentence 1 states, "The results from an Analysis of Variance (ANOVA) to compare the mean concentrations of the chemical by soil boring and the results from a Kruskal-Wallis test to compare the median concentrations by soil boring." If a regular ANOVA model is run (i.e. fixed effects) then the interpretation is valid for only those borings where samples were taken. If, however, a random effects model were run, then this approach would allow for inferences among all possible boreholes.
    e. Section 1.1, page 1-2, number 6b, first sentence states "If both sets of data were considered to follow lognormal normal distributions, a t-test was performed on the logarithms of the data to compare the means of the logarithms of the data." First, it is not clear what it means for data to follow a "lognormal normal" distribution. Second, it is not clear that it is of interest to detect differences between the means of the logarithms of the data. Differences in the means of the logarithms of the data are not equivalent to differences in the means of the untransformed datasets.
    f. Page 2-17 appears to have a graphics error.
    g. Table F-1. The title has a typo. TRONOX is spelled TONOX.
    h. Comment 12a of the meeting minutes from 1/16/2007 states "It was noted that the TRX upgradient data showed conformance with the BRC/TIMET background data set via the box and whisker plots but not via the quantitative statistical tests." The test results appear to have been interpreted correctly. Since the tests were performed as two-sided tests, significant differences will be indicated if, for a given analyte, either the center of the distribution of the Upgradient data is greater than center of the distribution for the BRC/TIMET data or the center of the distribution of the BRC/TIMET data is greater than center of the distribution for the Upgradient data. This is a possible reason for the confusion.

37. Appendix I, the NDEP has the following comments:
    a. 1st subsection titled "Historical Groundwater Sampling". The first sentence makes a statement that is not achievable from the data analysis. The data analysis can point to a difference, but the nature of the difference can only be provided by a conceptual understanding of why it occurred. The difference cannot by itself point to a conclusion of which method is most representative.

b. Other statistical comments have been made in the main text, but they apply equally here. These pertain mostly to the need to run paired *t*-tests instead of relying on RPD.
c. Page 3 of 3. For example, arsenic is classified as a metal that did not meet the RPD standard. However, it failed in only 1 of the 6 pairs. Considering the data as a whole would lead to a different conclusion for arsenic (i.e., that, statistically, there are no differences).
d. Page 1, based on this memorandum it appears that the wells were sampled via a bailer, a micro-purge pump was installed and then the well was sampled via micro-purge techniques. The specific timing of these activties needs to be discussed. Please note that these activties would result in a large amount of agitation (and volatization) within the well. These issues should be discussed in the body of the Appendix.
e. Page 2, since TPH, VOCs, and other compounds were not detected, this study was of limited use. The volatile compounds are of particular interest when discussing bailers and micro-purge techniques. Metals and radionuclides are also of interest and the study did note significant differences in these analyses.
f. Page 3, TRX summarizes the results of the study but does not draw any significant conclusions. For example, the study does demonstrate that bailing does bias some metals and radionuclides artificially high. In addition, it appears that bailing does bias some VOCs artificially low. It would benefit TRX to utilize the micro-purge technique to produce more representative data.
g. Additional comments on the micropurge method are provided below:

Low flow purging and sampling is a method of collecting a "representative" sample using the maximum flow rate that causes minimum drawdown; thereby, minimizing the stress to the groundwater system. Mobile colloid particles ranging in size from 1 to 1,000 nm have been observed under different conditions. For a sample to be considered representative of the formation water, the sample should contain the total mobile contaminant loading that includes both the dissolved contaminants and the naturally suspended particles (Puls & Barcelona 1996; Powell & Puls 1997; Kearl et al. 1994). Using low flow purging and sampling helps prevent the entrainment of larger, not naturally mobile particles into the groundwater. Low flow purging and sampling are applicable for various contaminants and naturally occurring analytes including volatile and semi-volatile organic compounds (VOCs and SVOCs), metals, other inorganic compounds, pesticides, polychlorinated biphenyls (PCBs), other organic compounds, radionuclides, and microbiological constituents. Low flow purging and sampling are not applicable for non-aqueous-phase liquids (ASTM 2002; Yeskis & Zavala 2002; Richey 2002, FDEP 2003).

The typical range of flow rates vary from 0.1 to 0.5 L/min. Some high permeability formations may be able to use flow rates as high as 1 L/min (US EPA Region 1 1996; Powell & Puls 1997; ASTM 2002; Ritchey 2002; Kaminiski 2003). The actual flow rate and amount of drawdown that may be sustained for a particular monitoring well should be determined prior to sampling. A stabilized pumping water level should be achieved with minimal

drawdown (to minimize stress to the system) at as high a flow rate as possible (to minimize sampling time). Minimizing turbulence should also be considered when selecting a flow rate (Barcelona et al. 2005). Minimal drawdown may vary from inches for high permeability formations to several feet for low permeability formations (FDEP 2003; Barcelona et al. 2005). The flow rate should not be determined by assigning an arbitrary number for acceptable drawdown. Minimal drawdown and corresponding flow rate will be dependent upon hydrogeologic setting and well construction characteristics (Barcelona et al. 2005).
The advantages of low flow sampling are collection of groundwater samples that are representative of the mobile contaminant load, minimization of sampling artifacts, less operator variability with greater operator control, minimization of stress on formation, minimization of mixing of stagnant casing water with formation water, reduced need for filtration of samples, reduced waste generation, and higher sample consistency (NMED 2001; Puls & Barcelona 1996). The disadvantages of low flow sampling are higher initial capital costs, longer set-up time in field, additional equipment to transport, and increased training of staff (Puls & Barcelona 1996). It should be noted that the costs of obtaining representative groundwater samples may be insignificant to the costs of potential remediation decisions made based on the data collected from the samples (Yeskis & Zavala 2002).

Metals sampling should not be conducted with bailers due to increased turbidity, which may bias metals concentrations high if the samples are not filtered (Yeskis & Zavala 2002; Kaminiski 2003). However, filtering samples may bias metal concentrations low due to the filtration of naturally mobile suspended solids (Puls & Barcelona 1996; Browner, 1997). Filtering of samples has also been shown to produce inconsistent results in terms of metals mobility (Kearl et al. 1994). No filtration or sampling method exists to restore data quality of a groundwater sample after the aquifer matrix and/or sand pack has been disturbed during purging / sampling and turbidity has been artificially increased (Powell & Puls 1997). Sampling with a bailer may also bias metals concentrations by the agitation of groundwater during the insertion and removal of the bailer, causing the introduction of air into the well bore and consequently cause some metals to precipitate (Kaminiski, 2003). VOC sampling should not be conducted with the use of bailers, which may bias VOC concentrations low due to the agitation of the groundwater and the introduction of air into the groundwater within the well (NMED 2000, US EPA Region 4 2001; Yeskis & Zavala 2002; Kaminiski 2003).

Dedicated sampling pumps are recommended for low flow purging and sampling to avoid the generation of excess turbidity caused by insertion of the sampling pump thereby mixing the stagnant water in the casing above the screen with the screened interval water zone. Additionally, insertion of a portable system may cause the resuspension of solids that may have collected at the bottom of the well (US EPA Region 9 1995; Puls & Barcelona 1996; NMED 2000). Dedicated sampling pumps are also recommended to reduce the amount of waste material generated by minimizing purge volume required for stabilization of water quality indicator parameters. The time required for set-up and purging is also reduced with the dedicated systems (Puls & Barcelona 1996). Dedicated sampling pumps would not be as important in wells screened across the water table as for wells with submerged screens where stagnant water would exist above the screen interval. If dedicated sampling pumps cannot be left in-place, then the sampling pump should be slowly lowered into the screened interval to

minimize mixing followed by immediate low-flow purging and sampling (Powell & Puls 1997).

Recent research has demonstrated that the entire screened interval is sampled during a low-flow purging independent of pump placement within the screened interval. Additionally, this research demonstrated that the ratio of flow yielded by higher permeability layers versus lower permeability layers is independent of pump placement within the screened interval (Varljen et al. 2006).

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Tronox Response to NDEP March 23, 2007 Comments on Upgradient Investigation Results
(Report is dated October 30, 2006**)**

NDEP Comment:

1. General comment:
   a. There is inconsistency in the report with respect to the subject-verb agreement for the usage of the word "data". In some places it is treated as singular and in others it is treated (correctly) as a plural.
   b. When statistical tests are performed, it is preferable to present the *p*-values that correspond to the test as opposed to a binary indicator of whether the null hypothesis was rejected or not. Because the *p*-value quantifies the weight of evidence against the null hypothesis, the actual value is useful when hypothesis tests are used as part of the decision-making process, as opposed to the sole determinant of the decision-making process itself.
   c. Regarding data usability, it would be helpful if TRX followed the recent example from the BRC Borrow Pit Human Health Risk Assessment for the revised version of the Upgradient Report. Please note that the revised version of the BRC Borrow Pit Human Health Risk Assessment has not been published as of the date of this letter. In addition, the NDEP would be happy to review this issue with TRX. The TRX data usability is currently incomplete.
   d. The evaluation of Data Quality Indicators is also incomplete. In particular, comparability and representativeness are insufficiently addressed.
   e. Too much reliance is placed on statistical test results, and not enough on the weight of evidence. Summary statistics and exploratory data analysis are presented, but the statistical test results dominate conclusions. They should be considered in light of the plots and summary statistics, so that informed decisions are made. This approach might shed some light on why some of the statistical results are significant and others are not. Exploration and interpretation are key, and cannot be replaced by a flowchart approach to performing statistics in a vacuum. The data can tell a story; the data analysis should expose that story. In general, this is a case where it would be helpful if some more analysis and interpretation was given. Why do some of these tests fail? Which boreholes cause the failure? Is it because they have relatively high or low concentrations? Why are depth differences seen when geological differences are not? Why are depth and geologic differences both seen for some chemicals. It is important to use the data to understand what is going on, and not simply report statistical analysis results. It is not enough to simply state that statistical tests fail or do not fail. This is a general comment that applies to all of the analyses reported.
   f. In addition, the pieces should be used to build a picture of what is happening and then there should be a report on the big picture as well. However, the presentation of results is at the level of each chemical, without building a case for what these results mean collectively. For example, there are differences between the TRX and the City of Henderson (COH) and BMI/TIMET background. This would imply that the background distributions are different, or that there are releases impacting the site. If the latter, then it is probably inappropriate to combine data for any of the chemicals considered. This analysis is at a detail level that does not help understand what is going on at the site. The bigger picture needs to be pulled together from the pieces.

Response:

On April 5, 2007, representatives of Tronox met with NDEP and its consultants to discuss, among other things, the general approach to responding to these comments and finalizing the Upgradient Investigation Report. At that meeting, it was agreed that a comment-by-comment response would be provided, and that revisions to the Upgradient Report would be primarily focused on the conclusions and interpretations of the results, specifically, discussion of statistics, the executive summary and conclusions*. Comment-specific responses are provided below.*

a. *Tronox will take care to treat data as plural in future submittals to NDEP.*
b. *The p-values are included in the detailed statistical calculations presented in Appendix F. As agreed, the statistical calculations in the Upgradient Report will not be modified. However, p-values will be reported in summary tables for future statistical calculations on the project.*
c. *In future data usability evaluations Tronox will follow the BRC model. Tronox would like to discuss with NDEP what NDEP regards as the most important aspects of the data usability assessment that are missing from the data validation memos and data validation summary.*
d. *Data comparability for the Upgradient Investigation was deemed adequate by Tronox because no historical data had been acquired by Tronox for many of the analytes and only approved EPA methods were used for sample analysis of the new analytes. Methods used to determine analytes previously characterized as a part of the routine monitoring program were either identical or judged to be highly comparable based on a comparison of the Clean Water Act (CWA) and equivalent RCRA method details. Comparability with the BRC/TIMET and COH background datasets was verified by comparing the method lists in the BRC/TIMET database and the COH data risk assessment by Environ. The cited methods were identical or essentially equivalent to those employed in the Tronox Upgradient investigation.*

   Representativeness was ensured by proper study design, proper field techniques and a combination of field and lab QC measurements to verify adequate precision was achieved for both sampling and analysis.
e. *As discussed in the meeting on April 5, 2007, Tronox will revise the discussion of the statistical results to include interpretation and conclusions. This is been presented in a new appendix (Appendix J) to the report, as well as in the conclusions and Executive Summary.*
f. *As discussed in the meeting on April 5, 2007, Tronox will revise the discussion of the statistical results to include interpretation and conclusions. This is been presented in a new appendix (Appendix J) to the report, as well as in the conclusions and Executive Summary.*

NDEP Comment:

2. Table of Contents, the page numbers in the table of contents appear to be incorrect

Response:

A revised Table of Contents will be submitted with revisions to the Upgradient Investigation Report.

NDEP Comment:

3. Acronyms, page iv, ANOVA typically refers to general “analysis of variance” models and not just the “one-way analysis of variance” as stated on page vi.

Response:

Agreed

NDEP Comment:

4. Executive Summary, the NDEP has the following comments:
   a. Page ES-1, second paragraph, first sentence states, “The upgradient investigation successfully achieved the objective of gathering sufficient soil and groundwater chemistry data to characterize the local upgradient geochemistry of the sediments in the different upgradient formations as well as to characterize the groundwater that moves through the formations.” Some description of sufficiency should be presented here.
   b. Page ES-1, 1st para after the bullets, last sentence. The sentence implies the existence of groundwater background data. The sentence should be revised to make it clear that background comparisons with the COH and BMI data are only applicable to soil data. The groundwater data have not been compared to other background data.
   c. Page ES-1, 2nd paragraph after the bullets, 2nd sentence, it is not clear why this RPD objective was used. This has no statistical basis for determining the importance of differences that are observed. See other comments below on the comparison of micro-purge and bailer results.

d. Page ES-2, TRX states "Statistical comparisons between the Tronox and COH data sets indicate that all species, except arsenic and iron, represent different populations and should not be combined for subsequent analyses." Please note that the NDEP does not necessarily concur and believes that this issue should be discussed amongst statistical personnel.
e. Page ES-2, TRX goes on to state "This is not surprising because the COH data were collected from alluvial materials approximately 2.4 to 3.4 miles to the east of the upgradient samples." Please note that the 2.4 to 3.4 mile distance has little to do with the comparability of these samples. This issue should be discussed in terms of geochemical similarities.
f. Page ES-2, TRX goes on to discuss the BRC/TIMET data set in a similar manner as above. Again, the NDEP believes that this issue warrants further discussion between statistical personnel.
g. Page ES-2, 1st full paragraph, 3rd sentence. It is not clear how samples were qualified based on "representativeness". This is a qualitative issue that refers to how the samples collected represent the populations they are meant to represent. Some clarification (or deletion) would help.
h. Page ES-2, second full paragraph, second sentence states, "The upgradient data for metals and perchlorate in soil samples were statistically compared boring to boring, depth-to-depth (20 ft or less vs. 30 ft or more), and alluvium to Muddy Creek formations." It is not clear what this means. Perhaps the sentence could be broken into bullets that describe each set of comparisons.
i. Page ES-2, 3rd full paragraph. This and the next paragraph indicate that some of the populations are different. It is important to know more about what this means. Are the TRX concentrations greater than or less than the background concentrations in these cases? Are the differences large or small (statistical but not practical perhaps)? This gets at the general concern that too much reliance is placed on statistical test results, and that more attention should be paid to interpreting the data from summary statistics, plots and test results (including professional judgement).
j. Page ES-2, 5th full paragraph. Similar concerns about the level of interpretation provided for the statistical results that have been presented. Its also not clear if the goal here is to merge datasets, or simply to note whether the TRX and background datasets are similar or not. The background data set is quite rich at this point, so inclusion of new data in the background dataset may not be needed. In addition, since several metals and radionculides do not exhibit site concentrations that are similar to the background data, this begs the question of the reasonableness of combining any of those data. The goal instead should be comparison of the TRX data with the background data, not with a view to combination of the data for some chemicals.
k. Page ES-3, 1st full paragraph. Perchlorate is detected again below 50 feet. It would be helpful if some indication of concentrations were provided.
l. Page ES-3, 1st full paragraph. A depth is not provided for the term "shallow groundwater". It would be helpful to know the depth of the shallow groundwater here.
m. Page ES-3, 2nd full paragraph. In the context of the Executive Summary, it is not clear why a paragraph is devoted to perchlorate. Some explanation is needed for why perchlorate is called out when this is not the case for any other chemicals (except Cr).
n. Page ES-3, 2nd full paragraph. In the context of the Executive Summary, it is not clear why a paragraph is devoted to Cr. Some explanation is needed for why Cr is called out when this is not the case for any other chemicals.

Response:

Tronox will revise the Executive Summary to provide more emphasis on interpretations and conclusions. NDEP's comments on the Executive Summary will be addressed or clarified in the revised document.

a. The sentence will be modified
b. Groundwater will be removed from the sentence
c. It is acknowledged that other methods are available to compare the two samples. However RPD is also considered an acceptable way to compare these values, recognizing it is not a method of hypothesis testing.

d. The statistical discussion will be revised in the executive summary and conclusions section of the report.
e. Acknowledged.
f. The statistical discussion will be revised in the executive summary and conclusions section of the report.
g. The reference to representativeness will be removed from the sentence.
h – j The statistical discussion will be revised in the executive summary and conclusions section of the report.
k. The concentration 181 ug/kg will be added.
l. The depth of about 78 feet will be added.
m.-n. Perchlorate and Chromium were discussed in the executive summary because they are the primary, known, site related contaminants that have been the focus of investigation and remediation for the past 16 years. These discussions will be removed.

NDEP Comment:

5. Section 1.2.3, page 1-4, TRX states "At the request of the NDEP, soil from one boring (M-120) was analyzed for the full list of SRCs." Please revise this statement as this was never requested by the NDEP. If TRX believes that the NDEP is in error, please provide the documentation to support the above statement.

Response:
Tronox acknowledges that NDEP did not request this specific sample analysis.

NDEP Comment:

6. Section 1.2.3, page 1-4, bullets at top of page. It might be helpful to present these items on a Figure.

Response:
Acknowledged. For future submittals, Tronox will consider where additional figures may be helpful for clarification.

NDEP Comment:

7. Section 1.2.3, page 1-4, last paragraph of Section 1.2.3. The borings are shown on Figure 1-2 rather than Figure 1-1.

Response:
Acknowledged.

NDEP Comment:

8. Section 2.5.2, page 2-4, please note that the background summary report is currently being revised in response to NDEP comments.

Response:
Acknowledged.

NDEP Comment:

9. Section 2.5.3, page 2-5, TRX refers to the NDEP's consultant as "Neptune Company". Please note that the proper company name is "Neptune and Company, Inc.".

Response:
Acknowledged. This will be corrected in future submittals to NDEP.

NDEP Comment:

10. Section 2.5.3, 2nd paragraph, suggest rewording the back end of sentence that states "however, the elimination of these rejected data did not adversely affect the data set statistics

used in this study. It is not clear what "data set statistics" means. Perhaps the term "statistical analyses" or "data analyses" would be more appropriate.

Response:
Acknowledged.

NDEP Comment:
11. Section 2.5.3, 4th paragraph, last sentence. Suggest changing "comparable" to "similar" but in the context of the distributions of the concentrations. One problem with the term comparable here is that EPA uses that term for a different purpose as one of its Data Quality Indicators.

Response:
Agreed.

NDEP Comment:
12. Section 2.5.3, 4th paragraph, 1st sentence. Sentence does not make sense as written. It includes a clause that background data for the River range were collected because the northern McCullough range is the primary source of material… Suggest rewriting the sentence.

Response:
The rewritten sentence: "Background data for the McCullough Range and River Mountains were collected and analyzed in the BRC/TIMET and COH background studies. It appears that the northern McCullough Range is the primary source of material upslope of the BMI Complex."

NDEP Comment:
13. Section 2.5.3, 5th paragraph, 1st sentence. Replace test with tests at the end of the sentence.

Response:
Acknowledged.

NDEP Comment:
14. Section 2.5.3, page 2-6, 1st paragraph, last sentence. It is not clear that this sentence makes sense. It is not clear what is meant by the "BRC/TIMET data set incorporates the variability of the COH data set". Perhaps this should be explained in terms of the range of the data, but variability usually means variance or standard deviation, in which case the sentence does not make sense. Some clarification is needed.

Response:
The intent of the sentence was to remark that the concentration range of the COH dataset is within the range of the BRC/Timet dataset. Tronox agrees that the wording suggested by NDEP would be more clear. However, as discussed at the meeting on April 5, 2007, the technical sections of the report will not be revised at this time, only the conclusions and interpretations.

NDEP Comment:
15. Section 3. It appears that the data usability step has been missed. Data validation has been performed, data evaluation has been performed, but the intermediate step as part of EPA's quality system has not been performed. See also general comment above.

Response:
In future data usability evaluations Tronox will follow the BRC model. See the response to comment 1c above.

NDEP Comment:

16. Section 3.1, page 3-1, TRX states "The boreholes were backfilled with the unused core material". Please note that this practice is forbidden by the Nevada Division of Water Resources and should not be repeated in the future. Please note that this comment applies to similar instances discussed in other sections of the report.

Response:

Acknowledged. Subsequent to the Upgradient Investigation field activities, soil borings at the Site have been abandoned by backfilling the borehole with a neat cement grout using a tremie pipe. Future borings at the Site will be abandoned similarly.

NDEP Comment:

17. Section 3.1, page 3-1, TRX states that a Photovac PID was used. Please discuss the bulb that was used in this PID and how this bulb relates to the ionization potential of the chemicals that were being investigated.

Response:

A 10.2 eV was used in the photovac. This lamp energy is sufficient to ionize most of the aromatic and unsaturated target analytes as well as the ketones, ethers, and esters. It is not sufficient to adequately ionize methanol, ethanol, chlorinated alkanes, or most aliphatic alkanes associated with gasoline. In the future an 11.7 eV lamp will be utilized to assure more sensitivity for these saturated volatile compounds during field screening.

NDEP Comment:

18. Section 3.5, page 3-5, please clarify if the wells were sampled with the bailer or micro-purge technique first. Also, please discuss the time that elapsed between each event. In addition, please discuss the amount of time that elapsed between the installation of the micro-purge well and the sampling event.

Response:

As described in Appendix I bailer samples were collected first on March 13 and 14, 2006 from TR-7, TR-8, TR-9, TR-10 and M-103. Micropurge pumps were installed in the wells and micropurge samples were collected March 20 to 24, 2006. The amount of time varied between micropurge pump installation and sampling depending on how quickly the water level equilibrated and how long it took for monitoring parameters to stabilize.

NDEP Comment:

19. Section 3.12, NDEP has the following comments:
    a. Page 3-10, second to last paragraph states, "When more than two sets of data were compared, such as when the concentrations of more than two soil borings were compared, the ANOVA and the Kruskal-Wallis tests were applied." It isn't clear to NDEP that this comparison makes sense. Is this approach looking for differences between boreholes? If so, some further explanation of why this is potentially useful is needed. Is the intent to search for spatial differences in the data, so it is basically an effort at exploratory data analysis. In addition, a downside of running as many tests as have been run on the same data is that the error rate being used of 0.05 is no longer supportable.
    b. Page 3-10. The Gehan test is a generalization of the Wilcoxon Rank Sum test. That is, if there are no censored data (non-detects) then they give exactly the same results. All that the Gehan test does that is different is provide a different ranking system for the data when non-detects are involved. Otherwise the statistical tests (Gehan and WRS) are the same. This issue seems to be missed in the presentation and in the report.
    c. Page 3-10. The value of running a t-test on log-transformed data is not totally clear. Log-transformations essentially smooth the data, especially lessening the effect of higher values. Consequently, running a test that says that the mean of the logs are similar (or not) is not conceptually appealing. EPA, in its Data Quality Assessment guidance (2006)

does not require testing on transformed data, but instead suggests using non-parametric tests when the normality assumptions are sufficiently violated. We would prefer that TRX performs t-tests on the untransformed data, and the WRS test (along with the Quantile and Slippage tests – see below), when comparing two sets of data, especially when one set is meant to be background. This set of tests has been long approved by EPA, and are customarily run when comparison is needed between two sets of environmental data, especially when one of the sets is a background or reference set.

d. Page 3-10, last paragraph. The NDEP does not concur with the reasons given for not running the Quantile and Slippage tests. The objectives of the statistical analysis are, in general, to determine of different sets of data (distributions of concentrations) are similar. The reason that Gilbert introduced the Quantile and Slippage tests for environmental data was precisely because it is not unusual to see differences in the tails of such distributions, when the centers are similar. Background comparisons, among other comparisons, have been performed here, and use of these tail tests is relevant and should not be dismissed without some better justification.

Response:

a. *Tronox agrees with NDEP and believes the results of these tests are not particularly useful. While they may have been useful as an aid in initially examining and evaluating the data, the results do not provide information that is useful, so they should not have been included in the Report.*
b. *The distinction between the two is understood. The confusion may be due to performing the tests using two different software programs. Thus, for the evaluations in this report, they were run as distinct tests, although the difference is not in the test itself, but in the handling of non-detect values.*
c. *Tronox understands NDEP's concerns about the potential bias introduced when data are transformed. However, for t-tests, both datasets are transformed, so the means within log-space are being compared. Since the data are not transformed back, there is no bias introduced. Parametric t-tests have greater power than non-parametric methods. For future statistical comparisons of log-normally distributed data on this project, Tronox will use non-parametric methods in addition to transformed parametric methods if appropriate.*
d. *As requested by NDEP in the meeting on April 5, 2007, slippage and quantile tests will be used in evaluating the Phase A data, and may also be used as appropriate in later phases of this project. For the purposes of the Upgradient Investigation Report, histograms have been prepared that show visually whether there may be elevated concentrations in one or more of the datasets.*

NDEP Comment:

20. Section 3.13.1, pages 3-11 through 3-12, it is not clear to the NDEP why TRX has included an extended discussion of the data validation process in this section. NDEP and TRX have mutually agreed to a process and this should not be repeated in the revised report. This process should be summarized via a reference to the documentation between NDEP and TRX.

Response:

The discussion of the data validation process will not be included in future reports.

NDEP Comment:

21. Section 3.13.2, the NDEP has the following comments:

a. Page 3-12, Section 3.13.2, 2nd bullet. It is noted that only a small number of radionuclide analyses were performed. Is this regarded as a data gap? Or, do more such data need to be collected to support hypothetical DQOs or data needs and requirements? We also note that the last sentence states, "(the comparisons for radionuclides was limited because only a small number of radionuclide analyses were conducted below the Quaternary Alluvium)." The word "was" should be changed to "were".
b. Page 3-12, Section 3.13.2, 3rd bullet. Background comparisons will be performed, but it is not clear that there is justification in combining TRX and background data sets. See earlier

comments. It would be up to NDEP to decide if the background dataset should be augmented, but the arguments provided are not sufficient to justify this as a goal or objective. Background comparisons can be performed, but the purpose should be to determine if the TRX data are similar to background.

c. Page 3-12, paragraph after bullets. It is questionable that averaging field duplicates is standard statistical procedure. Field duplicates for soil samples often should be represented as separate samples, depending perhaps on the nature of the contamination. Most metals are sufficiently particulate that field duplicates serve very little purpose for QA because they do not account for small scale variability. If the duplicates are splits (splits of a homogenized sample), then there is some QA value in their collection. A further problem is that averaging violates some basic statistical assumptions. We agree that averaging is done, but and that the assumptions violation (of independent and identically distributed assumptions) is ignored. The preference these days is to treat them as separate samples unless there is any reason not to (e.g., because they are splits). Otherwise averaging is accepted. Other options include using the first sample because the second one was collected for a different reason. From the perspective of classical statistics this is also justifiable. There is an example in EPA's Data Quality Assessment guidance (G-9, 2006) that addresses this issue, and treats the field duplicates as separate samples. Also, when it should be stated how the detection status is determined for duplicates when one of the duplicates is detected and the other is not (e.g. Sb:sample id M117-20, perchlorate M118-20)
d. Page 3-12, 2nd last paragraph. The boxplots for the "all results" for each chemical are not particularly useful. There might be better choices for showing distributions like this, such as histograms, or density estimates, but the main purpose of this data analysis is comparison, for which the side-by-side boxplots are helpful.
e. Page 3-13, second paragraph, middle. It is stated that, for reasons given, the "average arsenic concentration …. is an approximation of the true mean". This is not a correct statistical statement. Despite the fact that many statisticians do not believe in the concept of a "true mean", the average is not an approximation, it is an estimate of the "true mean".
f. Page 3-13, second paragraph, last sentence states, "Instead, statistical tests can be applied to determine with reasonable confidence if the measured concentrations came from two separate formations, even if the mean arsenic concentrations are the same or similar." The phrase "are the same or" should be omitted. If the measured concentrations from two formations are the same than there can be no statistical difference between the two.
g. Page 3-13, 3rd paragraph, third sentence states, "An appropriate statistical test could be conducted to determine the probability that the null hypothesis is true." This is technically incorrect. Statistical hypothesis tests do not compute the probability that the null hypothesis is true. Hypothesis tests are performed to determine the probability of observing a result (this result is based on the statistic of interest, and the way the data are summarized with respect to the statistic of interest) outside of the expected range of results that would be obtained when assuming that the null hypothesis is true. Basically, we assume the null hypothesis is true and then see how incongruous the data are with respect to that assumption. Perhaps the following statement could be used as a replacement: "An appropriate statistical test could be conducted to determine whether the null hypothesis should be rejected."
h. Page 3-13, fourth paragraph, last sentence states, "In contrast, nonparametric tests can be applied to any dataset regardless of the distributions." There are some distributional requirements for some non-parametric tests. For example, the Wilcoxon class of tests does technically require that the distribution be symmetric about a median. In general, non-parametric tests do not require that the distribution follow a form that can be parametrized (e.g. normal, gamma, etc).
i. Page 3-13, last paragraph, first sentence states, "If both subsets of data were assumed to follow normal distributions, the parametric F-test was conducted to evaluate if the standard deviations are equal." The F-test is performed using the variance and tests for the equality of variances. Even though the standard deviation is a function of the variance, since the

test is performed on the variance, the results of the test should be interpreted in terms of the variance. An analog is that equality of the means does not imply equality of the logarithm of the means. This correction should be made in subsequent sentences as well. Additionally, it isn't clear if this test was one-sided or two-sided. This should be stated.

j. Page 3-14, first paragraph, first sentence states, "Differences among borings were evaluated using a parametric ANOVA to test the null hypothesis that the mean concentrations from all of the borings are the same and using a non-parametric Kruskal-Wallis test to test the null hypothesis that the median concentrations from all of the borings are the same." It isn't clear that this is an appropriate use of the ANOVA model. If a regular ANOVA model is run (i.e. fixed effects) then the interpretation is valid for only those borings where samples were taken. If, however, a random effects model were run, then this approach would allow for inferences among the collection of all possible boreholes.

Response:

a. Tronox will rely on radionuclide data from the approved BRC/COH background dataset, and not its own, limited, upgradient dataset. If the approved background dataset is determined to be insufficient (for example, lacking samples from the Muddy Creek formation), Tronox may decide to perform additional background sampling. In addition, Tronox understands that BMI is in the process of expanding their background dataset to include samples of differing geologic materials.

b. Tronox agrees, and further notes that the use of datasets, combined or otherwise, in future evaluations is dependent on the objectives of that evaluation and cannot be stated categorically beforehand. Revisions to the conclusions of the Upgradient Investigation Report will make recommendations about potential future use of the upgradient data, including under what circumstances it might be appropriate to combine it with other datasets.

c. Tronox agrees that, given the nature of most soil samples, field duplicate samples do not provide a realistic method of evaluating reproduceability. Tronox would prefer not to collect field duplicates for soils; however, such samples are required by NDEP. Statistically, when duplicates meet QA/QC criteria, it should be appropriate to average the results, as they are determined to be consistent with each other. Averaging of duplicates is preferred over treating them as separate samples, as the latter approach will bias any calculations towards the duplicates. For the Phase A statistical calculations, duplicates will not be averaged.

d. Tronox doesn't disagree. However, side-by-side box plots based on boring, depth, and geologic unit, as well as comparing the Tronox upgradient dataset to the BRC/Timet and COH datasets were also provided. The revised report includes histograms comparing the Tronox data to the approved background datasets.

e. Acknowledged.

f. The original statement refers to the means being the same, not the data. The datasets can certainly be different but still have the same means. However, Tronox agrees that the entire discussion may be confusing.

g. Agreed.

h. Agreed.

i. The clarification of the F-test is agreed. The use of the F-test is described in more detail in Appendix F of the Report; it was a two-tailed test.

j. As stated in response to comment 19a, Tronox doesn't believe these tests were particularly useful and would have been appropriately omitted from the report.

NDEP Comment:

22. Section 4.2 subsections. Please explain why comparisons have been performed with PRGs for some of the suites of chemicals and not for others.

Response:

Comparisons to PRG values (where indicated in Section 4.2) were provided as a point of reference for discussion purposes only. It should be noted that on the tables summarizing all of the Upgradient Investigation analytical results (Tables 4-1 through 4-23), the established PRG values are shown for all of the analytes.

NDEP Comment:

23. Section 4.2.6, page 4-3, "Uranium (natural)" should be changed to "Uranium (elemental)."

Response:

The requested change has been made to the database for the project.

NDEP Comment:

24. Section 4.2.6, page 4-4, the summary of the radionuclide analysis presented here is fine. However, no backup is provided. These results need to be justified with the calculations that were performed. The calculations should involve some statistical analysis to demonstrate the similarities that are reported.

Response:

Additional statistical analysis in the revised Report (Appendix J) show that the activities for the various radionuclides in soil samples are consistent with each other, indicating they are in secular equilibrium. Additional discussion of secular equilibrium is provided in the revised report.

NDEP Comment:

25. Section 4.3, page 4-5, first sentence. It is not clear that the data can lead to a conclusion about which approach leads to more representative samples. The data can lead to a conclusion that the two methods yield different results. Then a conclusion can perhaps be drawn that the micro-purge method produces more representative data, but only because there is a difference and it is believed that the micro-purge approach is likely to give better data. That is the conclusion is based on what is expected, and then supported by the data, and not purely on the statistical evaluation. The statistics can only indicate if there is a difference.

Response:

Acknowledged Please note that subsequent to the Upgradient Investigation, site investigation (ECA) activities involving the collection of groundwater samples from monitoring wells will involve groundwater sampling using the micropurge or low-flow purge and sampling methodology.

NDEP Comment:

26. Section 4.3, page 4-6, it is not clear why RPD was used for this comparison. This limits the comparison to a pair of data points at a time, does not adequately account for the direction of the differences, and the RPD provides no statistical basis for drawing conclusions. It is more appropriate, statistically, to perform a paired *t*-test (or non-parametric analog) on the paired data.

Response:

It is acknowledged that RPD is not a statistical method of hypothesis testing. However, RPD is used, for example, in data validation to evaluate the differences between field duplicates. The evaluation presented in the Upgradient Report is similar in intent, that is, to simply quantify the differences between two samples.

NDEP Comment:

27. Section 4.3, page 4-6, paragraph in middle of page. It is stated that: "An RPD greater than 30% represents a statistically significant difference in duplicate water samples". This statement is not correct. There is no statistical significance associated with the RPD measure.

Response:

Agreed.

NDEP Comment:

28. Section 4.5, general comment, please explain what it means that the intent is to examine potential issues related to matrix interferences? How is this done? What statistical methods are used? Is it based purely on chemistry data validation? These samples are hoped to be close to background, hence relatively unimpacted, so what is expected here? It is not clear how analysis of samples that probably will not have high concentrations of these chemicals will help when analyzing samples that have high concentrations of these analytes.

Response:

The intent was to review MS/MSD datasets during data validation for analytes not previously analyzed by Tronox at the Henderson site to determine if significant interferences were caused by the site specific soil and water matrices when using the selected methods. If significant matrix interferences had been observed then alternative analytical methods or cleanup procedures would have been considered for subsequent investigations at the site.

NDEP Comment:

29. Section 4.5.1, the NDEP has the following comments:
    a. Page 4-7, 1st paragraph, 3rd sentence. This sentence requires some cleanup. Otherwise it seems as though silica was measured in 45 samples. Use of semi-colons to separate items might help.
    b. Page 4-7, 1st paragraph, 4th sentence. The way the sentence is worded makes it seem as though perchlorate is a metal. Perhaps the sentence can be reworded.
    c. Page 4-7, second paragraph, first sentence states "Box and whisker plots of the data for each metal and for perchlorate in the soil samples are presented in Figure 4-7." The legend in figure 4-7 states that the whiskers of the boxplot extend to the minimum and maximum value. This is incorrect. The third to last sentence in this paragraph correctly states "The whiskers extend to the largest and smallest values that are not more then 1.5 times the IQR range above or below the box." The same changes need to be made to the legends in Figures 4-8 through 4-15.
    d. Page 4-7, second paragraph, last sentence. Note that the box plots as presented show the mean concentration as well.
    e. Page 4-8, first sentence states, "Box and whisker plots for metals and perchlorate grouped by boring are presented in Figure 4-8." It isn't clear how or when multiple samples were collected from within each borehole. Please clarify if these samples from multiple depths within the same borehole.
    f. Page 4-8, 1st paragraph, in looking at some of the plots, some of the ANOVA results are "unexpected". This is a case where it would be helpful if some more analysis and interpretation was given. Why do some of these tests fail? Which boreholes cause the failure? Is it because they have relatively high or low concentrations? It is not enough to simply state that statistical tests fail or do not fail. This is a general comment that applies to all of the analyses reported.
    g. Page 4-8, second paragraph, first sentence states, "Box and whisker plots grouped by sample depth are presented in Figure 4-9." Why is only a subset of the analytes presented in Figure 4-9?
    h. Page 4-8, second paragraph, last sentence states, "Based on the apparent differences in concentrations between these two depths, statistical tests were conducted to compare subsets of the data in these two depth ranges." There should be a reference to the table where the results of these statistical tests are presented. Additionally, is there a physical reason that these differences between data greater than 20ft and less than 20ft exist? It isn't clear that dividing the data based on observed differences and then running statistical tests to quantify these differences makes sense in the absence of a physical reason for differences that can be incorporated into the conceptual model.
    i. Page 4-8, 3rd paragraph, if only 3 samples were collected from the fine-grained facies, did TRX also consider removing them from the analysis? Please consider if it would make any practical difference in the statistical results.

j. Page 4-8, bullets. This separation is curious. The separation by depth needs to compared to the separation by geology. That is, perhaps when both distinctions occur they are for the same basic reason. This should be investigated further in an attempt to simplify this process of separating data sets. When there are statistical differences in one case and not the other, is it because the difference is marginal statistically. Presumably the data are being split similarly for these 2 cases (depth and geology), at least there must be overlap, in which case it is worth exploring the data further to understand what the results of the statistical analyses are trying to say.
k. Page 4-8, fifth paragraph, first sentence states, "Differences were statistically significant by depth range but not by geological formation for two chemicals: tungsten, vanadium, and perchlorate." Tungsten should be removed.
l. Page 4-8, last bullet on the page states, "If differences were statistically significant by both depth range and geological formation, preference was given to the categorization (i.e., by depth range or by geological formation) that resulted in subsets of the data that followed either normal or lognormal distributions. This selection was made to provide subsets of the data that could be used in parametric statistical tests for future comparisons. If both categorizations led to subsets that followed normal or lognormal distributions, the data were categorized by geological formation. Similarly, if neither categorization led to subsets that followed normal or lognormal distributions, the data were also categorized by geological formation." The decision process for partitioning should account for a conceptual understanding of the site as opposed to convenience for statistical testing. For example, differences as a function of both depth and geology are not surprising since geology is a function of depth. The existence of normal distributions for both subsets of data defined as a function of geology, provides some evidence that the differences are due to geology as opposed to anthropogenic contamination that is diluting as a function of depth and hydrogeology (e.g. perchlorate). However, the existence of normal distributions for both subsets of the arsenic and potassium data defined as a function of depth suggests that something is missing from the conceptual model. For example, is 20 ft the vertical extent of groundwater rise during anomalous precipitation events? Additionally, it seems odd that so many analytes have lognormal distributions for both subsets of the data defined as a function of depth (e.g. barium, chromium cobalt, magnesium, uranium, and vanadium).
m. Page 4-9, "Upgradient Data vs. Background Data" section. There should be some brief review of the relevant aspects of the COH and BRC/TIMET datasets here. Specifically, what are the depths for the COH and BRC/TIMET datasets and why is it meaningful to compare the TRX data to the COH and BRC/TIMET datasets?
n. Page 4-9, Section 4.5.1. Given the results that for many chemicals there are statistical differences between geologies or depths, and between TRX data and background, it is more reasonable, in a bigger picture sense, to conclude that TRX and background data sets should not be merged. It would be very difficult to justify merging for some chemicals and not others, when the differences that exist can be due to releases as well as to geology differences. If there are any releases in this area, then background conditions as a whole do not exist, and combination of TRX and background data sets may not make sense.
o. Please discuss if TRX considered comparing the upgradient data only to the McCullough Mountains data set from the BRC/TIMET/COH data set.

Response:

a. Acknowledged.
b. Acknowledged.
c. Acknowledged.
d. Acknowledged.
e. Samples for metals and perchlorate were collected at multiple depths at each boring. A surface soil sample was collected, followed by samples at 5 and 10 ft, then at approximately 10-ft intervals until groundwater was encountered. The total number of samples from the borings ranged from 7 to 9. Each box-and-whisker plot was based on these multiple samples at each

boring. If more detailed information is needed, the sampling program is presented in Table 2 of the Upgradient Workplan Addendum.

f. *Agreed. As noted in response to earlier comments, the ANOVA comparisons are not very useful. Additional interpretation of the other tests is provided in the revised report (Appendix J).*
g. *Some box-and-whisker plots were inadvertently omitted from Figure 4-9. A revised Figure 4-9 is included in the revised report (Appendix J).*
h. *Agreed. The results of the statistical comparisons are provided on Table F-2 in Appendix F of the report. As discussed in the revised report, the reason for the observed differences is due to changes in geology. Although difficult to distinguish in the field in this area, it appears that the soils transition from alluvial to Muddy Creek between 20 and 30 feet depth. The concentration differences coincide with geologic unit (see Table F-2) and with an increase in the fine grained portion of the samples. This interpretation is presented and discussed in the revised report.*
i. *It appears that these samples do contribute to the statistical significance, as they include some values near the end of the data ranges. For example, the lowest Sr concentration is present in M119-40, the sample that also includes the highest Cr concentration. However, these samples would not affect the outcome of the comparisons to the BRC and COH datasets, the most important comparisons, because all the MCfg1 samples are deep and therefore not appropriate to compare to the shallow BRC and COH samples.*
j. *Agreed. Table F-2 in Appendix F shows that the depth difference is typically related to a difference in geology. This interpretation is presented and discussed in the revised portions of the report.*
k. *Agreed.*
l. *As noted in response to comment 21b, it is not necessarily appropriate within the context of the Upgradient Investigation Report to decide which datasets will be used in future evaluations. That decision depends at least in part on the nature of the evaluations to be performed.*
m. *Acknowledged.*
n. *As previously discussed, it is not appropriate to discuss potentially combining datasets for future use at this time. Additional interpretation of the results is provided in the revised portions of the report.*
o. *Tronox did not consider performing this comparison. (The approved BRC/COH background dataset represents an appropriate background dataset, regardless of specific geologic conditions.)*

NDEP Comment:

30. Section 4.5.2, page 4-9, earlier it was indicated that the radionuclides are in secular equilibrium. However, in this section some radionuclides are considered greater than background and others are not. Are there any further observations that can be made to clarify the interplay between the background comparisons and secular equilibrium?

Response:

The text actually states that there are statistically significant differences between the means/medians, not whether the Tronox data is greater. The box-and-whisker plots on Figure 4-15 and the histograms in the revised report (Appendix J) indicate that the activity in the Tronox samples is consistent with (not greater than) background, with the exception of lead-212 (analyzed in the COH samples but not the BRC samples). In addition, while concentrations above background might suggest impacts from site operations, the evidence that the radionuclides are in secular equilibrium suggests instead that the samples are made up of natural geologic materials that have been in place for a long time, and therefore represent background.

NDEP Comment:

31. Section 5.0, the NDEP has the following comments:
    a. Page 5-1, Data Validation section, reference is made to data quality indicators, however, it is not clear how the issues of representativeness and comparability were dealt with or if there is any effect from them on the results and conclusions.
    b. Page 5-1, statistical evaluation section, last sentence states, “For this reason, the data for these 15 metals and perchlorate from the specific geologic formation, alluvium, or Muddy

Creek Formation, or from specific ranges of depth, 20 ft or less or 30 ft or more, should be used separately for future comparisons with downgradient data." Based on the previous two sentences, this statement does not make sense. Specifically, which 15 metals are referenced? Additionally, it is not clear how the results of the differences among borehole analysis are useful in a decision-making context.

c. Page 5-1, section "Statistical comparison with Off-Site Data Sets", second sentence states, "Statistical comparisons between the Tronox and COH data sets indicate that all species, except arsenic and iron and selenium represent different populations and should not be combined for subsequent analyses." This conclusion for Selenium needs to be supported by additional interpretation of results found on Page 4-9, section Upgradient Data vs. Background Data, paragraph 2. Note again, given this analysis a more reasonable conclusion is that the TRX and background datasets should not be combined.
d. Page 5-1, section "Statistical comparison with Off-Site Data Sets", last sentence states, "Because arsenic, iron and selenium concentrations did not exhibit statistically significant differences in their mean or median concentrations or standard deviations, those parameters, for the samples collected at depths of 20 ft or less, from the COH and Tronox datasets can be combined for subsequent analysis." The results for differences in standard deviation for subsets of the data have not been presented or discussed in the text.
e. Page 5-2, background comparisons in general. Comparability is a very important issue for comparing two different data sets. There should be some discussion of this issue.
f. Page 5-2, first sentence states, "Statistical comparisons between the Tronox and BRC/TIMET data sets indicate that all species, except calcium and lead, represent different populations and should not be combined for subsequent analyses." The reasoning for not combining any of the analytes except calcium or lead needs to be better explained either here or on Page 4-9, section "Upgradient Data vs. Background Data", third paragraph. Specifically, Page 4-9, section "Upgradient Data vs. Background Data", third paragraph, first sentence states " Differences between the means or medians of Tronox and BRC/TIMET data are not statistically significant for 11 of the 27 chemicals that were measured in both studies." However, 9 of the 11 chemicals (excluding lead and calcium) are not discussed.
g. Page 5-2, second paragraph, last sentence states, "Statistical comparisons between the Tronox and BRC/TIMET data sets indicated that data for thorium 230 and uranium 234 could probably be combined for subsequent analysis." This conclusion is made based on results presented in Page 4-10, section "Upgradient Data vs. Background Data" second paragraph, although this paragraph does not explicitly state which datasets are being compared to obtain these results. Previous more general comments about combining datasets apply, again.
h. Page 5-2, section "Groundwater Sampling Comparison", second paragraph, first sentence states, "In general, the less soluble constituents appear to be affected more than the highly soluble constituents." It should be mentioned in this statement that differences in measured concentrations between methods is a function of solubility.
i. Page 5-2, Evaluation for matrix effects section. Again, it is not clear exactly what the purpose is of this evaluation.
j. Page 5-2, Groundwater Sampling Comparison section, "Perchlorate", states "Below a depth of 20 ft bgs, perchlorate was not detected in soil samples until 50 ft bgs, which suggests that the perchlorate at this depth in soil is not related to vertical downward migration of shallow sources but is related to the perchlorate in the groundwater." Is it possible that the decreased concentrations observed above ground water but below 20 ft. are a consequence of fluctuations in the water table that "wash" the perchlorate out of the soil and into ground water? Also, the text indicates that perchlorate is present upgradient. Isn't there also an onsite source? Some clarification would help.

Response:

Section 5, conclusions, has been substantially revised to include more interpretation of the data collected. As discussed with NDEP, the focus was to address statistical comments and interpretation of data, so some comments may not be addressed or clarified in the body of the revised report

a. *The following discussion will be added to Section 5: Data comparability for the Upgradient Investigation was deemed adequate by Tronox because no historical data had been acquired by Tronox for most of the analytes and only approved EPA methods were used for sample analysis of the new analytes. Methods used to determine analytes previously characterized as a part of the routine monitoring program were either identical or judged to be highly comparable based on a comparison of the CWA and equivalent RCRA method details. Comparability with the BRC/TIMET and COH background datasets was verified by comparing the method lists in the BRC/TIMET database and the COH data risk assessment by Environ. The cited methods were identical or essentially equivalent to those used in the Tronox Upgradient investigation. Representativeness was ensured by proper study design, proper location and number of samples collected, correct field techniques and a combination of field and lab QC measurements to verify adequate precision was achieved for both sampling and analysis.*
b. *The discussion of the statistical evaluation has been substantially revised in the revised version of the report.*
c. *The discussion of the statistical evaluation has been substantially revised in the revised version of the report.*
d. *The discussion of the statistical evaluation has been substantially revised in the revised version of the report.*
e. *The discussion of the statistical evaluation has been substantially revised in the revised version of the report. In addition, a discussion of the analytical methods comparability between the Tronox Upgradient, BRC/TIMET, and COH background investigations has been added to the conclusions.*
f. *The discussion of the statistical evaluations has been substantially revised in the revised Upgradient Report.*
g. *The discussion of the statistical evaluations has been substantially revised in the revised Upgradient Report.*
h. *The following sentence will be added: This relationship is expected if the measured concentrations using different sampling techniques are a function of analyte solubility.*
i. *As stated in the response to question 28, the intent was to review MS/MSD datasets during data validation for analytes not previously analyzed by Tronox at the Henderson site to determine if significant interferences were caused by the site specific soil and water matrices when using the selected methods. If significant matrix interferences had been observed then alternative analytical methods or cleanup procedures would have been considered for subsequent investigations at the site*
j. *It is acknowledged that there are on-site sources of perchlorate and that rising and falling groundwater can wash perchlorate out of soil. At the locations M-120 and M-121 it appears that the concentrations of perchlorate detected in soil at 80 feet below ground surface are below the water table.*

NDEP Comment:

32. Figure 3-1. The diagram provides a flow path for statistical analysis steps. The first problem with this type of approach is that it takes professional judgement out of the decision making process. Exploratory data analysis and statistical test results are disjointed, which is also evident in the main report. In addition, many statistical tests are performed on the same subsets of data, in which case a different *p*-value should be used if an omnibus *p*-value of 0.05 is desired. Simplification is possible by not performing log –transforms ,which can only lead to conclusions in the log-space, so they are not very useful. The final conclusions are based on the test statistic results with a straight comparison to a *p*-value of 0.05. Apart from probably being the wrong *p*-value to use in the context of family-wise error rates, a straight comparison without revisiting the data implies a lack of interpretation of the entire statistical package that is offered. This is evident in the main report. Much more needs to be made of all of the statistical tools and analyses.

Response:
The flowchart is a factual documentation of the statistical tests performed. Regardless of the tests, Tronox agrees with NDEP's overall recommendation that the test results need to be interpreted. The revised portions of the report (Appendix J, Section 5, Executive Summary) provide additional discussion and interpretation.

NDEP Comment:
33. Figure 4-7 by itself is not very useful. Other ways of displaying single distributions could be used, such as histograms and density estimates, but the basic issue remains. Single plots of the combined TRONOX data are not very helpful.

Response:
Agreed, as noted in the response to comment 21d.

NDEP Comment:
34. Table 4-4. For Well IDs H-11 and M-117, the detection limit is 16 µg/L, which is four times greater than the detection limit for TR-07 and TR-09. Additionally, since the USEPA PRG is equal to 4 µg/L, the utility of these samples may be limited.

Response:
Acknowledged.

NDEP Comment:
35. Appendix E, the NDEP has the following comments:
    a. General comment, the groundwater radionuclide data is not in secular equilibrium. Please discuss this matter in the main body of the report.
    b. The NDEP's review of this Appendix included a supplemental deliverable that was provided by TRX. Please include this information in the finalized report.
    c. Table E-6 contains a column labeled "Results." However, these are not actually the sample concentrations but the reporting limits in most cases. The Table should clarify this discrepancy.
    d. Section 3.3, page 7. The report states, "No data from the SW-846 601B analyses …" Please revise "601B" to "6010B".
    e. Section 3.4 and General, regarding trip blanks, the report states, "No data required qualification due to trip blank contamination." However, there is confusion whether trip blanks were included with these samples. Section 3.8.1 of the main report indicates trip blanks were included in the field QA/QC. However, the data validation memos labeled "TH021voclms.rev" and "TH018voclms.rev" indicate that no trip blanks were submitted. The data validation report should clarify if, or for which sample sets, trip blanks were included for the VOC analysis.

Response:
a. The issue of secular equilibrium in groundwater samples is discussed in Section 4.2.6 of the report. Secular equilibrium would not necessarily be expected in groundwater samples due to significant solubility differences between uranium, thorium, and other radionuclides in the U-238 and Th-232 decay chains.
b. The requested information will be included in the future reports.
c. Acknowledged.
d. Acknowledged.
e. Trip blanks were included with the groundwater VOC sample sets but not the soil analyses which were field preserved. The field blanks and equipment blanks associated with soil samples served as checks of possible contamination during transport and storage. No significant contamination by VOC analytes was discovered in any of the trip blanks analyzed.

NDEP Comment:

36. Appendix F, the NDEP has the following comments:
    a. Section 1.1, page 1-1, Item 1. Was the Gehan ranking scheme also used for the Kruskal-Wallis test when non-detects were involved?
    b. Section 1 subsections. There is a lot of redundancy in these subsections, suggesting that the subsections could be reorganized to reduce repetition.
    c. Other statistical comments have been made in the main text, but they apply equally here.
    d. Section 1.1, page 1-1, subsection 1, sentence 1 states, "The results from an Analysis of Variance (ANOVA) to compare the mean concentrations of the chemical by soil boring and the results from a Kruskal-Wallis test to compare the median concentrations by soil boring." If a regular ANOVA model is run (i.e. fixed effects) then the interpretation is valid for only those borings where samples were taken. If, however, a random effects model were run, then this approach would allow for inferences among all possible boreholes.
    e. Section 1.1, page 1-2, number 6b, first sentence states "If both sets of data were considered to follow lognormal normal distributions, a t-test was performed on the logarithms of the data to compare the means of the logarithms of the data." First, it is not clear what it means for data to follow a "lognormal normal" distribution. Second, it is not clear that it is of interest to detect differences between the means of the logarithms of the data. Differences in the means of the logarithms of the data are not equivalent to differences in the means of the untransformed datasets.
    f. Page 2-17 appears to have a graphics error.
    g. Table F-1. The title has a typo. TRONOX is spelled TONOX.
    h. Comment 12a of the meeting minutes from 1/16/2007 states "It was noted that the TRX upgradient data showed conformance with the BRC/TIMET background data set via the box and whisker plots but not via the quantitative statistical tests." The test results appear to have been interpreted correctly. Since the tests were performed as two-sided tests, significant differences will be indicated if, for a given analyte, either the center of the distribution of the Upgradient data is greater than center of the distribution for the BRC/TIMET data or the center of the distribution of the BRC/TIMET data is greater than center of the distribution for the Upgradient data. This is a possible reason for the confusion.

Response:

a. Gehran's approximation was not used to handle the non-detect values in the Krusksal-Wallis statistical test.
b. Agreed.
c. Agreed.
d. See response to comment 21j.
e. See response to comment 19c.
f. Agreed.
g. Agreed.
h. Agreed. Additional discussion and interpretation of the test results are provided in the revised portions of the report (especially Appendix J).

NDEP Comment:

37. Appendix I, the NDEP has the following comments:
    a. 1st subsection titled "Historical Groundwater Sampling". The first sentence makes a statement that is not achievable from the data analysis. The data analysis can point to a difference, but the nature of the difference can only be provided by a conceptual understanding of why it occurred. The difference cannot by itself point to a conclusion of which method is most representative.
    b. Other statistical comments have been made in the main text, but they apply equally here. These pertain mostly to the need to run paired t-tests instead of relying on RPD.
    c. Page 3 of 3. For example, arsenic is classified as a metal that did not meet the RPD standard. However, it failed in only 1 of the 6 pairs. Considering the data as a whole

would lead to a different conclusion for arsenic (i.e., that, statistically, there are no differences).

d. Page 1, based on this memorandum it appears that the wells were sampled via a bailer, a micro-purge pump was installed and then the well was sampled via micro-purge techniques. The specific timing of these activities needs to be discussed. Please note that these activities would result in a large amount of agitation (and volatization) within the well. These issues should be discussed in the body of the Appendix.
e. Page 2, since TPH, VOCs, and other compounds were not detected, this study was of limited use. The volatile compounds are of particular interest when discussing bailers and micro-purge techniques. Metals and radionuclides are also of interest and the study did note significant differences in these analyses.
f. Page 3, TRX summarizes the results of the study but does not draw any significant conclusions. For example, the study does demonstrate that bailing does bias some metals and radionuclides artificially high. In addition, it appears that bailing does bias some VOCs artificially low. It would benefit TRX to utilize the micro-purge technique to produce more representative data.
g. Additional comments on the micropurge method are provided below:

Low flow purging and sampling is a method of collecting a “representative” sample using the maximum flow rate that causes minimum drawdown; thereby, minimizing the stress to the groundwater system. Mobile colloid particles ranging in size from 1 to 1,000 nm have been observed under different conditions. For a sample to be considered representative of the formation water, the sample should contain the total mobile contaminant loading that includes both the dissolved contaminants and the naturally suspended particles (Puls & Barcelona 1996; Powell & Puls 1997; Kearl et al. 1994). Using low flow purging and sampling helps prevent the entrainment of larger, not naturally mobile particles into the groundwater. Low flow purging and sampling are applicable for various contaminants and naturally occurring analytes including volatile and semi-volatile organic compounds (VOCs and SVOCs), metals, other inorganic compounds, pesticides, polychlorinated biphenyls (PCBs), other organic compounds, radionuclides, and microbiological constituents. Low flow purging and sampling are not applicable for non-aqueous-phase liquids (ASTM 2002; Yeskis & Zavala 2002; Richey 2002, FDEP 2003).

The typical range of flow rates vary from 0.1 to 0.5 L/min. Some high permeability formations may be able to use flow rates as high as 1 L/min (US EPA Region 1 1996; Powell & Puls 1997; ASTM 2002; Ritchey 2002; Kaminiski 2003). The actual flow rate and amount of drawdown that may be sustained for a particular monitoring well should be determined prior to sampling. A stabilized pumping water level should be achieved with minimal drawdown (to minimize stress to the system) at as high a flow rate as possible (to minimize sampling time). Minimizing turbulence should also be considered when selecting a flow rate (Barcelona et al. 2005). Minimal drawdown may vary from inches for high permeability formations to several feet for low permeability formations (FDEP 2003; Barcelona et al. 2005). The flow rate should not be determined by assigning an arbitrary number for acceptable drawdown. Minimal drawdown and corresponding flow rate will be dependent upon hydrogeologic setting and well construction characteristics (Barcelona et al. 2005).

The advantages of low flow sampling are collection of groundwater samples that are representative of the mobile contaminant load, minimization of sampling artifacts, less operator variability with greater operator control, minimization of stress on formation, minimization of mixing of stagnant casing water with formation water, reduced need for filtration of samples, reduced waste generation, and higher sample consistency (NMED 2001; Puls & Barcelona 1996). The disadvantages of low flow sampling are higher initial capital costs, longer set-up time in field, additional equipment to transport, and increased training of staff (Puls & Barcelona 1996). It should be noted that the costs of obtaining representative groundwater samples may be insignificant to the costs of potential remediation decisions made based on the data collected from the samples (Yeskis & Zavala 2002).

Metals sampling should not be conducted with bailers due to increased turbidity, which may bias metals concentrations high if the samples are not filtered (Yeskis & Zavala 2002; Kaminiski 2003). However, filtering samples may bias metal concentrations low due to the filtration of naturally mobile suspended solids (Puls & Barcelona 1996; Browner, 1997). Filtering of samples has also been shown to produce inconsistent results in terms of metals mobility (Kearl et al. 1994). No filtration or sampling method

exists to restore data quality of a groundwater sample after the aquifer matrix and/or sand pack has been disturbed during purging / sampling and turbidity has been artificially increased (Powell & Puls 1997). Sampling with a bailer may also bias metals concentrations by the agitation of groundwater during the insertion and removal of the bailer, causing the introduction of air into the well bore and consequently cause some metals to precipitate (Kaminiski, 2003). VOC sampling should not be conducted with the use of bailers, which may bias VOC concentrations low due to the agitation of the groundwater and the introduction of air into the groundwater within the well (NMED 2000, US EPA Region 4 2001; Yeskis & Zavala 2002; Kaminiski 2003).

Dedicated sampling pumps are recommended for low flow purging and sampling to avoid the generation of excess turbidity caused by insertion of the sampling pump thereby mixing the stagnant water in the casing above the screen with the screened interval water zone. Additionally, insertion of a portable system may cause the resuspension of solids that may have collected at the bottom of the well (US EPA Region 9 1995; Puls & Barcelona 1996; NMED 2000). Dedicated sampling pumps are also recommended to reduce the amount of waste material generated by minimizing purge volume required for stabilization of water quality indicator parameters. The time required for set-up and purging is also reduced with the dedicated systems (Puls & Barcelona 1996). Dedicated sampling pumps would not be as important in wells screened across the water table as for wells with submerged screens where stagnant water would exist above the screen interval. If dedicated sampling pumps cannot be left in-place, then the sampling pump should be slowly lowered into the screened interval to minimize mixing followed by immediate low-flow purging and sampling (Powell & Puls 1997).

Recent research has demonstrated that the entire screened interval is sampled during a low-flow purging independent of pump placement within the screened interval. Additionally, this research demonstrated that the ratio of flow yielded by higher permeability layers versus lower permeability layers is independent of pump placement within the screened interval (Varljen et al. 2006).

Response

a. Acknowledged.
b. Acknowledged.
c. Acknowledged.
d. The dates and timing for bailer sampling and micropurge installation are documented in the appendix and in the field sheets. In most instances the bailer sampling was a day to several days before the micropurge pump installation and the water level was allowed to recover and stabilize after carefully inserting the micropurge pump. Effort was taken to minimize or eliminate effects from water agitation.
e. It is acknowledged that the use of this evaluation is limited to metals and inorganic constituents.
f. Acknowledged. Please note that subsequent to the Upgradient Investigation, site investigation (ECA) activities involving the collection of groundwater samples from monitoring wells will involve groundwater sampling using the low-flow purge and sampling methodology.
g. Acknowledged. Please note that subsequent to the Upgradient Investigation, site investigation (ECA) activities involving the collection of groundwater samples from monitoring wells will involve groundwater sampling using the low-flow purge and sampling methodology.