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HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT REPORT

828 MARTIN LUTHER KING, JR. BOULEVARD PROPERTY
CHAPEL HILL, NORTH CAROLINA

MAY 6, 2021

PREPARED FOR:

TOWN OF CHAPEL HILL
CHAPEL HILL, NORTH CAROLINA

PREPARED BY:

SYNTERRA CORPORATION
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EXECUTIVE SUMMARY

As requested by the Town of Chapel Hill (the Town), Duncklee & Dunham, P.C. (Duncklee & Dunham), now part of SynTerra Corporation (SynTerra), prepared this Human Health and Ecological Risk Assessment (HHERA) report regarding the property located at 828 Martin Luther King Jr. Boulevard in Chapel Hill, North Carolina (the Site). The HHERA was conducted in conjunction with Dr. Kenneth Rudo of Rudo Toxicological Consultants, LLC. The HHERA was prepared in order to evaluate potential human health and ecological risk at the 10.24 acre Site and was conducted in accordance with the United States Environmental Protection Agency (USEPA) and North Carolina risk assessment guidance. The site generally slopes along an embankment to the south to a lower area along Bolin Creek and the Bolin Creek Greenway Trail.

Two primary assessments were performed for the site (pre- and post- remedial measures). A preliminary risk evaluation was performed in 2019 and concluded that interim remedial measures (IRM), including the removal of surficial coal ash in selected locations in the lower portion of the Site, would be protective of trail users. The interim remedial measures were to be performed in conjunction with the completion of modifications to the Bolin Creek Greenway Trail (Greenway). Human health risk calculations were updated in September 2019 by Dr. Kenneth Rudo in order to reflect results of additional data collected in August 2019, including the results of a trail use survey to better establish the duration and frequency of exposure to trail users of different ages.

The second assessment performed included a post-IRM risk assessment update. The Town performed IRM from January through 2020 in conjunction with the completion of modifications to the Bolin Creek Greenway Trail (Greenway). The IRM included removal and off-Site disposal of exposed CCPs along the Greenway, implementation of cover and migration control measures to minimize the potential for exposed CCPs in the embankment to mobilize to the Greenway in the future, and implementation of stormwater control measures. The results of the post IRM risk assessment in conjunction with the implementation of additional protective measures indicate the levels of risks to construction workers, recreational trail users, and trespassers posed by coal combustion products (CCPs) are currently acceptable based on North Carolina Department of Environmental Quality (NCDEQ) and United States Ecological Protection Agency (USEPA) criteria.

A Screening Level Ecological Risk Assessment (SLERA) was performed for the Site as part of the post IRM assessment. The SLERA concludes that no significant ecological risk exists; however, additional ecological study is recommended as part of the design and selection of the final remedy.

The SLERA included a comparison of constituents in the source area surface water, sediment and soil to published ecological screening levels. Constituents detected at concentrations greater than ecological screening levels are recommended for further evaluation. The COPCs after consideration of background concentrations are summarized below:

Media/Location	COPC
Surface Water- source area	None
Sediment- source area	Barium Chromium
Soil- source area	Arsenic Lead Mercury Strontium Thallium Vanadium Zinc

The following conclusions and recommendations were made:

- IRM have been effective in reducing risk to Greenway users to within acceptable USEPA ranges.
- Ecological risk is believed to be minimal. However, the final remedy design process should include the performance of an ecological risk assessment that includes evaluation of the ecological COPCs.
- The Town should continue to monitor Site conditions so that effects from events are noted and can be evaluated.
- If Site conditions change such that new areas of exposure to CCP are evident, additional data collection efforts should be implemented and the human health risk calculations should be updated.

- If additional construction activities are needed in areas of concern, the current site worker training plan, which includes the use of PPE, should be continued. Depending on the nature of construction activities, additional sampling and update of the human health risk assessment may also be warranted.

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1.0 INTRODUCTION

1.1 Background

As requested by the Town of Chapel Hill (the Town), Duncklee & Dunham, P.C. (Duncklee & Dunham), now part of SynTerra Corporation (SynTerra), prepared this Human Health and Ecological Risk Assessment (HHERA) report regarding the property located at 828 Martin Luther King Jr. Boulevard in Chapel Hill, North Carolina (the Site). The HHERA was conducted in conjunction with Dr. Kenneth Rudo of Rudo Toxicological Consultants, LLC.

The HHERA was prepared in order to evaluate potential human health and ecological risk at the Site and was conducted in accordance with the United States Environmental Protection Agency (USEPA) and North Carolina risk assessment guidance. The Site consists of one parcel approximately 10.24 acres in size and features a two-story police station building of approximately 35,000-square feet (Figure 1). Previous reports indicate the Site was used as a borrow pit from the late 1950s to the early 1960s, with structural fill placed on the property from the mid-1960s to the mid-1970s. Available information indicates the fill consist of a mix of construction debris and coal combustion products (CCPs). Site topography is elevated in the area of the building and associated parking lots and slopes along an embankment to the south to a lower area along Bolin Creek and the Bolin Creek Greenway Trail (Figure 2).

The requested work scope included an evaluation of what extent the use of interim remedial measures would better control the risk profile of the site. The use of interim measures was designed to enable the Town to ensure protectiveness of the nearby community, including users of the adjacent Bolin Creek Greenway Trail, while the development, feasibility, and selection of a final remedial plan is completed. The Town determined the performance of the interim measures risk evaluation should be supported by the collection of additional environmental samples for analytical testing.

Duncklee & Dunham prepared a Sampling and Analysis Plan (SAP), dated March 29, 2019, that recommended the collection of samples for soil, groundwater, sediment, and surface water. The SAP also recommended the collection of additional samples from the coal combustion products (CCP) exposed along the southern-facing bluff located south on the Chapel Hill Police Department property. Hart & Hickman documented these additional sampling activities in A Results of Data Gap Sampling Report dated May 23, 2019.

1.2 Summary of Primary Work Scope Items

This report describes the following primary work scope items:

- **Preliminary Risk Evaluation findings.** The initial risk evaluation findings were described in a draft memorandum dated May 2019 prepared by Duncklee & Dunham. This initial analysis, which was based upon data collected from the Site from 2013 to 2016, concluded that interim remedial measures (IRM), including the removal of surficial coal ash in selected locations in the lower portion of the Site, would be protective of trail users. The initial risk evaluation findings have been updated and finalized and are presented in **Section 2** of this report.
- **Update HHRA calculations.** These calculations, updated in September 2019 by Dr. Kenneth Rudo, are in included in **Section 3.1**. These updates were conducted to reflect results of additional data collected in August 2019 to fill in data gaps, including the results of a trail use survey to better establish the duration and frequency of exposure to trail users of different ages.
- **Post-IRM risk assessment update.** The Town performed IRM from January through 2020 in conjunction with the completion of modifications to the Bolin Creek Greenway Trail (Greenway). The IRM included removal and off-Site disposal of exposed CCPs along the Greenway, implementation of cover and migration control measures to minimize the potential for exposed CCPs in the embankment to mobilize to the Greenway in the future, and implementation of stormwater control measures. **Section 3.2** describes the results of updating the risk assessment after the recent completion of the IRM based upon the results of analysis of additional soil sampling completed in the southern exposure unit after the removal of surficial CCPs (**Figure 3**). The results of the post IRM risk assessment (as well as other protective measures implemented such as posting of informative signs along the Greenway) indicate the levels of risks to construction workers (with training and protective clothing), trail users, and trespassers posed by CCPs are currently acceptable based on North Carolina Department of Environmental Quality (NCDEQ) and United States Ecological Protection Agency (USEPA) criteria.
- **Screening Level Ecological Risk Assessment findings. Section 4.0** presents the findings of a Screening Level Ecological Risk Assessment. These findings did not find evidence of significant ecological risks. However, additional ecological study is recommended as part of the design and selection of the final remedy.

2.0 PRELIMINARY RISK EVALUATION FINDINGS FOR INTERIM REMEDIAL MEASURES DESIGN

Assessment of the Site soil, groundwater, surface water, and sediment was conducted in phases from 2013 to 2016 which culminated in the preparation of a *Phase II Remedial Investigation Report Revision 2* dated August 25, 2017. To fill assessment data gaps for the risk assessment process, additional soil, sediment, surface water, and groundwater testing was performed at the Site in April 2019. Using this and the previously collected Site data, Dr. Rudo used the 2018 NCDEQ Risk Calculator to perform preliminary human health risk assessments pertaining to the Site. The most recent version of the NCDEQ Risk Calculator can be found at (https://deq.nc.gov/permits-rules/risk-based-remediation/risk-evaluation-resources). The results of this work were presented in the memorandum *Draft Preliminary Risk Evaluation -Findings for Interim Measures Along Bolin Creek Greenway* dated May 24, 2019.

The purpose of this HHERA is to evaluate potential risks associated with COIs that might remain in environmental media on-Site and in the vicinity. The HHERA includes four steps defined by the National Academy of Sciences (1983) in their report, "Risk Assessment in the Federal Government: Managing the Process." These steps include:

1. Hazard Identification
2. Exposure Assessment
3. Toxicity Assessment
4. Risk Characterization

The hazard identification process: 1) evaluates the nature and extent of constituents reported at the Site and 2) selects a subset of constituents of interest (COIs). The exposure assessment evaluates the likelihood, magnitude, and frequency of exposure to the COIs, and identifies exposure pathways and routes by which receptors may be exposed to these constituents. For this Site, completed exposure pathways were evaluated as part of the exposure assessment. The assessment identified completed two complete exposure receptors: human recreators and construction workers. Exposure pathways for these receptors are further described in the NCDEQ Risk Calculator User Guide (https://files.nc.gov/ncdeq/Waste%20Management/DWM/SF/RiskBasedRemediation/FINAL-RiskCalculatorUserGuide-Feb-2021.pdf). The toxicity assessment incorporates toxicity indices literature sources for each COI. Toxicity factors for each COI are

included in the NCDEQ Risk Calculator. Exposure Point concentrations (EPCs) are calculated for each COI and used in the risk characterization step of the process.

Exposure doses are defined differently for potential carcinogenic and non-carcinogenic effects in humans. Target Risk, or the level of risk that above which is unacceptable is calculated for human health. For known or suspected carcinogens, the sum of individual excess lifetime cancer risk values for all constituents and for all exposure pathways may not exceed 1 in 10,000. For systemic toxicants (non-carcinogenic), the Hazard Index (HI) for all contaminants for all complete exposure pathways may not exceed 1.0.

The most conservative data were input to these calculations. The maximum concentrations of COIs detected in samples from each media were used as the EPC. Human health risk estimates were evaluated using soil toxicity values and exposure parameters as specified by USEPA and NCDEQ. Next, the data sets collected from 2014 and 2016 were used to establish a baseline condition for the Site. The April 2019 data set was used, along with conservative scenarios and default values, to help identify the exposure scenarios that would most benefit from risk minimization steps, and to help lead to the most effective and protective interim measures.

The findings of this work indicated:

- An increase in the potential for risk was suggested by the 2019 data set when compared with the 2014/2016 data set.
- Potential unacceptable risk pertaining to two exposure scenarios at the Site existed:
    - Future construction worker – Arsenic and manganese non-cancer risks from soil
    - Recreational user – Arsenic non-cancer risks from soil exposure
- Cancer risks were not greater than NCDEQ or USEPA criteria.
- Exposure risks estimated for the recreational pathway along or in Bolin Creek using the 2019 data did not increase as compared to risk estimates using the 2014 to 2016 data.

Other receptors and pathways are present, by default, in the risk calculator tool output (*e.g.*, resident and non-residential worker). Neither of those pathways are applicable to

Site conditions due to the different exposure frequencies and durations of those scenarios.

The risk calculation results for a construction worker were within a range such that proper training and the use of personal protective equipment (PPE) could minimize actual risk. Also, the results of the preliminary risk evaluation indicated that potential risks under the recreational user scenario could be reduced through implementation of interim measures. Those measures included the following components:

- Removal of exposed CCPs that had migrated from the embankment to locations adjacent to and near the Greenway
- Installation of clean backfill in excavated areas
- Placement of additional signage along the paved trail segment adjacent to the embankment where CCPs are present to inform users of the presence of CCPs and to encourage them to stay on the Greenway
- Polling of Greenway users to collect data regarding frequency and duration of trail use to better reflect actual use conditions rather than use of default exposure parameters used in the preliminary calculation
- Repair of existing standard silt fence and installation of new standard and "super" silt fencing in the wooded area along the embankment where exposed CCPs are present
- Hydroseeding on the embankment where exposed CCPs are present for stabilization purposes
- Periodic inspections to identify newly migrated CCPs if present
- Sampling and analytical testing along the Greenway after removal of CCPs
- Updated risk assessment to confirm interim measures have accomplished protectiveness goals

Following these findings, the Town proceeded to implement these IRMs in January through November 2020 and keep the Greenway open. A report which describes the IRMs has been prepared by Hart & Hickman, PC and is provided under separate cover.

The following section describes the results of HHRA calculations conducted in September 2019 prior to the IRMs and the results of risk calculations conducted after completion of the IRMs.

3.0 HUMAN HEALTH RISK ASSESSMENT

3.1 Recreational Receptors for the Bolin Creek Greenway – Pre-Interim Measures September 2019

In September 2019 (pre-interim measures), an HHRA was performed by Dr. Rudo that included risk estimates using data from soil, surface water, and sediment samples collected on the Site in April 2019 and August 2019 (see **Appendix A**). The maximum concentrations of constituents detected in samples collected near or adjacent to the Greenway from each media (soil, surface water, and sediment) were used as the exposure point concentrations.

Risk estimates for soil exposures were determined using the maximum COI concentrations from the data set that included the April 2019 soil samples and the soil and sediment samples collected in August 2019 from eight locations - SS-3A, and SED-11 though SED-17. Constituent concentrations of beryllium, trivalent chromium, cobalt, and manganese from the August 2019 samples included in the recreational user risk assessment represented the maximum soil concentrations of the April 2019 and August 2019 data sets.

All risk estimates in this analysis were for recreational user exposures. USEPA and NCDEQ Division of Waste Management (DWM) default exposure parameters pertaining to recreational users were used, except as specified below and in Appendix A, to identify potential Site-specific exposures. Survey data collected from actual trail users was used to modify default input parameters for the number of Greenway visits per week and the duration of those visits. These risk estimates were calculated using the February 2018 NCDEQ Risk Calculator.

For the September 2019 Site-specific risk analyses, the following were modified for the range of reported data provided in the Greenway user survey: 1) the exposure frequency (EF), in days per week on the Greenway; and 2) the exposure duration (ED), as minutes per day on the Greenway. Risk estimates were calculated for the reported minimum frequency and duration responses, average frequency and duration responses, and maximum frequency and duration responses for each age group. Frequency values for Site-specific recreational user exposure pertaining to each age group were set as one, three, and seven days per week. Duration values for Site-specific recreational user exposure used for each age group were set as 1 hour, 2 hours, and 8 hours per visit. Average frequency and duration values were selected rather than median reported values since the calculated average values were greater than the

median values and, thus, the average values reflected greater potential exposure risks. Appendix A includes a summary of the default and Site-specific exposure assumptions.

Child and adult recreational receptors were evaluated as part of this assessment. Three age groups were selected on the basis of responses provided in the user survey to reflect common HHRA receptor age ranges and to reflect age and duration ranges known to represent sensitive users. The child age groups are: birth to 1 year of age (0 to 1 year), birth to 2 years of age (0 to 2 years), and birth to 6 years of age (0 to 6 years). Adult recreational receptors were assumed to live in the area for a period of 26 years.

For the birth to 2 years of age child receptor, a body weight (BW) value of 9.60 kg was used to reflect risks to this specific age range. This BW value was calculated using data derived by the Agency for Toxic Substances and Disease Registry (ATSDR)[1] and reflects the time-weighted average BW for children in the birth to 1 year of age and from 1 to 2 years of age. The BW used for the 0 to 6 years of age child receptor was the default 15 kilogram (kg) BW value. Adult recreational receptors were assumed to live in the area for a period of 26 years, reflective of default USEPA and NCDEQ DWM upper-bound residential occupancy periods. The adult recreational receptors were assumed to use the Greenway at the Site-specific exposure frequency and duration during this 26-year period. Appendix A summarizes the exposure parameters for each receptor.

As specified in DWM protocols, constituents reported at sample reporting levels (SRLs) equal to or greater than the 0.1 non-cancer toxicity endpoint hazard quotient (HQ) or the 1 in 1,000,000 cancer endpoint toxicity value were included in the risk calculations at the reported SRL concentration. Laboratory practical quantitation limit (PQL) must be used for points where concentrations are at or below lab reporting limits. Sample data should not be diluted or elevated unnecessarily above normal reporting limits. Chromium (Cr) is a polyvalent element and can exist in several distinct oxidation states, but only trivalent chromium [Cr (III)] and hexavalent chromium [Cr (VI)] occur with any frequency in the natural environment. The mobility, bioavailability, and toxicity of chromium largely depend on which of these two chemical species is prevalent. Where chromium data was not speciated to trivalent [Cr(III)] and hexavalent chromium [Cr(VI)], the reported total chromium (CrT) concentration was assumed to be the more toxic Cr(VI) species. Speciated hexavalent and trivalent chromium were used for risk estimates when available.

[1] ATSDR is a federal public health agency within the Centers for Disease Control and Prevention (CDC) that conducts and establishes protocols and methodology for public health assessments. ATSDR web page at: https://www.atsdr.cdc.gov/

Using the input data described above, output from the risk calculator tool shows: 1) the NCDEQ DWM human health acceptable additive (cumulative) risk criteria is less than or equal to 1.0 HI for a specific target organ or critical effect for non-cancer effects (systemic effects), and 2) an additive lifetime increased cancer risk of less than or equal to 1 in 100,000 for cancer endpoints. These maximum acceptable risk criteria apply to COIs for the combined exposure routes (ingestion, inhalation, and dermal) and exposure pathways for each receptor.

The maximum concentration of a constituent detected in each media was used for the September 2019 risk estimates, without consideration of naturally occurring background (or unaffected reference) concentrations. Background constituent levels will be considered in the discussion of the results of the risk assessment. The need to refine the risk estimates for naturally occurring background contributions may be considered as the Site-specific HHRAs are further developed. It is important to recognize that background COI concentrations contribute to the risk of persons exposed on the Site and should be considered in the risk management and risk communication.

A summary of the calculated risk estimates, pertaining to each receptor classification and the range of exposure frequency and exposure duration parameter values, was used to perform the September 2019 Site-specific recreational receptor risk analysis.

The DWM risk calculator allows for determination of risks to specific receptors by allowing for the adjustment of exposure parameters including for a specific selected age range of concern for site-specific receptors. The risk estimates for each exposure medium (soil, sediment, sediment) were calculated individually for each site-specific recreational receptor age range (0-2 years old, 0-6 years old, and adults). Maximum detected media concentrations were used as the exposure concentrations. Receptor-specific exposure parameters including exposure duration, exposure frequency and body weight were adjusted as appropriate based on USEPA values and site-specific criteria and risk estimates calculated for each media

The Site-specific recreational receptor risk estimates, using the survey-determined exposure parameters, indicate increased levels of risk (greater than 1.0 non-cancer HI and greater than 1E-04 lifetime excess cancer risk) for children in the birth through 6 years of age group who may be exposed to Site soil and sediment near the Greenway.

Recreational Adult Risk Results

Site-specific increased risks were not identified for adult recreational receptors under the defined exposure scenario for individuals or combined soil, surface water and sediment media.

Recreational Child Risk Results

Increased risks to children were identified by media for the following exposures:

Children from birth (0) to 2 years of age –

1. Non-cancer risks for combined soil, surface water, and sediment exposures of one or more visits per week for visit durations. The major proportion (90 percent) of the risk is attributed to the soil exposures.
2. Non-cancer risks for soil exposures of three or more visits per week for all visit durations.

Children from birth (0) to 6 years of age –

1. Non-cancer risks for the combined soil, surface water, and sediment exposures for three or more visits per week for visit durations. Ninety percent (90 percent) of the risk is attributed to the soil exposures.
2. Non-cancer risks for soil exposures for three or more visits per week for visit durations.
3. Cancer risks for soil exposures for seven or more visits per week for all visit durations.

Summary of the September 2019 Risk Evaluation

The non-cancer risk driver for children in the September 2019 analysis was attributed to arsenic and cobalt. The cancer risk driver for children in the 0-6 years age range was attributed to arsenic. For adult recreators, elevated risks were not indicated for individuals or combined soil, surface water and sediment media for each Site-specific exposure parameter. Interim measures were implemented to address these risk identified during the September 2019 assessment. A post-remediation risk evaluation was performed after implementation of interim measures and is summarized in the following section.

3.2 Recreational and Trespasser Receptors for the Bolin Creek Greenway – Post Interim Measures

After the completion of IRMs conducted from January through November 2020, SynTerra conducted additional Bolin Creek human health risk estimate calculations for recreators and trespassers exposed to soil and surface water. The 2020 risk estimates incorporate post interim measure soil and surface water constituent concentrations (note that the CCP removal was conducted initially prior to the remainder of the IRMs). **Table 1** presents the soil data used to model the 2020 risk estimates, and **Table 2** presents the surface-water data used to model the 2020 risk estimates.

To evaluate the greatest potential for risk, the maximum concentration of constituents in samples collected adjacent to or near the Greenway for each media were used as the EPCs. These data were included in the risk estimates with no modification for potential background constituent concentrations. Hexavalent and trivalent chromium analytical data was collected and used for risk estimates. Risk estimates were calculated using the January 2021 version of the NCDEQ risk calculator.

The May 2020 site-specific recreator and trespasser receptor risk estimates for exposure to the soil and surface water media were calculated using reasonable maximum values (RM) and are summarized in Appendix B. The selected RM for exposure duration (ED) is 0.5-hour, a more conservative (health protective) value relative to the median 8-minute ED identified in the on-site user survey. The U.S.EPA and DWM default 195-day per year Exposure Frequency was used for the recreator receptor to reflect a value greater than the median value determined in the 2019 user survey. The final soil and surface water analyte concentrations for samples collected following the interim measures undertaken at the site were used for the exposure concentrations.

3.3 Construction Worker Receptor for the Bolin Creek Greenway – Post Interim Measures

The construction worker scenario was evaluated for the Greenway using the maximum concentrations of constituents in soil remaining at the site after implementation of interim measures. The exposure parameters used for the construction worker risk estimates reflect the default USEPA and NCDEQ DWM exposure parameters.

3.4 Risk Characterization Results - Post Interim Measures

Table 3 presents risk summary data from the risk calculator for recreational/trespasser user and construction worker pathways. **Table 4** summarizes the risk assessment results for the recreational/trespasser and construction worker pathways. **Appendix B**

contains the exposure factors, target risks, and direct contact risk calculator output for of these exposure scenarios.

The NCDEQ DWM human health acceptable additive (cumulative) risk criteria is less than or equal to 1.0 hazard index (HI) to a specific target organ or critical effect for non-cancer effects (systemic effects), and an additive lifetime increased cancer risk of less than or equal to 1 in 10,000 for cancer endpoints. The maximum acceptable risk criteria apply to constituents for the combined exposure routes (ingestion, inhalation, and dermal) and exposure pathways for each receptor.

The SRLs for constituents reported as not detected in analyses were evaluated relative to cancer and non-cancer screening values. These were calculated using the Site-specific exposure parameters to evaluate whether these constituents should be included in the risk estimates. NCDEQ DWM criteria states that constituents reported as not-detected (ND or U qualifier) with SRLs that exceed the cancer risk level (1 in 1,000,000) or the 0.1 non-cancer hazard quotient (HQ) level are to be included in the risk estimate.

In the surface water data set, thallium was not detected in concentrations at a maximum SRL [10 micrograms per liter (µg/L)], which is greater than the 0.2 HQ level. Including thallium at the 10 µg/L SRL value in the risk estimate for the recreator user results in a 2.3 HQ, indicating concentrations of thallium at greater than non-cancer risk levels. As thallium was not detected in the surface water or soil data for the Site, it was determined that including the thallium SRL value in the risk estimates was not representative of Site conditions.

The 2020 additive non-cancer and cancer risk estimates for the recreator and trespasser receptors, using the Site-specific exposure parameters identified above, are within acceptable risk levels as established by the NCDEQ DWM. The additive cancer risk estimates for the construction worker receptor calculated using the Site-specific exposure parameters are less than cancer risk levels. As indicated by a hazard index (HI) equal to 3.5, the non-cancer additive risk estimate for the construction worker, using the Site-specific exposure parameters, was calculated to be greater than the non-cancer risk levels. With an HQ equal to 2.7, manganese is the constituent with the greatest contribution to the non-cancer risk estimate for the construction worker scenario. Manganese concentrations detected at the Site are consistent with the range of background concentrations for the site. Construction worker risk model inputs are extremely conservative and do not account for implementation of personal protection requirements and best management practices for construction activities. Implementation of personal protection equipment and best management practices was

required at the Site for all construction activities, which would minimize and/or prevent construction worker exposure. This pathway is not required by NCDEQ and is only included as a conservative evaluation. A Site construction plan was developed and implemented as part of the interim measure activities.

The 2020 Site-specific human health risk estimates for Bolin Creek Greenway recreational users, trespassers, and construction worker receptors assume the data is representative of the current and future soil and surface water at the Site. Persons exposed to constituent concentrations that are greater than those reflected in the data provided or exposed to other environmental constituents not represented in this data, or persons who are exposed on the basis of the exposure parameters used for this risk analysis, may be subject to greater levels of potential health risks.

4.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

To be protective of site ecology, and to help the Town plan for the future design of the full remedy, SynTerra performed screening level ecological risk assessment calculations utilizing USEPA guidance documents. Surface water, sediment, and soil data were compared with ecological screening values (ESVs) that are designed to provide a conservative estimate of the concentration to which an ecological receptor can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive screening levels, it can be assumed that concentrations less than screening levels will not result in any adverse effects to receptor survival, growth, and/or reproduction; therefore, further evaluation is not necessary. Concentrations greater than conservative risk-based screening levels do not necessarily indicate that a potential ecological risk exists; however, further evaluation might be warranted.

These calculations were performed using data collected after interim measures were conducted. Also, data from soil samples collected deeper than 4 feet and under impervious surfaces (*e.g.*, parking lots) were excluded from the screening level assessment. Once remedial options for the full remedy are proposed, these calculations and assumptions can be reset to show the effectiveness of the proposed final remedies on Site ecological issues.

As shown in **Appendix C**, maximum concentrations in surface water, sediment, and soil data were input into tables to identify the presence of constituents of potential concern (COPCs). A set of tables for surface water, sediment, and soil are provided for background areas and the source area. The downgradient area was evaluated for surface water and sediment (no soil sample data are available in this area).

Table C1, **Table C2**, and **Table C3** show background values compared to the recommended USEPA ecological screening criteria (**Table C4**). The data show COPCs were found in background sediment and soil locations exceeding the ESVs. Surface water COPCs were not found above ESVs in the background area, the source area, nor areas downgradient of the source area.

Sediment calculations pertaining to background samples are presented in **Table C2**, calculations pertaining to the source area are presented in **Table C6**, and calculations pertaining to areas downgradient of the source area are presented in **Table C10**. The COPCs barium, chromium, and manganese were identified in background sediment. As summarized below, sediment in the source area and areas downgradient of the source area contained the COPCs barium and chromium. The maximum detected source area

concentration for barium and chromium is within the range detected in background. Otherwise, the COPCs identified (using the USEPA ecological screening criteria shown in **Table C8** and **Table C11**) in source area samples or downgradient samples were found in background samples.

Table C7 shows the findings for the ecological screening for soils in the source area. Seven COPCs were identified after consideration of constituents that were found with concentrations consistent with background soil concentrations, as shown in **Table 5** and summarized below. The result of this screening is a list of COPCs to be further evaluated quantitatively in a baseline risk assessment.

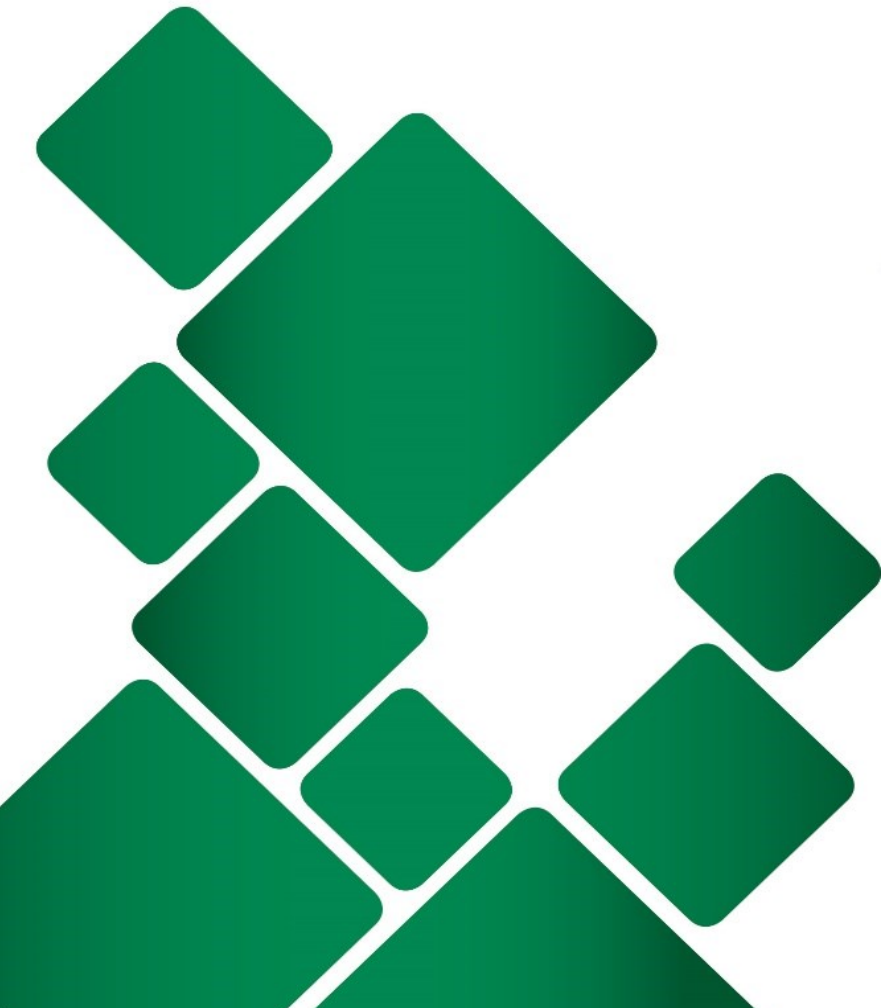
Media/Location	COPC
Surface Water- source area	None
Sediment- source area	Barium Chromium
Soil- source area	Arsenic Lead Mercury Strontium Thallium Vanadium Zinc

5.0 CONCLUSIONS AND RECOMMENDATIONS

SynTerra concludes and recommends the following:

- Interim remedial measures have been effective in reducing risk to Greenway users to within acceptable EPA ranges. Based on the current site use and data, this risk assessment concludes the greenway trail is safe for use.
- Ecological risk is believed to be minimal. However, the final remedy design process should include the performance of an ecological risk assessment that includes evaluation of the seven constituents referenced in **Section 4.0** above.
- The Town should continue to monitor Site conditions so that effects from storms or potential flooding events are noted and can be evaluated.
- If Site conditions change due to newly identified migration or exposure of CCP, we recommend the collection of additional samples to update the human health risk calculations.
- If additional construction activities are needed in areas of concern, the current site worker training plan, which includes the use of PPE, should be continued. Depending on the nature of construction activities, additional sampling and update of the human health risk assessment may also be warranted.

FIGURES



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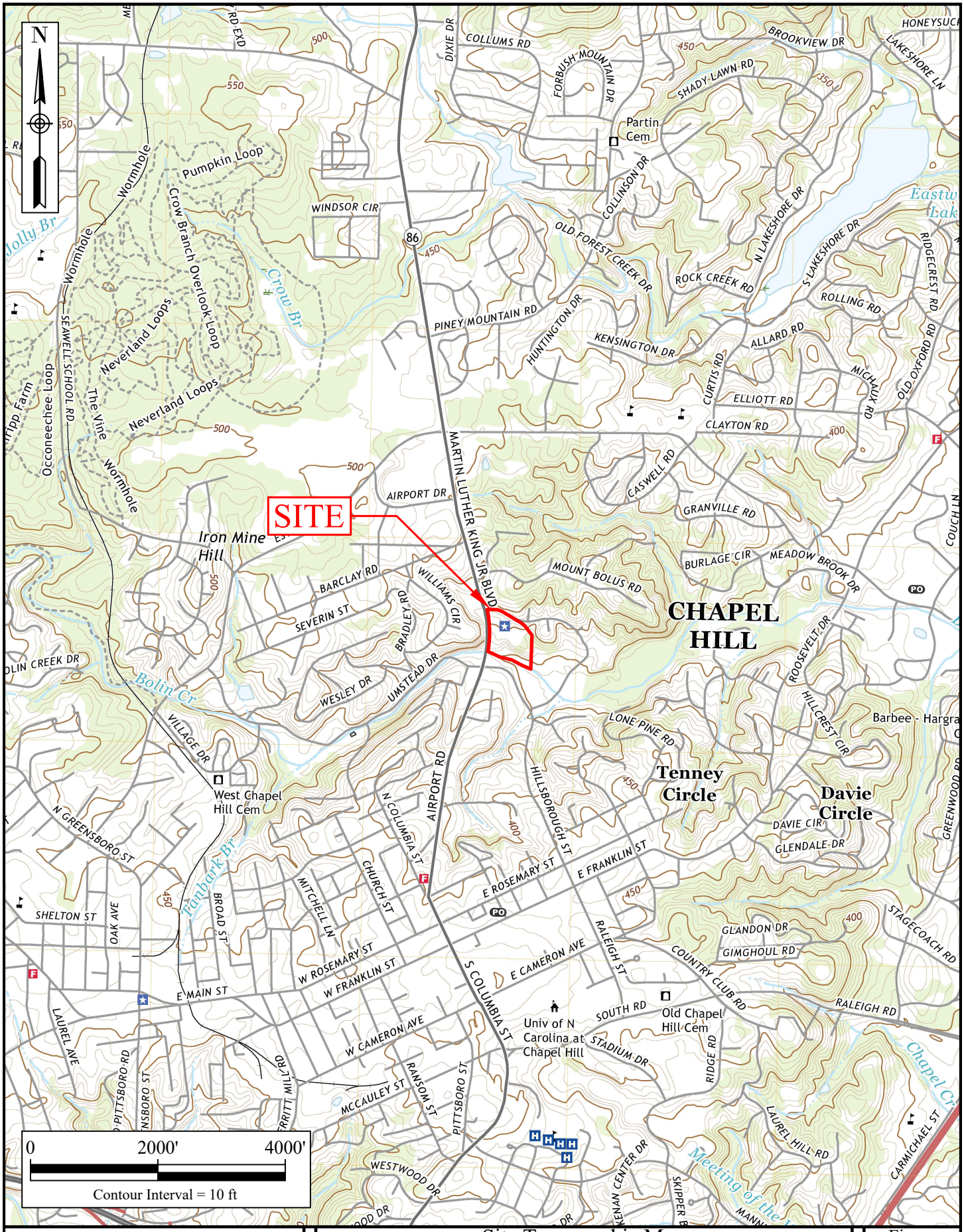

synTerra

Site Topographic Map

828 Martin Luther King, Jr. Boulevard Property
Chapel Hill, North Carolina

Figure 1

Drawn By:	Checked By:	Project Number:	Date:	References:
pjs		201959	January 2021	USGS: Chapel Hill (2019)

Scale:	Size:	Layers:	Filename:
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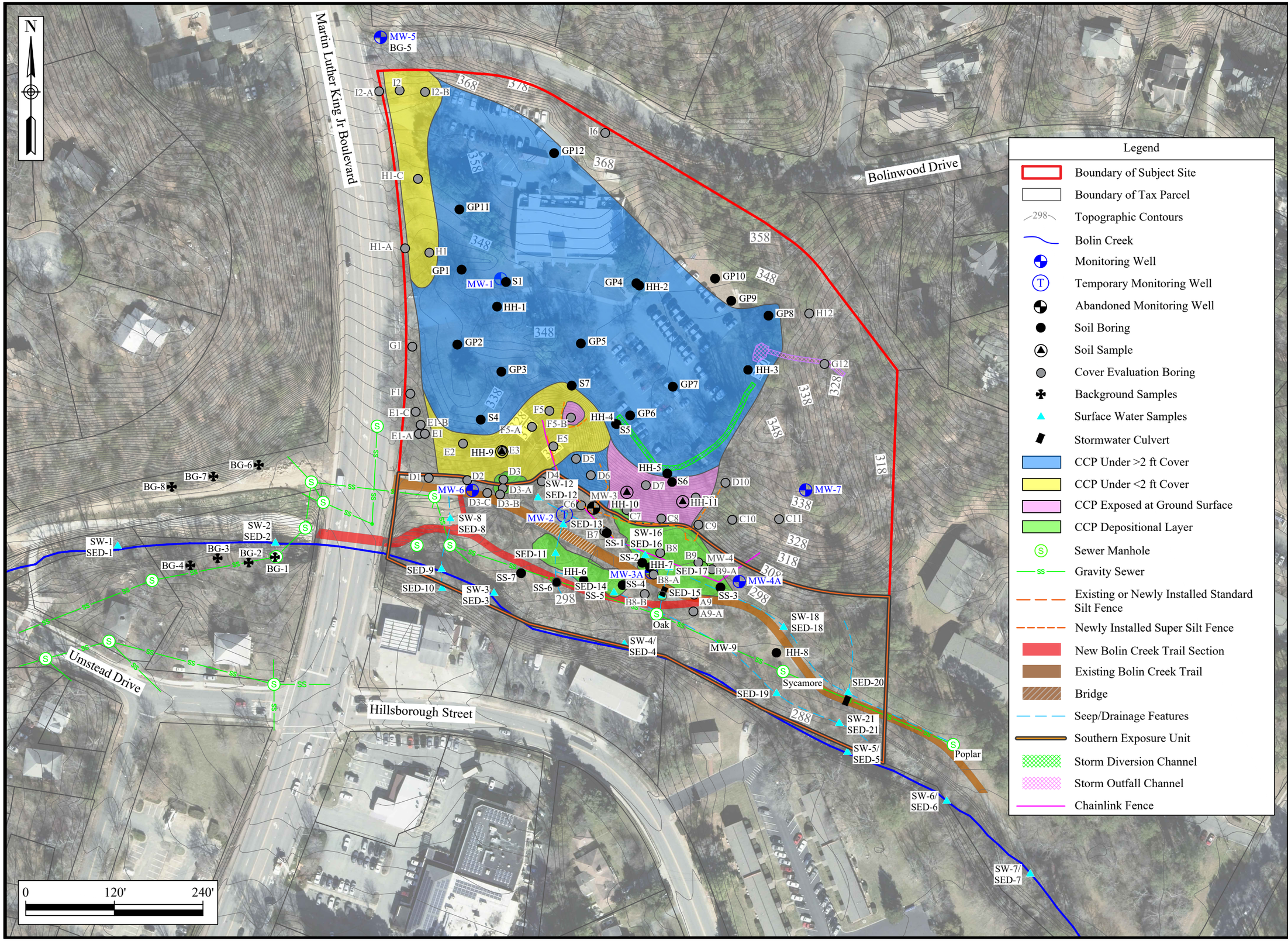


Site Boundary and Exposure Unit Map

828 Martin Luther King, Jr. Boulevard Property
Chapel Hill, North Carolina

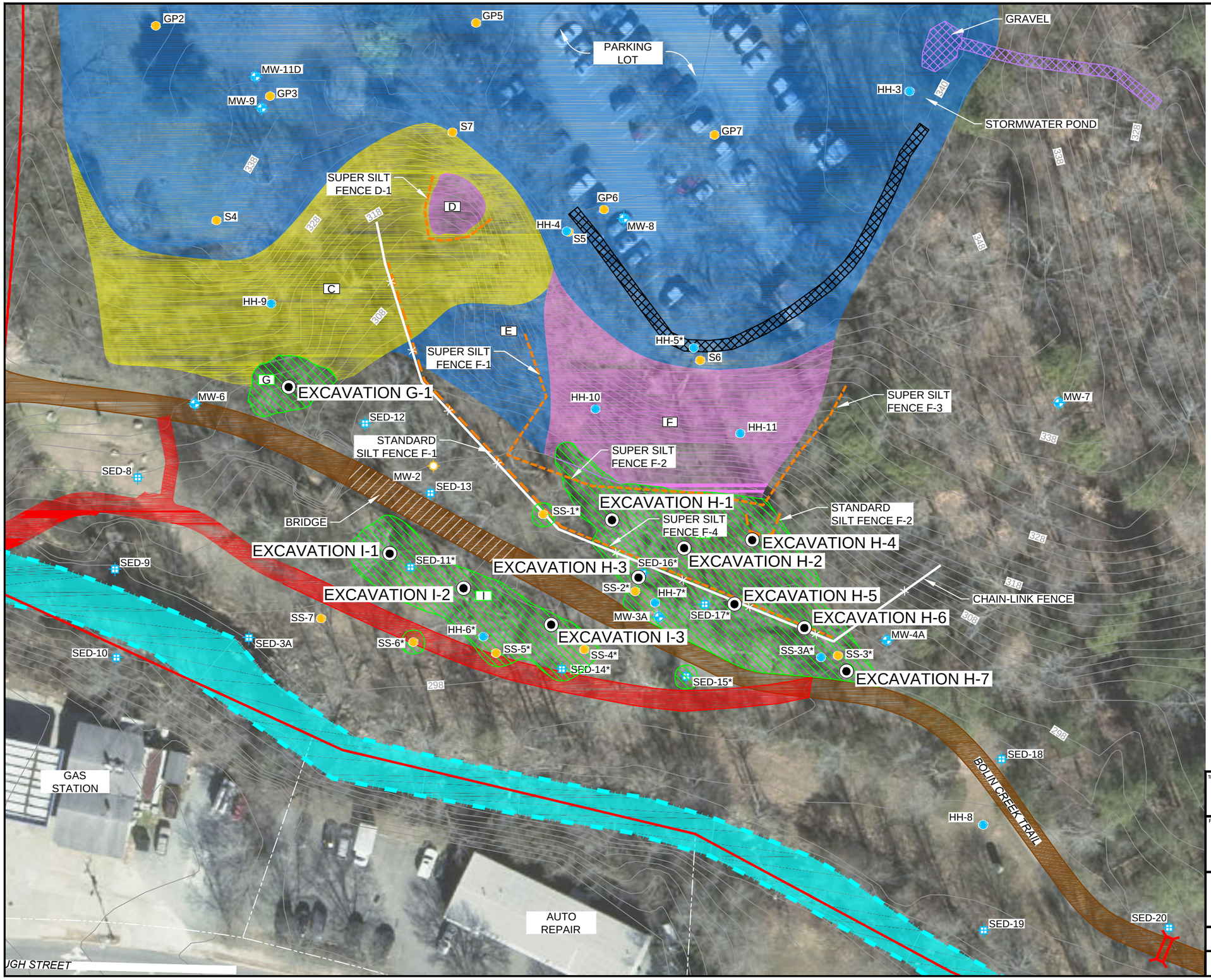
References: Phase II Remedial Investigation Report (Hart & Hickman,2017); NCOneMap, Orange County GIS

Drawn By:	Checked By:	Project Number:	Date:
PJS		00.2312.00	March 2021

Scale:	Size:	Layers:	Filename:
1" = 120'	11" x 17"	0-13,15-18,20,22-24	P:\Chapel Hill, Town of\2019\59-Bolin Creek HHECO RA\CAD_Drawings\site map.dwg

Figure

2



LEGEND

- SITE PROPERTY BOUNDARY
- BOLIN CREEK
- —328— TOPOGRAPHIC CONTOUR ELEVATION (FT MSL)
- CCP UNDER > 2 FT COVER
- CCP UNDER < 2 FT COVER
- CCP EXPOSED AT GROUND SURFACE (HYDROSEEDED)
- EXCAVATED CCP DEPOSITIONAL LAYER
- EXISTING BOLIN CREEK TRAIL
- NEW BOLIN CREEK TRAIL SECTION
- EXISTING OR NEWLY INSTALLED STANDARD SILT FENCE
- NEWLY INSTALLED SUPER SILT FENCE
- STORM DIVERSION CHANNEL
- STORM OUTFALL CHANNEL
- STORMWATER CULVERT
- [A] CCP AREA DESIGNATION
- SOIL BORING LOCATION (FALCON ENGINEERING)
- SOIL BORING LOCATION (H&H)
- MONITORING WELL LOCATION (H&H)
- DRAINAGE PATHWAY SOIL SAMPLE LOCATION (H&H)
- POST INTERIM REMEDIAL MEASURES SOIL SAMPLE LOCATION (H&H)

NOTES:

1. CCPs = COAL COMBUSTION PRODUCTS
2. * = SOIL AND SOIL/CCPs SAMPLE LOCATIONS EXCAVATED AS PART OF INTERIM REMEDIAL MEASURES AND TRAIL CONSTRUCTION.

N

APPROXIMATE
0 50 100
SCALE IN FEET

TITLE

POST INTERIM REMEDIAL MEASURES SAMPLE LOCATION MAP

PROJECT

TOWN OF CHAPEL HILL
828 MARTIN LUTHER KING JR. BOULEVARD
CHAPEL HILL, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)
License # C-1269 / #C-245 Geology

DATE: 12-10-20	REVISION NO. 0
JOB NO. TCH-009	FIGURE NO. 3

TABLES

Science & Engineering Consultants

Table 1
Soil and Sediment Data Input to Risk Calculator Tool
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Concentration Used for Screening (mg/kg}	Current Interim Maximum Allowable Concentration
				Min.	Q	Max.	Q			
Antimony	7440-36-0	2	0	NA		NA		NA	NA	NA
Arsenic	7440-38-2	26	26	0.792		14.5		SED-13	14.5	14.5
Barium	7440-39-3	26	26	20.0		958		SED-13	958	958
Beryllium	7440-41-7	26	16	0.118	J	1.56		SED-13	1.56	1.56
Boron	7440-42-8	1	0	NA		NA		NA	NA	NA
Cadmium	7440-43-9	26	6	0.122	J	0.284	J	SED-13	0.284	0.284
Chromium, Trivalent	16065-83-1	25	25	5.76		63.8		Excavation H-2	63.8	63.8
Chromium, Hexavalent	18540-29-9	25	12	0.313	J	0.578	J	Excavation H-2	0.578	0.578
Chromium (Total)	7440-47-3	1	1	14		14		SS-7	NA	NA
Cobalt	7440-48-4	26	26	3.68		20.8		Excavation H-4	15*	15.0
Copper	7440-50-8	26	26	6.58		59.2		Excavation H-2	59.2	59.2
Lead	7439-92-1	2	2	13		18		HH-8	18	400**
Manganese	7439-96-5	26	26	193		1,480		H-4	591*	591
Mercury	7439-97-6	26	23	0.0071	J	0.077		SED-12	0.077	0.077
Molybdenum	7439-98-7	1	0	NA		NA		NA	NA	NA
Nickel	7440-02-0	26	26	2.19		19.2		SED-13	19.2	19.2
Selenium	7782-49-2	26	14	0.237	J	3.07		SED-13	3.07	3.07
Strontium	7440-24-6	26	26	6.2		125.0		SED-13	125.0	125
Thallium	7440-28-0	2	0	NA		NA		NA	NA	NA
Vanadium	7440-62-2	2	2	37		52		HH-8	52	52
Zinc	7440-66-6	2	2	37		54		HH-8	54	54

Notes:
NA - Not Applicable
* - 95% UCL of site-specific backround range was used
**-Note that EPA has no consensus on reference does or cancer slop factor values for lead, therefore it is not possible to calculate cancer risk, or hazard quotient. Lead concentrations are compared to the EPA screeing level of 400 mg/kg for Residential soil

Table 2
Surface-Water Data Input to Risk Calculator Tool
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Concentration Used for Screening (ug/L)
				Min.	Q	Max.	Q		
Aluminum	7429-90-5	2	0	NA		NA		NA	NA
Antimony	7440-36-0	4	0	NA		NA		NA	NA
Arsenic (tot)	7440-38-2	10	6	0.15		0.45		SW-3	0.45
Barium	7440-39-3	10	10	16.9		32.1		SW-21	32.1
Beryllium (tot)	7440-41-7	10	0	NA		NA		NA	NA
Cadmium (tot)	7440-43-9	10	0	NA		NA		NA	NA
Chromium (Total recov)	7440-47-3	10	2	0.62		0.73		SW-21	0.73
Chromium, Trivalent	16065-83-1	NA	NA	NA		NA		NA	NA
Chromium, Hexavalent	18540-29-9	4	0	NA		NA		NA	NA
Cobalt	7440-48-4	10	6	0.094		0.36		SW-21	0.36
Copper (tot)	7440-50-8	10	6	0.88		3.2		SW-21	3.2
Iron	7439-89-6	4	NA	NA		NA		NA	NA
Lead (tot)	7439-92-1	4	NA	NA		NA		NA	NA
Manganese	7439-96-5	10	10	9.3		37.4		SW-3	37.4
Mercury (tot)	7439-97-6	10	0	NA		NA		NA	NA
Nickel (tot)	7440-02-0	6	6	0.21	J	0.62		SW-21	0.62
Selenium	7782-49-2	10	5	0.088	J	0.120	J	SW-5	0.120
Strontium	7440-24-6	10	10	43.5		89.1		SW-4	89.1
Thallium	7440-28-0	4	0	NA		NA		NA	NA
Vanadium	7440-62-2	4	0	NA		NA		NA	NA
Zinc (tot)	7440-66-6	4	0	NA		NA		NA	NA

Notes:
NA- Not Applicable

Table 3
Risk Calculator Tool Risk Summary with Polling Data Adjustments - Recreator
Chapel Hill, North Carolina

Risk for Individual Pathways **Output Form 1A**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Recreator

Exposure Unit ID: Southern Exposure Unit

DIRECT CONTACT SOIL AND WATER CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Soil	NC	NC	NC
	Groundwater Use*	NC	NC	NC
Non-Residential Worker	Soil	NC	NC	NC
	Groundwater Use*	NC	NC	NC
Construction Worker	Soil	1.4E-06	3.5E+00	YES
Recreator/Trespasser	Soil	1.3E-05	9.0E-01	NO
	Surface Water*	3.3E-06	1.8E-02	NO

VAPOR INTRUSION CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Groundwater to Indoor Air	NC	NC	NC
	Soil Gas to Indoor Air	NC	NC	NC
	Indoor Air	NC	NC	NC
Non-Residential Worker	Groundwater to Indoor Air	NC	NC	NC
	Soil Gas to Indoor Air	NC	NC	NC
	Indoor Air	NC	NC	NC

CONTAMINANT MIGRATION CALCULATORS

Pathway	Source	Target Receptor Concentrations Exceeded?	
Groundwater	Source Soil	Exceedence of 2L at Receptor?	NM
	Source Groundwater	Exceedence of 2L at Receptor?	NC
Surface Water	Source Soil	Exceedence of 2B at Receptor?	NM
	Source Groundwater	Exceedence of 2B at Receptor?	NC

Notes:

1. If lead concentrations were entered in the exposure point concentration tables, see the individual calculator sheets for lead concentrations in comparison to screening levels. Note that lead is not included in cumulative risk calculations.

2. * = If concentrations in groundwater exceed the NC 2L Standards or IMAC, or concentrations in surface water exceed the NC 2B Standards, appropriate remediation and/or institutional control measures will be necessary to be eligible for a risk-based closure.
3. NM = Not Modeled
4. NC = Pathway not calculated

Table 4
Risk Calculator Tool Risk Summary with Polling Data Adjustments - Trespasser
Chapel Hill, North Carolina

Risk for Individual Pathways **Output Form 1A**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Trespasser

Exposure Unit ID: Southern Exposure Unit

DIRECT CONTACT SOIL AND WATER CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Soil	NC	NC	NC
	Groundwater Use*	NC	NC	NC
Non-Residential Worker	Soil	NC	NC	NC
	Groundwater Use*	NC	NC	NC
Construction Worker	Soil	1.4E-06	3.5E+00	YES
Recreator/Trespasser	Soil	1.7E-06	7.7E-02	NO
	Surface Water*	7.3E-07	4.4E-03	NO

VAPOR INTRUSION CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Groundwater to Indoor Air	NC	NC	NC
	Soil Gas to Indoor Air	NC	NC	NC
	Indoor Air	NC	NC	NC
Non-Residential Worker	Groundwater to Indoor Air	NC	NC	NC
	Soil Gas to Indoor Air	NC	NC	NC
	Indoor Air	NC	NC	NC

CONTAMINANT MIGRATION CALCULATORS

Pathway	Source	Target Receptor Concentrations Exceeded?	
Groundwater	Source Soil	Exceedence of 2L at Receptor?	NM
	Source Groundwater	Exceedence of 2L at Receptor?	NC
Surface Water	Source Soil	Exceedence of 2B at Receptor?	NM
	Source Groundwater	Exceedence of 2B at Receptor?	NC

Notes:

1. If lead concentrations were entered in the exposure point concentration tables, see the individual calculator sheets for lead concentrations in comparison to screening levels. Note that lead is not included in cumulative risk calculations.

2. * = If concentrations in groundwater exceed the NC 2L Standards or IMAC, or concentrations in surface water exceed the NC 2B Standards, appropriate remediation and/or institutional control measures will be necessary to be eligible for a risk-based closure.
3. NM = Not Modeled
4. NC = Pathway not calculated

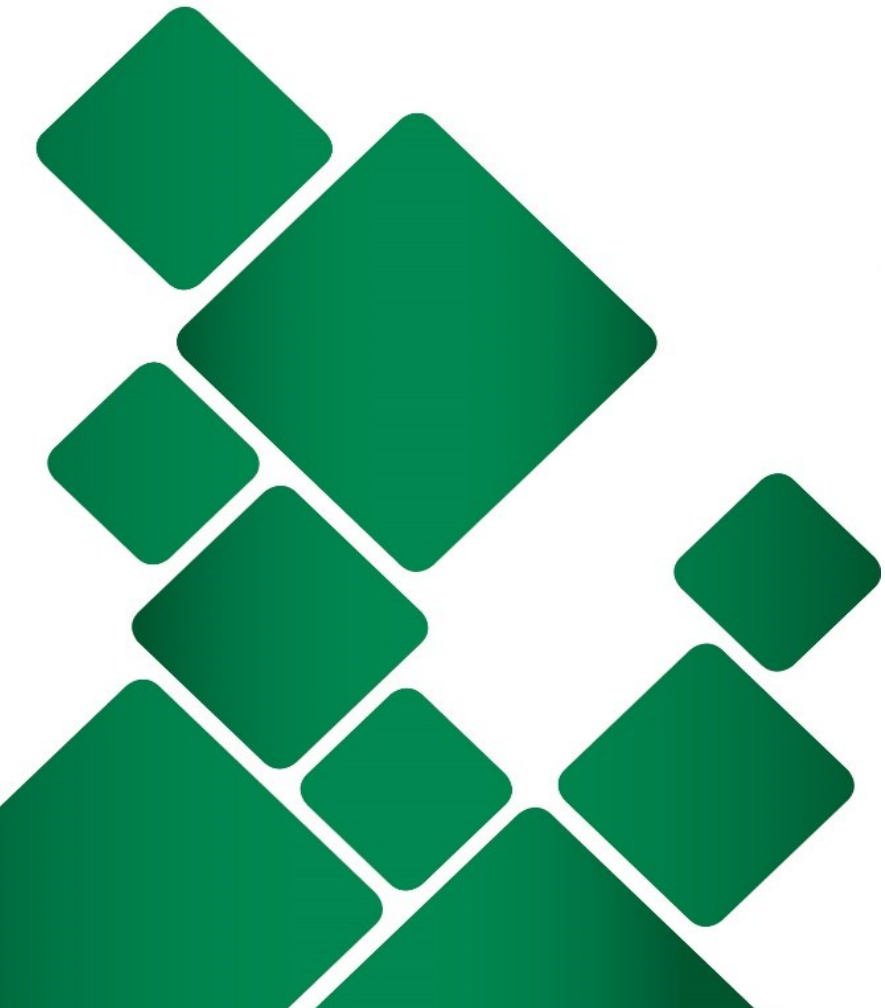
Table 5
Ecological Screening Results
Chapel Hill, North Carolina

Area/Media	SW	SED	SOIL
Background	NONE	Barium	
		Chromium (Total)	Chromium (Total)
			Chromium, Hexavalent
			Chromium, Trivalent
			Cobalt
			Copper
		Manganese	Manganese
			Selenium
Source	NONE		**Arsenic**
		Barium	Barium
		Chromium (Total)	Chromium (Total)
			Chromium, Hexavalent
			Chromium, Trivalent
			Cobalt
			Copper
			Lead
			Manganese
			Mercury
			Nickel
			Selenium
			Strontium
			Thallium
			Vanadium
			Zinc
Downgradient	NONE	Barium	NO DATA
		Chromium (Total)	

Notes:
Compounds in bold are Contaminants of Potential Concern that exhibit elevated concentrations in the source area.
Soil samples in the source area that are under impervious areas and are at depths greater than four feet were excluded in this assessment

APPENDIX A

SEPTEMBER 2019 RISK CALCULATOR TOOL OUTPUT



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Summary of Risk Assessment Output **Output Form 1A**

Version Date: February 2018

Basis: November 2017 EPA RSL Table

Site ID: Resident, Occptl, Construction Wrkr, Recreational - default

Exposure Unit ID: sediment adjacent to Bolin Crk, April 2019 samples

PRIMARY CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Soil Combined Pathways	5.7E-06	4.2E-01	NO
	Groundwater Combined Pathways*	0.0E+00	0.0E+00	NO
Non-Residential Worker	Soil Combined Pathways	8.9E-07	2.9E-02	NO
	Groundwater Combined Pathways*	0.0E+00	0.0E+00	NO
Construction Worker	Soil Combined Pathways	5.3E-07	1.5E+00	YES
User Defined	Soil Combined Pathways	3.2E-06	2.4E-01	NO
	Surface Water Combined Pathways*	0.0E+00	0.0E+00	NO

VAPOR INTRUSION CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Groundwater to Indoor Air	0.0E+00	0.0E+00	NO
	Soil Gas to Indoor Air	0.0E+00	0.0E+00	NO
	Indoor Air	0.0E+00	0.0E+00	NO
Non-Residential Worker	Groundwater to Indoor Air	0.0E+00	0.0E+00	NO
	Soil Gas to Indoor Air	0.0E+00	0.0E+00	NO
	Indoor Air	0.0E+00	0.0E+00	NO

CONTAMINANT MIGRATION CALCULATORS

Pathway	Source	Target POE Concentrations Exceeded?	
Protection of Groundwater Use	Source Soil	Exceedence of 2L at POE?	NM
	Source Groundwater	Exceedence of 2L at POE?	NM
Protection of Surface Water	Source Soil	Exceedence of 2B at POE?	NM
	Source Groundwater	Exceedence of 2B at POE?	NM

Notes:

1. If lead concentrations were entered in the exposure point concentration tables, see the individual calculator sheets for lead concentrations in comparison to screening levels. Note that lead is not included in cumulative risk calculations.

2. * = If concentrations in groundwater exceed the NC 2L Standards or IMAC, or concentrations in surface water exceed the NC 2B Standards, appropriate remediation and/or institutional control measures will be necessary to be eligible for a risk-based closure.

Summary of Risk Assessment Output **Output Form 1A**

Version Date: February 2018

Basis: November 2017 EPA RSL Table

Site ID: 828 MLK, Chapel Hill

Exposure Unit ID: sediment adjacent to Bolin Crk, April 2019 samples

PRIMARY CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Soil Combined Pathways	5.7E-06	4.2E-01	NO
	Groundwater Combined Pathways*	0.0E+00	0.0E+00	NO
Non-Residential Worker	Soil Combined Pathways	8.9E-07	2.9E-02	NO
	Groundwater Combined Pathways*	0.0E+00	0.0E+00	NO
Construction Worker	Soil Combined Pathways	5.3E-07	1.5E+00	YES
User Defined	Soil Combined Pathways	5.9E-07	3.7E-02	NO
	Surface Water Combined Pathways*	0.0E+00	0.0E+00	NO

VAPOR INTRUSION CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Groundwater to Indoor Air	0.0E+00	0.0E+00	NO
	Soil Gas to Indoor Air	0.0E+00	0.0E+00	NO
	Indoor Air	0.0E+00	0.0E+00	NO
Non-Residential Worker	Groundwater to Indoor Air	0.0E+00	0.0E+00	NO
	Soil Gas to Indoor Air	0.0E+00	0.0E+00	NO
	Indoor Air	0.0E+00	0.0E+00	NO

CONTAMINANT MIGRATION CALCULATORS

Pathway	Source	Target POE Concentrations Exceeded?	
Protection of Groundwater Use	Source Soil	Exceedence of 2L at POE?	NM
	Source Groundwater	Exceedence of 2L at POE?	NM
Protection of Surface Water	Source Soil	Exceedence of 2B at POE?	NM
	Source Groundwater	Exceedence of 2B at POE?	NM

Notes:

1. If lead concentrations were entered in the exposure point concentration tables, see the individual calculator sheets for lead concentrations in comparison to screening levels. Note that lead is not included in cumulative risk calculations.

2. * = If concentrations in groundwater exceed the NC 2L Standards or IMAC, or concentrations in surface water exceed the NC 2B Standards, appropriate remediation and/or institutional control measures will be necessary to be eligible for a risk-based closure.

Summary of Risk Assessment Output **Output Form 1A**

Version Date: February 2018

Basis: November 2017 EPA RSL Table

Site ID: 828 MLK April 2019 Sample data

Exposure Unit ID: April 2019 sample data, with 6Cr

PRIMARY CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Soil Combined Pathways	1.4E-04	3.9E+00	YES
	Groundwater Combined Pathways*	4.4E-04	6.7E+00	YES
Non-Residential Worker	Soil Combined Pathways	3.2E-05	2.9E-01	NO
	Groundwater Combined Pathways*	8.9E-05	1.0E+00	YES
Construction Worker	Soil Combined Pathways	6.0E-06	5.8E+00	YES
User Defined	Soil Combined Pathways	8.0E-05	2.1E+00	YES
	Surface Water Combined Pathways*	1.0E-05	3.0E-02	NO

VAPOR INTRUSION CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Groundwater to Indoor Air	0.0E+00	2.3E-01	NO
	Soil Gas to Indoor Air	0.0E+00	0.0E+00	NO
	Indoor Air	0.0E+00	0.0E+00	NO
Non-Residential Worker	Groundwater to Indoor Air	0.0E+00	5.4E-02	NO
	Soil Gas to Indoor Air	0.0E+00	0.0E+00	NO
	Indoor Air	0.0E+00	0.0E+00	NO

CONTAMINANT MIGRATION CALCULATORS

Pathway	Source	Target POE Concentrations Exceeded?	
Protection of Groundwater Use	Source Soil	Exceedence of 2L at POE?	NM
	Source Groundwater	Exceedence of 2L at POE?	NM
Protection of Surface Water	Source Soil	Exceedence of 2B at POE?	NM
	Source Groundwater	Exceedence of 2B at POE?	NM

Notes:

1. If lead concentrations were entered in the exposure point concentration tables, see the individual calculator sheets for lead concentrations in comparison to screening levels. Note that lead is not included in cumulative risk calculations.

2. * = If concentrations in groundwater exceed the NC 2L Standards or IMAC, or concentrations in surface water exceed the NC 2B Standards, appropriate remediation and/or institutional control measures will be necessary to be eligible for a risk-based closure.

Summary of Risk Assessment Output **Output Form 1A**

Version Date: February 2018

Basis: November 2017 EPA RSL Table

Site ID: 828 MLK April 2019 Sample data

Exposure Unit ID: April 2019 Sample data, Trespasser w/ 6Cr

PRIMARY CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Soil Combined Pathways	NC	NC	NC
	Groundwater Combined Pathways*	NC	NC	NC
Non-Residential Worker	Soil Combined Pathways	NC	NC	NC
	Groundwater Combined Pathways*	NC	NC	NC
Construction Worker	Soil Combined Pathways	NC	NC	NC
User Defined	Soil Combined Pathways	1.8E-05	3.6E-01	NO
	Surface Water Combined Pathways*	2.4E-06	7.8E-03	NO

VAPOR INTRUSION CALCULATORS

Receptor	Pathway	Carcinogenic Risk	Hazard Index	Risk exceeded?
Resident	Groundwater to Indoor Air	NC	NC	NC
	Soil Gas to Indoor Air	NC	NC	NC
	Indoor Air	NC	NC	NC
Non-Residential Worker	Groundwater to Indoor Air	NC	NC	NC
	Soil Gas to Indoor Air	NC	NC	NC
	Indoor Air	NC	NC	NC

CONTAMINANT MIGRATION CALCULATORS

Pathway	Source	Target POE Concentrations Exceeded?	
Protection of Groundwater Use	Source Soil	Exceedence of 2L at POE?	NM
	Source Groundwater	Exceedence of 2L at POE?	NM
Protection of Surface Water	Source Soil	Exceedence of 2B at POE?	NM
	Source Groundwater	Exceedence of 2B at POE?	NM

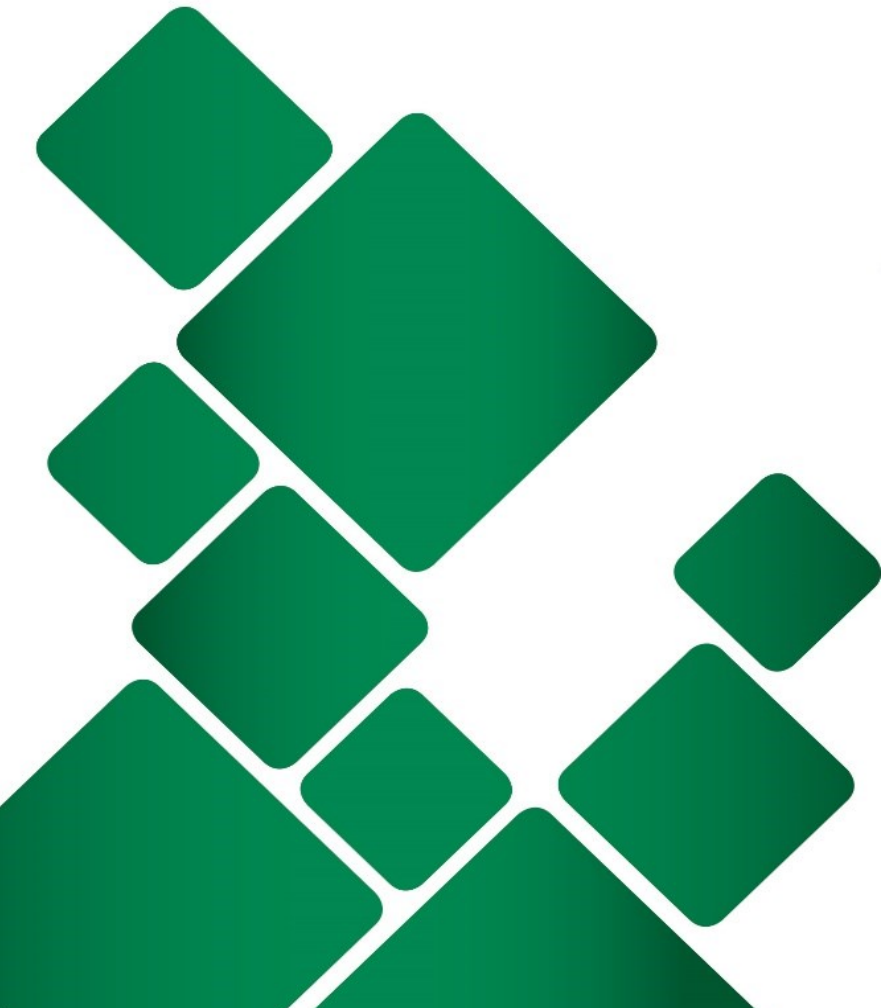
Notes:

1. If lead concentrations were entered in the exposure point concentration tables, see the individual calculator sheets for lead concentrations in comparison to screening levels. Note that lead is not included in cumulative risk calculations.

2. * = If concentrations in groundwater exceed the NC 2L Standards or IMAC, or concentrations in surface water exceed the NC 2B Standards, appropriate remediation and/or institutional control measures will be necessary to be eligible for a risk-based closure.

APPENDIX B

ANALYTICAL DATA SUMMARY TABLES FOR HUMAN HEALTH RISK ASSESSMENT



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Science & Engineering Consultants

Exposure Factors and Target Risks **Input Form 1B**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Recreator

Exposure Unit ID: Southern Exposure Unit

Exposure Parameter	Default Value	Site Specific Value	Justification
General			
Target Cancer Risk (individual)	1.0E-06	1.0E-06	
Target Cancer Risk (cumulative)	1.0E-04	1.0E-04	
Target Hazard Index (individual)	2.0E-01	2.0E-01	
Target Hazard Index (cumulative)	1.0E+00	1.0E+00	
Residential Child			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	15	15	
Exposure Duration (ED) (yr)	6	6	
Exposure Frequency (EF) (d/yr)	350	350	
Exposure Time (ET) (hr)	24	24	
Skin Surface Area - Soil Exposure (SA_s) (cm2)	2373	2373	
Soil Adherence Factor (AF) (mg/cm^2)	0.2	0.2	
Soil Ingestion Rate (IRS) (mg/day)	200	200	
Skin Surface Area - Water Exposure (SA_w) (cm2)	6365	6365	
Water Ingestion Rate (IRW) (L/d)	0.78	0.78	
Water Exposure Time (ET_{event}) (hr/event)	0.54	0.54	
Water Event Frequency (EV) (events/day)	1	1	
Residential Adult			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	80	80	
Exposure Duration (ED) (yr)	20	20	
Exposure Frequency (EF) (d/yr)	350	350	
Exposure Time (ET) (hr)	24	24	
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	6032	6032	
Soil Adherence Factor (AF) (mg/cm^2)	0.07	0.07	
Soil Ingestion Rate (IRS) (mg/day)	100	100	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	19652	19652	
Water Ingestion Rate (IRW) (L/d)	2.5	2.5	
Water Exposure Time (ET_{event}) (hr/event)	0.71	0.71	
Water Event Frequency (EV) (events/day)	1	1	
Non-Residential Worker			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	80	80	
Exposure Duration (ED) (yr)	25	25	
Exposure Frequency (EF) (d/yr)	250	250	
Exposure Time (ET) (hr)	8	8	
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	3527	3527	
Soil Adherence Factor (AF) (mg/cm^2)	0.12	0.12	
Soil Ingestion Rate (IR) (mg/day)	100	100	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	19652	19652	
Water Ingestion Rate (IRW) (L/d)	0.83	0.83	
Water Exposure Time (ET_{event}) (hr/event)	0.67	0.67	
Water Event Frequency (EV) (events/day)	1	1	
Construction Worker			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	80	80	
Working Weeks (EW) (wk/yr)	50	50	
Exposure Duration (ED) (yr)	1	1	
Exposure Frequency (EF) (d/yr)	250	250	
Exposure Time (ET) (hr)	8	8	
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	3527	3527	
Soil Adherence Factor (AF) (mg/cm^2)	0.3	0.3	
Soil Ingestion Rate (IR) (mg/day)	330	330	

Exposure Factors and Target Risks **Input Form 1B**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Recreator

Exposure Unit ID: Southern Exposure Unit

Exposure Parameter	Default Value		Site Specific Value	Justification
User Defined Child				
	Recreator	Trespasser		
Lifetime (LT) (years)	70	NA	70	
Averaging Time (AT) (days/yr)	365	NA	365	
Body Weight (BW) (kg)	15	NA	15	
Exposure Duration 0-2 (ED) (yr)	2	NA	2	
Exposure Duration 2-6 (ED) (yr)	4	NA	4	
Exposure Frequency (EF) (d/yr)	195	NA	195	
Exposure Time (ET) (hr)	2	NA	0.5	Polling data adjustment
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	2373	NA	2373	
Soil Adherence Factor (AF) (mg/cm^2)	0.2	NA	0.2	
Soil Ingestion Rate (IRS) (mg/day)	200	NA	200	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	6365	NA	6365	
Water Ingestion Rate (IRW) (L/hr)	0.124	NA	0.124	
Water Exposure Time (ET_{event}) (hr/event)	2	NA	0.5	Polling data adjustment
Water Event Frequency (EV) (events/day)	1	NA	1	
User Defined Adult				
	Recreator	Trespasser		
Lifetime (LT) (years)	70	70	70	
Body Weight (BW) (kg)	80	45	80	
Exposure Duration 6-16 (ED) (yr)	10	10	10	
Exposure Duration 16-26 (ED) (yr)	10	0	10	
Exposure Frequency (EF) (d/yr)	195	90	195	
Exposure Time (ET) (hr)	2	2	0.5	Polling data adjustment
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	6032	6032	6032	
Soil Adherence Factor (AF) (mg/cm^2)	0.07	0.2	0.07	
Soil Ingestion Rate (IRS) (mg/day)	100	200	100	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	19652	19652	19652	
Water Ingestion Rate (IRW) (L/hr)	0.0985	0.071	0.0985	
Water Exposure Time (ET_{event}) (hr/event)	2	2	0.5	Polling data adjustment
Water Event Frequency (EV) (events/day)	1	1	1	

DEQ Risk Calculator - Direct Contact - Construction Worker Soil **Output Form 2E**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Recreator

Exposure Unit ID: Southern Exposure Unit

** - Note that inhalation on this calculator refers to outdoor inhalation of volatiles and particulates, not indoor inhalation associated with vapor intrusion.*

*** - Note that the EPA has no consensus on reference dose or cancer slope factor values for lead, therefore it is not possible to calculate cancer risk or hazard quotient. Lead concentrations are compared to the EPA screening level of 800 mg/kg for commercial/industrial soil.*

CAS #	Chemical Name:	Ingestion Concentration (mg/kg)	Dermal Concentration (mg/kg)	Inhalation Concentration (mg/kg)*	Ingestion Carcinogenic Risk	Dermal Carcinogenic Risk	Inhalation Carcinogenic Risk	Calculated Carcinogenic Risk	Ingestion Hazard Quotient	Dermal Hazard Quotient	Inhalation Hazard Quotient	Calculated Non-Carcinogenic Hazard Quotient
7440-38-2	Arsenic, Inorganic	14.5	14.5	14.5	5.3E-07	8.4E-08	1.9E-07	8.0E-07	8.5E-02	1.4E-02	**2.2E-01**	**3.2E-01**
7440-39-3	Barium	958	958	958					1.4E-02		4.3E-02	5.7E-02
7440-41-7	Beryllium and compounds	1.56	1.56	1.56			1.2E-08	1.2E-08	9.2E-04		1.8E-02	1.8E-02
7440-43-9	Cadmium (Diet)	0.284	0.284	0.284			1.6E-09	1.6E-09	1.7E-03	2.1E-04	6.4E-03	8.3E-03
16065-83-1	Chromium(III), Insoluble Salts	63.8	63.8	63.8					1.3E-04		2.9E-03	3.0E-03
18540-29-9	Chromium(VI)	0.578	0.578	0.578	1.2E-08		1.5E-07	1.6E-07	3.4E-04		4.3E-04	7.7E-04
7440-48-4	Cobalt	15	15	15			4.2E-07	4.2E-07	1.5E-02		1.7E-01	1.8E-01
7440-50-8	Copper	59.2	59.2	59.2					1.7E-02			1.7E-02
7439-92-1	~Lead and Compounds	18	18	18					**<SL****	**<SL****	**<SL****	
7439-96-5	Manganese (Non-diet)	591	591	591					7.3E-02		**2.7E+00**	**2.7E+00**
7439-97-6	~Mercury (elemental)	0.077	0.077	0.077							7.9E-03	7.9E-03
7440-02-0	Nickel Soluble Salts	19.2	19.2	19.2			1.5E-08	1.5E-08	2.8E-03		2.2E-02	2.4E-02
7782-49-2	Selenium	3.07	3.07	3.07					1.8E-03		3.4E-05	1.8E-03
7440-24-6	Strontium, Stable	125	125	125					1.8E-04			1.8E-04
7440-62-2	Vanadium and Compounds	52	52	52					1.5E-02		1.2E-01	1.3E-01
7440-66-6	Zinc and Compounds	54	54	54					5.3E-04			5.3E-04
						Cumulative:		1.4E-06				**3.5E+00**

DEQ Risk Calculator - Direct Contact - Recreator/Trespasser Soil **Output Form 2F**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Recreator

Exposure Unit ID: Southern Exposure Unit

** - Note that inhalation on this calculator refers to outdoor inhalation of volatiles and particulates, not indoor inhalation associated with vapor intrusion.*

*** - Note that the EPA has no consensus on reference dose or cancer slope factor values for lead, therefore it is not possible to calculate cancer risk or hazard quotient. Lead concentrations are compared to the EPA screening level of 400 mg/kg for residential soil.*

Receptor Type: Recreator

CAS #	Chemical Name:	Ingestion Concentration (mg/kg)	Dermal Concentration (mg/kg)	Inhalation Concentration (mg/kg)*	Ingestion Carcinogenic Risk	Dermal Carcinogenic Risk	Inhalation Carcinogenic Risk	Calculated Carcinogenic Risk	Ingestion Hazard Quotient	Dermal Hazard Quotient	Inhalation Hazard Quotient	Calculated Non-Carcinogenic Hazard Quotient
7440-38-2	Arsenic, Inorganic	14.5	14.5	14.5	**1.0E-05**	**1.5E-06**	4.3E-12	**1.2E-05**	**2.1E-01**	2.5E-02	1.8E-07	**2.3E-01**
7440-39-3	Barium	958	958	958					3.4E-02		3.6E-07	3.4E-02
7440-41-7	Beryllium and compounds	1.56	1.56	1.56			2.6E-13	2.6E-13	5.6E-03		1.5E-08	5.6E-03
7440-43-9	Cadmium (Diet)	0.284	0.284	0.284			3.6E-14	3.6E-14	2.0E-03	1.9E-04	5.3E-09	2.2E-03
16065-83-1	Chromium(III), Insoluble Salts	63.8	63.8	63.8					3.0E-04			3.0E-04
18540-29-9	Chromium(VI)	0.578	0.578	0.578	**1.1E-06**		9.4E-12	**1.1E-06**	1.4E-03		1.1E-09	1.4E-03
7440-48-4	Cobalt	15	15	15			9.4E-12	9.4E-12	**3.6E-01**		4.7E-07	**3.6E-01**
7440-50-8	Copper	59.2	59.2	59.2					1.1E-02			1.1E-02
7439-92-1	~Lead and Compounds	18	18	18					**<SL****	**<SL****	**<SL****	
7439-96-5	Manganese (Non-diet)	591	591	591					1.8E-01		2.2E-06	1.8E-01
7439-97-6	~Mercury (elemental)	0.077	0.077	0.077							7.7E-05	7.7E-05
7440-02-0	Nickel Soluble Salts	19.2	19.2	19.2			3.5E-13	3.5E-13	6.8E-03		4.0E-08	6.8E-03
7782-49-2	Selenium	3.07	3.07	3.07					4.4E-03		2.9E-11	4.4E-03
7440-24-6	Strontium, Stable	125	125	125					1.5E-03			1.5E-03
7440-62-2	Vanadium and Compounds	52	52	52					7.4E-02		9.8E-08	7.4E-02
7440-66-6	Zinc and Compounds	54	54	54					1.3E-03			1.3E-03
						Cumulative:		1.3E-05				9.0E-01

DEQ Risk Calculator - Direct Contact - Recreator/Trespasser Surface Water **Output Form**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Recreator

Exposure Unit ID: Southern Exposure Unit

Receptor Type: Recreator

CAS #	Chemical Name:	Ingestion Concentration (ug/L)	Dermal Concentration (ug/L)	Ingestion Carcinogenic Risk	Dermal Contact Carcinogenic Risk	Calculated Carcinogenic Risk	Ingestion Hazard Quotient	Dermal Contact Hazard Quotient	Calculated Non-Carcinogenic Hazard Quotient
7440-38-2	Arsenic, Inorganic	0.45	0.45	1.9E-07	1.9E-08	2.1E-07	3.3E-03	1.7E-04	3.5E-03
7440-39-3	Barium	32.1	32.1				3.5E-04	2.6E-04	6.1E-04
18540-29-9	Chromium(VI)	0.73	0.73	4.4E-07	**2.6E-06**	**3.0E-06**	5.4E-04	2.2E-03	2.7E-03
7440-48-4	Cobalt	0.36	0.36				2.6E-03	5.4E-05	2.7E-03
7440-50-8	Copper	3.2	3.2				1.8E-04	9.1E-06	1.9E-04
7439-96-5	Manganese (Non-diet)	37.4	37.4				3.4E-03	4.4E-03	7.9E-03
7440-02-0	Nickel Soluble Salts	0.62	0.62				6.8E-05	1.8E-05	8.6E-05
7782-49-2	Selenium	0.12	0.12				5.3E-05	2.7E-06	5.6E-05
7440-24-6	Strontium, Stable	89.1	89.1				3.3E-04	1.7E-05	3.4E-04
					Cumulative:	3.3E-06			1.8E-02

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Page

Exposure Factors and Target Risks **Input Form 1B**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Trespasser

Exposure Unit ID: Southern Exposure Unit

Exposure Parameter	Default Value	Site Specific Value	Justification
General			
Target Cancer Risk (individual)	1.0E-06	1.0E-06	
Target Cancer Risk (cumulative)	1.0E-04	1.0E-04	
Target Hazard Index (individual)	2.0E-01	2.0E-01	
Target Hazard Index (cumulative)	1.0E+00	1.0E+00	
Residential Child			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	15	15	
Exposure Duration (ED) (yr)	6	6	
Exposure Frequency (EF) (d/yr)	350	350	
Exposure Time (ET) (hr)	24	24	
Skin Surface Area - Soil Exposure (SA_s) (cm2)	2373	2373	
Soil Adherence Factor (AF) (mg/cm^2)	0.2	0.2	
Soil Ingestion Rate (IRS) (mg/day)	200	200	
Skin Surface Area - Water Exposure (SA_w) (cm2)	6365	6365	
Water Ingestion Rate (IRW) (L/d)	0.78	0.78	
Water Exposure Time (ET_{event}) (hr/event)	0.54	0.54	
Water Event Frequency (EV) (events/day)	1	1	
Residential Adult			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	80	80	
Exposure Duration (ED) (yr)	20	20	
Exposure Frequency (EF) (d/yr)	350	350	
Exposure Time (ET) (hr)	24	24	
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	6032	6032	
Soil Adherence Factor (AF) (mg/cm^2)	0.07	0.07	
Soil Ingestion Rate (IRS) (mg/day)	100	100	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	19652	19652	
Water Ingestion Rate (IRW) (L/d)	2.5	2.5	
Water Exposure Time (ET_{event}) (hr/event)	0.71	0.71	
Water Event Frequency (EV) (events/day)	1	1	
Non-Residential Worker			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	80	80	
Exposure Duration (ED) (yr)	25	25	
Exposure Frequency (EF) (d/yr)	250	250	
Exposure Time (ET) (hr)	8	8	
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	3527	3527	
Soil Adherence Factor (AF) (mg/cm^2)	0.12	0.12	
Soil Ingestion Rate (IR) (mg/day)	100	100	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	19652	19652	
Water Ingestion Rate (IRW) (L/d)	0.83	0.83	
Water Exposure Time (ET_{event}) (hr/event)	0.67	0.67	
Water Event Frequency (EV) (events/day)	1	1	
Construction Worker			
Lifetime (LT) (years)	70	70	
Body Weight (BW) (kg)	80	80	
Working Weeks (EW) (wk/yr)	50	50	
Exposure Duration (ED) (yr)	1	1	
Exposure Frequency (EF) (d/yr)	250	250	
Exposure Time (ET) (hr)	8	8	
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	3527	3527	
Soil Adherence Factor (AF) (mg/cm^2)	0.3	0.3	
Soil Ingestion Rate (IR) (mg/day)	330	330	

Exposure Factors and Target Risks **Input Form 1B**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Trespasser

Exposure Unit ID: Southern Exposure Unit

Exposure Parameter	Default Value		Site Specific Value	Justification
User Defined Child				
	Recreator	Trespasser		
Lifetime (LT) (years)	70	NA	NA	trespasser
Averaging Time (AT) (days/yr)	365	NA	NA	trespasser
Body Weight (BW) (kg)	15	NA	NA	trespasser
Exposure Duration 0-2 (ED) (yr)	2	NA	NA	trespasser
Exposure Duration 2-6 (ED) (yr)	4	NA	NA	trespasser
Exposure Frequency (EF) (d/yr)	195	NA	NA	trespasser
Exposure Time (ET) (hr)	2	NA	NA	trespasser
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	2373	NA	NA	trespasser
Soil Adherence Factor (AF) (mg/cm^2)	0.2	NA	NA	trespasser
Soil Ingestion Rate (IRS) (mg/day)	200	NA	NA	trespasser
Skin Surface Area - Water Exposure (SA_w) (cm^2)	6365	NA	NA	trespasser
Water Ingestion Rate (IRW) (L/hr)	0.124	NA	NA	trespasser
Water Exposure Time (ET_{event}) (hr/event)	2	NA	NA	trespasser
Water Event Frequency (EV) (events/day)	1	NA	NA	trespasser
User Defined Adult				
	Recreator	Trespasser		
Lifetime (LT) (years)	70	70	70	
Body Weight (BW) (kg)	80	45	45	trespasser
Exposure Duration 6-16 (ED) (yr)	10	10	10	
Exposure Duration 16-26 (ED) (yr)	10	0	0	trespasser
Exposure Frequency (EF) (d/yr)	195	90	90	trespasser
Exposure Time (ET) (hr)	2	2	0.5	Polling data adjustment
Skin Surface Area - Soil Exposure (SA_s) (cm^2)	6032	6032	6032	
Soil Adherence Factor (AF) (mg/cm^2)	0.07	0.2	0.2	trespasser
Soil Ingestion Rate (IRS) (mg/day)	100	200	100	
Skin Surface Area - Water Exposure (SA_w) (cm^2)	19652	19652	19652	
Water Ingestion Rate (IRW) (L/hr)	0.0985	0.071	0.071	trespasser
Water Exposure Time (ET_{event}) (hr/event)	2	2	0.5	Polling data adjustment
Water Event Frequency (EV) (events/day)	1	1	1	

DEQ Risk Calculator - Direct Contact - Construction Worker Soil **Output Form 2E**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Trespasser

Exposure Unit ID: Southern Exposure Unit

** - Note that inhalation on this calculator refers to outdoor inhalation of volatiles and particulates, not indoor inhalation associated with vapor intrusion.*

*** - Note that the EPA has no consensus on reference dose or cancer slope factor values for lead, therefore it is not possible to calculate cancer risk or hazard quotient. Lead concentrations are compared to the EPA screening level of 800 mg/kg for commercial/industrial soil.*

CAS #	Chemical Name:	Ingestion Concentration (mg/kg)	Dermal Concentration (mg/kg)	Inhalation Concentration (mg/kg)*	Ingestion Carcinogenic Risk	Dermal Carcinogenic Risk	Inhalation Carcinogenic Risk	Calculated Carcinogenic Risk	Ingestion Hazard Quotient	Dermal Hazard Quotient	Inhalation Hazard Quotient	Calculated Non-Carcinogenic Hazard Quotient
7440-38-2	Arsenic, Inorganic	14.5	14.5	14.5	5.3E-07	8.4E-08	1.9E-07	8.0E-07	8.5E-02	1.4E-02	**2.2E-01**	**3.2E-01**
7440-39-3	Barium	958	958	958					1.4E-02		4.3E-02	5.7E-02
7440-41-7	Beryllium and compounds	1.56	1.56	1.56			1.2E-08	1.2E-08	9.2E-04		1.8E-02	1.8E-02
7440-43-9	Cadmium (Diet)	0.284	0.284	0.284			1.6E-09	1.6E-09	1.7E-03	2.1E-04	6.4E-03	8.3E-03
16065-83-1	Chromium(III), Insoluble Salts	63.8	63.8	63.8					1.3E-04		2.9E-03	3.0E-03
18540-29-9	Chromium(VI)	0.578	0.578	0.578	1.2E-08		1.5E-07	1.6E-07	3.4E-04		4.3E-04	7.7E-04
7440-48-4	Cobalt	15	15	15			4.2E-07	4.2E-07	1.5E-02		1.7E-01	1.8E-01
7440-50-8	Copper	59.2	59.2	59.2					1.7E-02			1.7E-02
7439-92-1	~Lead and Compounds	18	18	18					**<SL****	**<SL****	**<SL****	
7439-96-5	Manganese (Non-diet)	591	591	591					7.3E-02		**2.7E+00**	**2.7E+00**
7439-97-6	~Mercury (elemental)	0.077	0.077	0.077							7.9E-03	7.9E-03
7440-02-0	Nickel Soluble Salts	19.2	19.2	19.2			1.5E-08	1.5E-08	2.8E-03		2.2E-02	2.4E-02
7782-49-2	Selenium	3.07	3.07	3.07					1.8E-03		3.4E-05	1.8E-03
7440-24-6	Strontium, Stable	125	125	125					1.8E-04			1.8E-04
7440-62-2	Vanadium and Compounds	52	52	52					1.5E-02		1.2E-01	1.3E-01
7440-66-6	Zinc and Compounds	54	54	54					5.3E-04			5.3E-04
						Cumulative:		1.4E-06				**3.5E+00**

DEQ Risk Calculator - Direct Contact - Recreator/Trespasser Soil **Output Form 2F**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Trespasser

Exposure Unit ID: Southern Exposure Unit

** - Note that inhalation on this calculator refers to outdoor inhalation of volatiles and particulates, not indoor inhalation associated with vapor intrusion.*

*** - Note that the EPA has no consensus on reference dose or cancer slope factor values for lead, therefore it is not possible to calculate cancer risk or hazard quotient. Lead concentrations are compared to the EPA screening level of 400 mg/kg for residential soil.*

Receptor Type: Trespasser

CAS #	Chemical Name:	Ingestion Concentration (mg/kg)	Dermal Concentration (mg/kg)	Inhalation Concentration (mg/kg)*	Ingestion Carcinogenic Risk	Dermal Carcinogenic Risk	Inhalation Carcinogenic Risk	Calculated Carcinogenic Risk	Ingestion Hazard Quotient	Dermal Hazard Quotient	Inhalation Hazard Quotient	Calculated Non-Carcinogenic Hazard Quotient
7440-38-2	Arsenic, Inorganic	14.5	14.5	14.5	**1.0E-06**	6.2E-07	7.7E-13	**1.6E-06**	1.6E-02	9.6E-03	8.4E-08	2.5E-02
7440-39-3	Barium	958	958	958					2.6E-03		1.7E-07	2.6E-03
7440-41-7	Beryllium and compounds	1.56	1.56	1.56			4.6E-14	4.6E-14	4.3E-04		6.8E-09	4.3E-04
7440-43-9	Cadmium (Diet)	0.284	0.284	0.284			6.3E-15	6.3E-15	1.6E-04	7.5E-05	2.5E-09	2.3E-04
16065-83-1	Chromium(III), Insoluble Salts	63.8	63.8	63.8					2.3E-05			2.3E-05
18540-29-9	Chromium(VI)	0.578	0.578	0.578	6.8E-08		1.8E-12	6.8E-08	1.1E-04		5.0E-10	1.1E-04
7440-48-4	Cobalt	15	15	15			1.7E-12	1.7E-12	2.7E-02		2.2E-07	2.7E-02
7440-50-8	Copper	59.2	59.2	59.2					8.1E-04			8.1E-04
7439-92-1	~Lead and Compounds	18	18	18					**<SL****	**<SL****	**<SL****	
7439-96-5	Manganese (Non-diet)	591	591	591					1.3E-02		1.0E-06	1.3E-02
7439-97-6	~Mercury (elemental)	0.077	0.077	0.077							3.6E-05	3.6E-05
7440-02-0	Nickel Soluble Salts	19.2	19.2	19.2			6.2E-14	6.2E-14	5.3E-04		1.8E-08	5.3E-04
7782-49-2	Selenium	3.07	3.07	3.07					3.4E-04		1.3E-11	3.4E-04
7440-24-6	Strontium, Stable	125	125	125					1.1E-04			1.1E-04
7440-62-2	Vanadium and Compounds	52	52	52					5.7E-03		4.5E-08	5.7E-03
7440-66-6	Zinc and Compounds	54	54	54					9.9E-05			9.9E-05
						Cumulative:		1.7E-06				7.7E-02

DEQ Risk Calculator - Direct Contact - Recreator/Trespasser Surface Water **Output Form**

Version Date: January 2021

Basis: November 2020 EPA RSL Table

Site ID: Human Health Risk Assessment - Trespasser

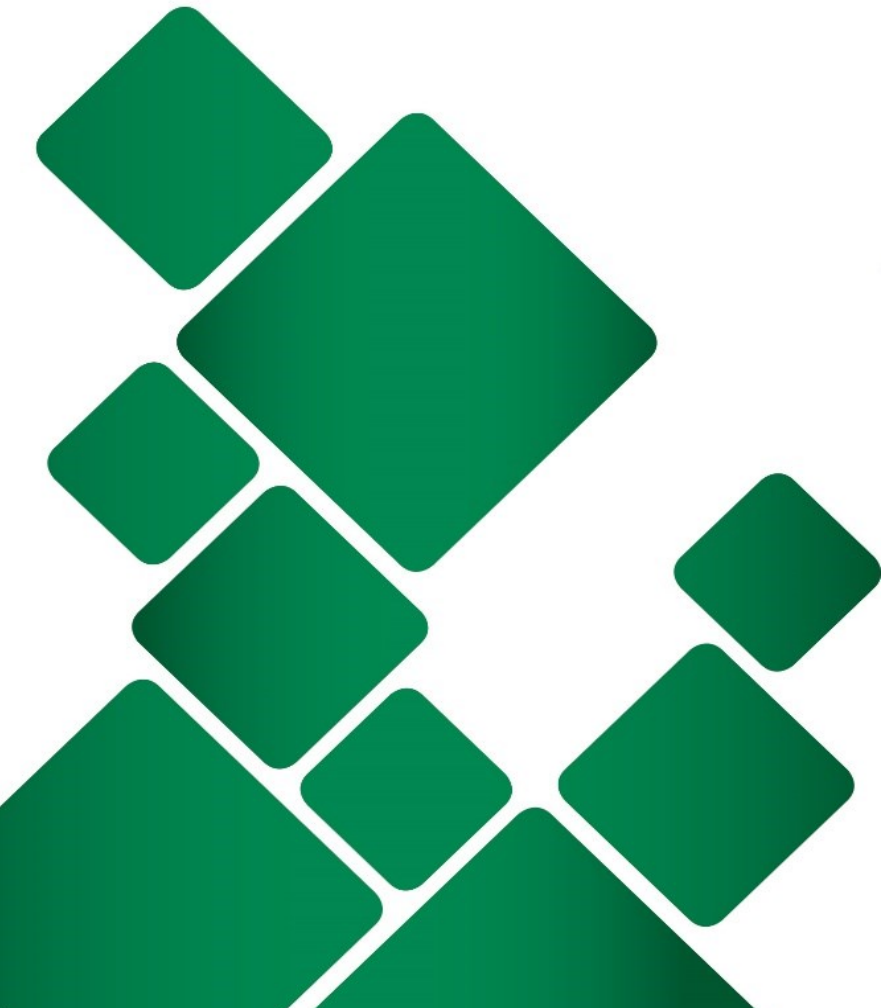
Exposure Unit ID: Southern Exposure Unit

Receptor Type: Trespasser

CAS #	Chemical Name:	Ingestion Concentration (ug/L)	Dermal Concentration (ug/L)	Ingestion Carcinogenic Risk	Dermal Contact Carcinogenic Risk	Calculated Carcinogenic Risk	Ingestion Hazard Quotient	Dermal Contact Hazard Quotient	Calculated Non-Carcinogenic Hazard Quotient
7440-38-2	Arsenic, Inorganic	0.45	0.45	1.9E-08	5.2E-09	2.4E-08	2.9E-04	8.1E-05	3.7E-04
7440-39-3	Barium	32.1	32.1				3.1E-05	1.2E-04	1.5E-04
18540-29-9	Chromium(VI)	0.73	0.73	3.0E-08	6.7E-07	7.0E-07	4.7E-05	1.0E-03	1.1E-03
7440-48-4	Cobalt	0.36	0.36				2.3E-04	2.6E-05	2.6E-04
7440-50-8	Copper	3.2	3.2				1.6E-05	4.3E-06	2.0E-05
7439-96-5	Manganese (Non-diet)	37.4	37.4				3.0E-04	2.1E-03	2.4E-03
7440-02-0	Nickel Soluble Salts	0.62	0.62				6.0E-06	8.3E-06	1.4E-05
7782-49-2	Selenium	0.12	0.12				4.7E-06	1.3E-06	6.0E-06
7440-24-6	Strontium, Stable	89.1	89.1				2.9E-05	8.0E-06	3.7E-05
					Cumulative:	7.3E-07			4.4E-03

APPENDIX C

ANALYTICAL DATA SUMMARY TABLES FOR SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT



synTerra
Science & Engineering Consultants

Table C1

Ecological Screening - Surface Water (Background) - Bolin Creek

Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Range of Detection Limits	Concentration Used for Screening (ug/L)	15A NCAC 28 Freshwater Aquatic Life Acute (f)		15A NCAC 28 Freshwater Aquatic Life Chronic (f)		USEPA Region 4 Freshwater		USEPA Region 4 Freshwater Chronic		USEPA AWQC (b) CMC (acute) (ug/L)		USEPA AWQC (b) CCC (chronic) (ug/L)		Screening Value Used (ug/L)	COPC?
				Min.	Q	Max.	Q				Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved		
Arsenic (tot)	7440-38-2	2	2	0.42		0.44		SW-1	NA	**0.45**	NA	NA	NA	NA	340 (b, h)	NA	150 (b,h)	NA	340 (h)	NA	150 (h)	NA	**150**	**N**
Barium	7440-39-3	2	2	23.10		23.20		SW-2	NA	**25.70**	NA	NA	NA	NA	2000 (cc)	NA	220 (cc)	NA	NA	NA	NA	NA	**220**	**N**
Beryllium (tot)	7440-41-7	2	0	<0.10		<0.10		NA	0.10	**0.10**	NA	NA	NA	NA	31 (r, cc)	NA	3.6 (r,cc)	NA	NA	NA	NA	NA	**3.6**	**N**
Cadmium (tot)	7440-43-9	2	0	<0.080		<0.080		NA	0.080	**0.080**	NA	NA	NA	NA	1.1 (r)	NA	0.16 (r)	NA	2.13 (r)	NA	0.27 (r)		**0.16**	**N**
Calcium	7440-70-2	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	116 ,000	NA	NA	NA	NA	NA	**116000**	**NA**
Chromium (Total recov)	7440-47-3	2	1	0.45	J	0.53		SW-1	NA	**0.62**	NA	NA	50	NA	1 ,022 (n, r)	NA	48.8 (n,r)	NA	1803 (n,r)	NA	86.2 (n,r)	NA	**50**	**N**
Cobalt	7440-48-4	2	2	0.16		0.16		SW-1/SW-2	NA	**0.16**	NA	NA	NA	NA	120 (cc)	NA	19 (cc)	NA	NA	NA	NA	NA	**19**	**N**
Copper (tot)	7440-50-8	2	2	1.1		1.2		SW-1	NA	**1.2**	NA	NA	NA	NA	7.3 (r)	NA	5.16 (r)	NA	14.0 (r)	NA	9.33 (r)	NA	**5.16**	**NA**
Iron	7439-89-6	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	1 ,000 (b)	NA	NA	NA	1,000	NA	**1000**	**NA**
Lead (tot)	7439-92-1	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	33 .8 (r)	NA	1.32 (r)	NA	81.6 (r)	NA	3.18 (r)	NA	**1. 32**	**NA**
Magnesium	7439-95-4	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	82000 (dd)	NA	NA	NA	NA	NA	**82000**	**NA**
Manganese	7439-96-5	2	2	21.2		22.2		SW-1	NA	**22.2**	NA	NA	NA	NA	1680 (cc)	NA	93 (cc)	NA	NA	NA	NA	NA	**93**	**N**
Mercury (tot)	7439-97-6	2	0	<0.20		<0.20		NA	0.20	**0.20**	NA	NA	0 .012	NA	1.4 (b,s)	NA	0.77 (b,s)	NA	1.4	NA	0.77 (s)	NA	**0.012**	**N**
Nickel (tot)	7440-02-0	2	2	0.29	J	0.33	J	SW-2	NA	**0.33**	NA	NA	NA	NA	261 (r)	NA	29.0 (r)	NA	469 (r)	NA	52.2 (r)	NA	**29**	**N**
Potassium	7440-09-7	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	53000 (dd)	NA	NA	NA	NA	NA	**53000**	**NA**
Selenium	7782-49-2	2	2	0.096	J	0.11	J	SW-2	NA	**0.11**	NA	NA	5	NA	20 (cc)	NA	5 (cc)	NA	12.82 (t)	NA	5 (t)	NA	**5**	**N**
Sodium	7440-23-5	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	680000 (dd)	NA	NA	NA	NA	NA	**680000**	**NA**
Strontium	7440-24-6	2	2	85.3		85.5		SW-2	NA	**85.5**	NA	NA	NA	NA	48000 (cc)	NA	5300 (cc)	NA	NA	NA	NA	NA	**5300**	**N**
Thallium	7440-28-0	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	54 (cc)	NA	6 (cc)	NA	NA	NA	NA	NA	**6**	**NA**
Vanadium	7440-62-2	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	79 (cc)	NA	27 (cc)	NA	NA	NA	NA	NA	**27**	**N**
Zinc (tot)	7440-66-6	2	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	67 (r)	NA	67 (r)	NA	120 (r)	NA	120 (r)	NA	**67**	**N**
pH	PH	2	2	7.13		7.22		SW-1	NA	**7.22**	NA	NA	6.0 - 9 .0	NA	NA	NA	6.5 - 9.0 (b)	NA	NA	NA	6.5 - 9.0	NA	**NA (ii)**	**NA**

Table C2
Ecological Screening - Sediment (Background) - Bolin Creek
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Range of Detection Limits	Concentration Used for Screening (mg/kg)	USEPA Region 4 Sediment Screening Values (g) (mg/kg)		Screening Value Used (mg/kg)	COPC?
				Min.	Q	Max.	Q				ESV	RSV		
Antimony	7440-36-0	2	NA	NA		NA		NA	NA	**NA**	2 (y)	25 (y)	**2**	**NA**
Arsenic	7440-38-2	2	2	1.95		2.74		SED-2	NA	**2.74**	9.8 (z)	33 (z)	**9.8**	**N**
Barium	7440-39-3	2	2	29.6		38.4		SED-1	NA	**38.4**	20 (z)	60 (z)	**20**	**Y**
Beryllium	7440-41-7	2	2	0.249	J	0.305	J	SED-2	NA	**0.305**	NA	NA	**NA**	**NA**
Cadmium	7440-43-9	2	0	0.619	<	0.636	<	NA	NA	**0.636**	1 (z)	5 (z)	**1**	**NA**
Chromium (Total)	7440-47-3	2	2	57.1		65.4		SED-1	NA	**65.4**	43.4 (z)	111 (z)	**43.4**	**Y**
Chromium, Hexavalent	18540-29-9	2	2	0.428	J	0.796	J	SED-2	NA	**0.796**	NA	NA	**NA**	**NA**
Chromium, Trivalent	16065-83-1	2	2	56.3		65.0		SED-1	NA	**65.0**	NA	NA	**NA**	**NA**
Cobalt	7440-48-4	2	2	7.63		20.9		SED-2	NA	**20.9**	50 (aa)	NA (aa)	**50**	**N**
Copper	7440-50-8	2	2	8.42		13.8		SED-2	NA	**13.8**	31.6 (z)	149 (z)	**31.6**	**N**
Lead	7439-92-1	2	NA	NA		NA		NA	NA	**NA**	35.8 (z)	128 (z)	**35.8**	**NA**
Manganese	7439-96-5	2	2	449		811		SED-2	NA	**811**	460 (bb)	1100 (bb)	**460**	**Y**
Mercury	7439-97-6	2	2	0.0053	J	0.0078		SED-1	NA	**0.0078**	0.18 (z)	1.1 (z)	**0.18**	**N**
Nickel	7440-02-0	2	2	7.10		9.16		SED-2	NA	**9.16**	22.7 (z)	48.6 (z)	**22.7**	**N**
Selenium	7782-49-2	2	1	0.306	J	0.409	J	SED-4	NA	**0.344**	11 (bb)	20 (bb)	**11**	**N**
Strontium	7440- 24-6	2	2	8.4		16.9		SED-4	NA	**16.9**	NA	NA	**NA**	**NA**

Table C3
Ecological Screening - Soil (Background) - Bolin Creek
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Concentration Used for Screening (mg/kg}	USEPA Region 4 Soil Screening Benchmark (g) (mg/kg)	Eco-SSL (ee) Avian Soil Screening Benchmark (mg/kg)	Eco-SSL (ee) Invertebrate Soil Screening Benchmark (mg/kg)	Eco-SSL (ee) Mammalian Soil Screening Benchmark (mg/kg)	Eco-SSL (ee) Plants Soil Screening Benchmark (mg/kg)	ORNL (ff) Invertebrate Soil Screening Benchmark (mg/kg)	ORNL (gg) Plant Screening Benchmark (mg/kg)	Screening Value Used (mg/kg)	COPC?
				Min.	Q	Max.	Q											
Arsenic	7440-38-2	3	3	1.8		2.05		BG-6	**2.05**	18	43	NA	46	18	60	10	**10**	**N**
Barium	7440-39-3	3	3	52.4		64.4		BG-6	**64**	330	NA	330	2,000	NA	NA	500	**330**	**N**
Beryllium	7440-41-7	3	3	0.370	J	0.625		BG-6	**0.6**	10	NA	40	21	NA	NA	10	**10**	**N**
Cadmium	7440-43-9	3	3	0.095	J	0.177	J	BG-6	**0.177**	0.36	0.77	140	0.36	32	20	4	**0.36**	**N**
Chromium (Total)	7440-47-3	3	3	24.5		70.2		BG-7	**70.2**	28	NA	NA	NA	NA	0.4	1	**0.4**	**Y**
Chromium, Hexavalent	18540-29-9	3	1	1.14	<	5.34		BG-6	**5.34**	0.35	NA	NA	130	NA	0.4	1	**0.35**	**Y**
Chromium, Trivalent	16065-83-1	3	3	24.5	J	70.2		BG-7	**70.2**	18	26	NA	34	NA	NA	NA	**18**	**Y**
Cobalt	7440-48-4	3	3	14.4		21.8		BG-8	**21.8**	13	120	NA	230	13	NA	20	**13**	**Y**
Copper	7440-50-8	3	3	26.40		62.8		BG-8	**62.8**	28	120	NA	230	13	50	100	**13**	**Y**
Manganese	7439-96-5	3	3	448.0		813		BG-7	**813**	220	4,300	450	4,000	220	NA	500	**220**	**Y**
Mercury	7439-97-6	3	3	0.007		0.025		BG-7	**0.025**	0.1	NA	0.1	NA	0. 3	0.1	0. 3	**0.1**	**N**
Nickel	7440-02-0	3	3	9.04		12.8		BG-6/BG-7	**12.8**	38	210	280	130	38	200	30	**38**	**N**
Selenium	7782-49-2	3	3	0.485	J	0.562	J	BG-6	**0.562**	0.52	1.2	4.1	0.63	0.52	70	1	**0.52**	**Y**
Strontium	7440-24-6	3	3	17.0		24.4		BG-8	**24.4**	96	NA	NA	NA	NA	NA	NA	**96**	**N**

Table C4

Ecological Screening Notes - (Background) - Bolin Creek

Chapel Hill, North Carolina

Notes:

(a) - USEPA Regional Screening Levels (June 2015). Values for Residential Soil, Industrial Soil, and Tap Water. HI = 0.2. Accessed November 2015. http:// www2 .epa.gov/risk/risk-based-screening-table-generic-tables

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed April 2015. http: / / water. epa.gov/scitech / swguidanee/standards/ criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. Accessed April 2015. http: // water.epa.gov/action /adviso ries/d rinking / upload/dwstandards2012.pdf

(d) - DHHS Screening Levels. Department of Health and Human Services, Division of Public Health, Epidemiology Section, Occupational and Environmental Epidemiolo y Branch. http: //po rta l.ncdenr.org /c/doc ument _library /ge t_file?p_U d= 1169848&folderid=24814087&name=DLFE-112704.pdf

(e) - North Carolina 15A NCAC 02L .0202 Ground wate r Standards & IMACs. http: // porta l.ncdenr.org /c/doc ument _library /ge t_file7uuid= l aa3fa13-2 c0f-45b7-ae96-5427fb1d25b4 &groupi d= 38364 Amended April 2013.

(f) - North Carolina 15A NCAC 02B Surface Water and Wetland Standards. Amended January 1, 2015.
http: // report s.oah.state.nc.us / ncac/ title%2015a%20-%20environmental%20quality /chapter%2002%20-%20en vironmental%20management /su bchapter%20b/subchapter%20b%20rules .pdf WS standards are applicable to all Water Supply Classifications. WS standards are based on the consumption of fish and water.
Human Health Standards are based on the consumption of fish only unless dermal contact studies are available.
For Class C, use the most stringent of freshwater (or, if applicable, saltwater) column and the Human Health column.
For a WS water, use the most stringent of Freshwater, WS and Human Health. Likewise, Trout Waters and High Quality Waters must adhere to the most stringent of all applicable standards.

(g) - USEPA Region 4. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. August.
http :/ /www 2.epa.gov/ sites/production/ files/ 2015-09 /document s/ r4 _era_guidance_document_draft_final_8-25-2015.pdf

(h) - Value applies to inorganic form of arsenic only.

(i) - Value is the Secondary Maximum Contaminant Level.

(j) - Value for Total Chromium.

(k) - Copper Treatment Technology Action Level is 1.3 mg/L.

(I) - Lead Treatment Technology Action Level is 0.015 mg/ L.

(m) - RSL for Antimony (metallic) used for Antimony.

(n) - Value for Chromium (III), Insoluble Salts used for Chromium.

(o) - RSL for Mercuric Chloride used for Mercury.

(p) - RSL for Nickel Soluble Salts used for Nickel.

(q) - RSL for Thallium (Soluble Salts) used for Thallium .

(r) - Criterion expressed as a function of total hardness (mg/L). Value displayed is the site-specific total hardne ss of mg/L.

(s) - Value for Inorganic Mercury.

(t) - Acute AWQC is equal to 1/[(fl/CMCl) + (f2/CMC2)] where fl and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMCl and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate, a likely overly conservative assumption.

(u) - Criterion expressed as a function of total hardness (mg/L). Value displayed is the site-specific total hardness of mg/L.

(v) - Chloride Action Level for Toxic Substances Applicable to NPDES Permits is 230,000 ug/L.

(w) - Applicable only to persons with a sodium restrictive diet.

(x) - Los Alamos National Laboratory ECORISK Database. http: // www. lanl.gov/ commu nity-en vironment /environmen tal-ste wardship/pro tection /e co-risk -assessment.php

(y) - Long, Ed ward R., and Lee G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Used effects range low (ER-L) for chronic and effects range medium (ER-M) for acute.

(z) - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G.; and T. Bernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters . Florida Department of Environmental Protection, Tallahassee, FL. Used threshold effect concentration (TEC) for the ESV and probable effect concentration (PEC) for the RSV.

(aa) - Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. (bb) - Washington State Sediment Management Standards, Cleanup Objections. http: // www.ecy.wa.gov/ programs/ tcp/smu/sed _standards.htm

(cc) - Great Lakes Initiative (GLI) Clearinghouse resources Tier II criteria revised 2013. http: // www.ep a.gov /g liclearinghouse/

(dd) - Suter, G.W., and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. ES/ER/ TM-96 / R2. http: // www .esd.o rnl.gov/ programs/eco risk/documents /t m96r2. pdf

(ee) - USEPA. 2015. Interim Ecological Soil Screening Level Documents. http: // www2.epa.gov/chem ical-research/i nter im-ecological- soil-screening-level-documents

(ff) - Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997a. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/ TM-126 / R2. (Available at http: // www.esd.o rnl.gov/ programs/ecorisk/doc uments /t m126r21.pdf)

(gg) - Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ ER/TM-85 /R3. (Available at http:// www.esd.o rnl.go v/ programs/ecorisk/doc uments / tm85r3.pdf)

(hh) - North Carolina Preliminary Soil Remediation Goals (PSRG) Table. HI= 0.2. September 2015. http://po rta l.ncdenr.org /c/ document _library/get _file7uuid= Of 601ffa-574d-4479-bbb4-253a f0665bf5&groupi d=38361

Source

Table C5
Ecological Screening - Surface Water (Source) - Bolin Creek
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Concentration Used for Screening (ug/L)	15A NCAC 28 Freshwater Aquatic Life Acute (f) (ug/L)		15A NCAC 28 Freshwater Aquatic Life Chronic (f) (ug/L)		USEPA Region 4 Freshwater Acute Screening Values		USEPA Region 4 Freshwater Chronic Screening Values (g)		USEPA AWQC (b) CMC (acute) (ug/L)		USEPA AWQC (b) CCC (chronic) (ug/L)		Screening Value Used (ug/L)	COPC?
				Min.	Q	Max.	Q			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved		
Arsenic (tot)	7440-38-2	2	2	0.41		0.45		SW-3	**0.45**	NA	NA	NA	NA	340 (b, h)	NA	150 (b,h)	NA	340 (h)	NA	150 (h)	NA	**150**	**N**
Barium	7440-39-3	2	2	23.70		25.70		SW-3	**25.70**	NA	NA	NA	NA	2000 (cc)	NA	220 (cc)	NA	NA	NA	NA	NA	**220**	**N**
Beryllium (tot)	7440-41-7	2	0	<0.10		<0.10		NA	**0.10**	NA	NA	NA	NA	31 (r, cc)	NA	3.6 (r,cc)	NA	NA	NA	NA	NA	**3.6**	**N**
Chromium (Total recov)	7440-47-3	2	1	0.62		0.62		SW-3	**0.62**	NA	NA	50	NA	1 ,022 (n, r)	NA	48.8 (n,r)	NA	1803 (n,r)	NA	86.2 (n,r)	NA	**50**	**N**
Cobalt	7440-48-4	2	2	0.14		0.26		SW-3	**0.26**	NA	NA	NA	NA	120 (cc)	NA	19 (cc)	NA	NA	NA	NA	NA	**19**	**N**
Copper (tot)	7440-50-8	2	2	0.98		2.8		SW-3	**2.8**	NA	NA	NA	NA	7.3 (r)	NA	5.16 (r)	NA	14.0 (r)	NA	9.33 (r)	NA	**5.16**	**NA**
Manganese	7439-96-5	2	2	24.80		37.40		NA	**37.40**	NA	NA	NA	NA	1680 (cc)	NA	93 (cc)	NA	NA	NA	NA	NA	**93**	**N**
Mercury (tot)	7439-97-6	2	0	<0.20		<0.20		NA	**0.20**	NA	NA	0 .012	NA	1.4 (b,s)	NA	0.77 (b,s)	NA	1.4	NA	0.77 (s)	NA	**0.012**	**N**
Nickel (tot)	7440-02-0	2	2	0.26	J	0.50		SW-3	**0.50**	NA	NA	NA	NA	261 (r)	NA	29.0 (r)	NA	469 (r)	NA	52.2 (r)	NA	**29**	**N**
Selenium	7782-49-2	2	2	0.11	J	0.088	J	SW-4	**0.088**	NA	NA	5	NA	20 (cc)	NA	5 (cc)	NA	12.82 (t)	NA	5 (t)	NA	**5**	**N**
Strontium	7440-24-6	2	2	87.7		88.8		SW-3	**88.8**	NA	NA	NA	NA	48000 (cc)	NA	5300 (cc)	NA	NA	NA	NA	NA	**5300**	**N**
pH	PH	2	2	7.39		7.46		SW-3	**7.46**	NA	NA	6.0 - 9 .0	NA	NA	NA	6.5 - 9.0 (b)	NA	NA	NA	6.5 - 9.0	NA	**NA (ii)**	**NA**

Table C6
Ecological Screening - Sediment (Source) - Bolin Creek
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Concentration Used for Screening (mg/kg)	USEPA Region 4 Sediment Screening Values (g) (mg/kg)		Screening Value Used (mg/kg)	COPC?
				Min.	Q	Max.	Q			ESV	RSV		
Arsenic	7440-38-2	2	2	1.36		2.35		SED-4	**2.35**	9.8 (z)	33 (z)	**9.8**	**N**
Barium	7440-39-3	2	2	16.4		20.3		SED-4	**20.3**	20 (z)	60 (z)	**20**	**Y**
Beryllium	7440-41-7	2	2	0.111	J	0.191	J	SED-4	**0.191**	NA	NA	**NA**	**NA**
Cadmium	7440-43-9	2	0	0.586	<	0.607	<	NA	**0.607**	1 (z)	5 (z)	**1**	**NA**
Chromium (Total)	7440-47-3	2	2	14.2		64.3		SED-4	**64.3**	43.4 (z)	111 (z)	**43.4**	**Y**
Chromium, Hexavalent	18540-29-9	2	2	0.456	J	0.670	J	SED-3	**0.670**	NA	NA	**NA**	**NA**
Chromium, Trivalent	16065-83-1	2	2	13.5		63.8		SED-4	**63.8**	NA	NA	**NA**	**NA**
Cobalt	7440-48-4	2	2	5.18		7.26		SED-4	**7.26**	50 (aa)	NA (aa)	**50**	**N**
Copper	7440-50-8	2	2	8.39		20.2		SED-3	**20.2**	31.6 (z)	149 (z)	**31.6**	**N**
Manganese	7439-96-5	2	2	225		293		SED-4	**293**	460 (bb)	1100 (bb)	**460**	**N**
Mercury	7439-97-6	2	2	0.0054	J	0.008		SED-4	**0.008**	0.18 (z)	1.1 (z)	**0.18**	**N**
Nickel	7440-02-0	2	2	4.81		10.5		SED-4	**10.5**	22.7 (z)	48.6 (z)	**22.7**	**N**
Selenium	7782-49-2	2	1	0.607	<	0.344	J	SED-4	**0.344**	11 (bb)	20 (bb)	**11**	**N**
Strontium	7440- 24-6	2	2	9.2		30.7		SED-4	**30.7**	NA	NA	**NA**	**NA**

Table C7
Ecological Screening - Soil (Source) - Bolin Creek
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Concentration Used for Screening (mg/kg)	USEPA Region 4 Soil Screening Benchmark (g) (mg/kg)	Eco-SSL (ee) Avian Soil Screening Benchmark (mg/kg)	Eco-SSL (ee) Invertebrate Soil Screening Benchmark (mg/kg)	Eco-SSL (ee) Mammalian Soil Screening Benchmark (mg/kg)	Eco-SSL (ee) Plants Soil Screening Benchmark (mg/kg)	ORNL (ff) Invertebrate Soil Screening Benchmark (mg/kg)	ORNL (gg) Plant Screening Benchmark (mg/kg)	Screening Value Used (mg/kg)	COPC?
				Min.	Q	Max.	Q											
Antimony	7440-36-0	8	0	NA		NA		NA	**NA**	0.27	NA	78	0.27	NA	NA	5	**NA**	**NA**
Arsenic	7440-38-2	39	39	0.792		60.3		HH-10	**60.3**	18	43	NA	46	18	60	10	**10**	**Y**
Barium	7440-39-3	39	39	13.5		3,260		HH-11	**3260**	330	NA	330	2,000	NA	NA	500	**330**	**Y**
Beryllium	7440-41-7	36	26	0.118		5.9		HH-11	**5.9**	10	NA	40	21	NA	NA	10	**10**	**N**
Boron	7440-42-8	1	0	NA		NA		NA	**NA**	7.5	NA	NA	NA	0.5	NA	0.5	**NA**	**NA**
Cadmium	7440-43-9	39	10	0.122	J	0.328	J	SED-15	**0.33**	0.36	0.77	140	0.36	32	20	4	**0.36**	**N**
Chromium (Total)	7440-47-3	39	39	5.76	B	45.0		HH-4	**45.0**	28	NA	NA	NA	NA	0.4	1	**0.4**	**Y**
Chromium, Hexavalent	18540-29-9	38	22	0.21	J	2.7		S-6	**2.7**	0.35	NA	NA	130	NA	0.4	1	**0.35**	**Y**
Chromium, Trivalent	16065-83-1	39	38	5.76		44.5		HH-4	**44.5**	18	26	NA	34	NA	NA	NA	**18**	**Y**
Cobalt	7440-48-4	36	36	3.9		20.8		Excavation H-4	**20.8**	13	120	NA	230	13	NA	20	**13**	**Y**
Copper	7440-50-8	36	36	3.90		180.0		MW-7	**180.0**	28	120	NA	230	13	50	100	**13**	**Y**
Lead	7439-92-1	11	11	2.3		30.0		HH-2	**30.0**	11	11	1700	56	120	500	50	**11**	**Y**
Manganese	7439-96-5	36	36	73.3		1480		Excavation H-4	**1480**	220	4,300	450	4,000	220	NA	500	**220**	**Y**
Mercury	7439-97-6	39	34	0.007		0.44		S-7	**0.4**	0.1	NA	0.1	NA	0. 3	0.1	0. 3	**0.1**	**Y**
Molybdenum	7439-98-7	1	0	NA		NA		NA	**NA**	2	NA	NA	NA	2	NA	2	**2**	**NA**
Nickel	7440-02-0	36	36	2.19		33.0		HH-4	**33.0**	38	210	280	130	38	200	30	**30**	**Y**
Selenium	7782-49-2	39	25	0.263	J	6.1		S-6	**6.1**	0.52	1.2	4.1	0.63	0.52	70	1	**0.52**	**Y**
Strontium	7440-24-6	36	36	6.7		269		HH-10	**269**	96	NA	NA	NA	NA	NA	NA	**96**	**Y**
Thallium	7440-28-0	8	2	0.60		0.81		MW-6	**0.81**	0.22	NA	NA	NA	NA	NA	NA	**0.22**	**Y**
Vanadium	7440-62-2	8	8	31.0		73.0		HH-4	**73.0**	7.8	7.8	NA	280	2	NA	2	**2**	**Y**
Zinc	7440-66-6	8	8	35.0		100		HH-3	**100.0**	46	46	120	79	160	100	50	**46**	**Y**

Table C8
Ecological Screening Notes - (Source) - Bolin Creek
Chapel Hill, North Carolina

Notes:

(a) - USEPA Regional Screening Levels (June 2015). Values for Residential Soil, Industrial Soil, and Tap Water. HI = 0.2. Accessed November 2015. http:// www2 .epa.gov/risk/risk-based-screening-table-generic-tables

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed April 2015. http: / / water. epa.gov/scitech / swguidanee/standards/ criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. Accessed April 2015. http: // water.epa.gov/action /adviso ries/d rinking / upload/dwstandards2012.pdf

(d) - DHHS Screening Levels. Department of Health and Human Services, Division of Public Health, Epidemiology Section, Occupational and Environmental Epidemiolo y Branch. http: //po rta l.ncdenr.org /c/doc ument _library /ge t_file?p_U d= 1169848&folderid=24814087&name=DLFE-112704.pdf

(e) - North Carolina 15A NCAC 02L .0202 Ground wate r Standards & IMACs. http: // porta l.ncdenr.org /c/doc ument _library /ge t_file7uuid= l aa3fa13-2 c0f-45b7-ae96-5427fb1d25b4 &groupi d= 38364 Amended April 2013.

(f) - North Carolina 15A NCAC 02B Surface Water and Wetland Standards. Amended January 1, 2015.
http: // report s.oah.state.nc.us / ncac/ title%2015a%20-%20environmental%20quality /chapter%2002%20-%20en vironmental%20management /su bchapter%20b/subchapter%20b%20rules .pdf WS standards are applicable to all Water Supply Classifications. WS standards are based on the consumption of fish and water.
Human Health Standards are based on the consumption of fish only unless dermal contact studies are available.
For Class C, use the most stringent of freshwater (or, if applicable, saltwater) column and the Human Health column.
For a WS water, use the most stringent of Freshwater, WS and Human Health. Likewise, Trout Waters and High Quality Waters must adhere to the most stringent of all applicable standards.

(g) - USEPA Region 4. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. August.
http :/ /www 2.epa.gov/ sites/production/ files/ 2015-09 /document s/ r4 _era_guidance_document_draft_final_8-25-2015.pdf

(h) - Value applies to inorganic form of arsenic only.

(i) - Value is the Secondary Maximum Contaminant Level.

(j) - Value for Total Chromium.

(k) - Copper Treatment Technology Action Level is 1.3 mg/L.

(I) - Lead Treatment Technology Action Level is 0.015 mg/ L.

(m) - RSL for Antimony (metallic) used for Antimony.

(n) - Value for Chromium (III), Insoluble Salts used for Chromium.

(o) - RSL for Mercuric Chloride used for Mercury.

(p) - RSL for Nickel Soluble Salts used for Nickel.

(q) - RSL for Thallium (Soluble Salts) used for Thallium .

(r) - Criterion expressed as a function of total hardness (mg/L). Value displayed is the site-specific total hardne ss of mg/L.

(s) - Value for Inorganic Mercury.

(t) - Acute AWQC is equal to 1/[(fl/CMCl) + (f2/CMC2)] where fl and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMCl and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate, a likely overly conservative assumption.

(u) - Criterion expressed as a function of total hardness (mg/L). Value displayed is the site-specific total hardness of mg/L.

(v) - Chloride Action Level for Toxic Substances Applicable to NPDES Permits is 230,000 ug/L.

(w) - Applicable only to persons with a sodium restrictive diet.

(x) - Los Alamos National Laboratory ECORISK Database. http: // www. lanl.gov/ commu nity-en vironment /environmen tal-ste wardship/pro tection /e co-risk -assessment.php

(y) - Long, Ed ward R., and Lee G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Used effects range low (ER-L) for chronic and effects range medium (ER-M) for acute.

(z) - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G.; and T. Bernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters . Florida Department of Environmental Protection, Tallahassee, FL. Used threshold effect concentration (TEC) for the ESV and probable effect concentration (PEC) for the RSV.

(aa) - Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. (bb) - Washington State Sediment Management Standards, Cleanup Objections. http: // www.ecy.wa.gov/ programs/ tcp/smu/sed _standards.htm

(cc) - Great Lakes Initiative (GLI) Clearinghouse resources Tier II criteria revised 2013. http: // www.ep a.gov /g liclearinghouse/

(dd) - Suter, G.W., and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. ES/ER/ TM-96 / R2. http: // www .esd.o rnl.gov/ programs/eco risk/documents /t m96r2. pdf

(ee) - USEPA. 2015. Interim Ecological Soil Screening Level Documents. http: // www2.epa.gov/chem ical-research/i nter im-ecological- soil-screening-level-documents

(ff) - Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997a. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/ TM-126 / R2. (Available at http: // www.esd.o rnl.gov/ programs/ecorisk/doc uments /t m126r21.pdf)

(gg) - Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ ER/TM-85 /R3. (Available at http:// www.esd.o rnl.go v/ programs/ecorisk/doc uments / tm85r3.pdf)

(hh) - North Carolina Preliminary Soil Remediation Goals (PSRG) Table. HI= 0.2. September 2015. http://po rta l.ncdenr.org /c/ document _library/get _file7uuid= Of 601ffa-574d-4479-bbb4-253a f0665bf5&groupi d=38361

Downgradient

Table C9

Ecological Screening - Surface Water (Downgradient) - Bolin Creek

Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Range of Detection Limits	Concentration Used for Screening (ug/L)	15A NCAC 28 Freshwater Aquatic Life Acute (f) (ug/L)		15A NCAC 28 Freshwater Aquatic Life Chronic (f) (ug/L)		USEPA Region 4 Freshwater Acute Screening Values		USEPA Region 4 Freshwater Chronic Screening Values (g)		USEPA AWQC (b) CMC (acute) (ug/L)		USEPA AWQC (b) CCC (chronic) (ug/L)		Screening Value Used (ug/L)	COPC?
				Min.	Q	Max.	Q				Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved		
Aluminum	7429-90-5	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	750 (b)	NA	87 (b)	NA	750	NA	87	NA	**87**	**NA**
Antimony	7440-36-0	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	900 (cc)	NA	190 (cc)	NA	NA	NA	NA	NA	**190**	**NA**
Arsenic (tot)	7440-38-2	3	3	0.40		0.42		SW-7	NA	**0.45**	NA	NA	NA	NA	340 (b, h)	NA	150 (b,h)	NA	340 (h)	NA	150 (h)	NA	**150**	**N**
Barium	7440-39-3	3	3	16.9		18.4		SW-7	NA	**25.70**	NA	NA	NA	NA	2000 (cc)	NA	220 (cc)	NA	NA	NA	NA	NA	**220**	**N**
Beryllium (tot)	7440-41-7	3	0	<0.10		<0.10		NA	0.10	**0.10**	NA	NA	NA	NA	31 (r, cc)	NA	3.6 (r,cc)	NA	NA	NA	NA	NA	**3.6**	**N**
Cadmium (tot)	7440-43-9	3	0	<0.080		<0.080		NA	0.080	**0.080**	NA	NA	NA	NA	1.1 (r)	NA	0.16 (r)	NA	2.13 (r)	NA	0.27 (r)	NA	**0.16**	**N**
Calcium	7440-70-2	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	116 ,000	NA	NA	NA	NA	NA	**116000**	**NA**
Chromium (Total recov)	7440-47-3	3	0	<0.50		<0.50		NA	NA	**0.50**	NA	NA	50	NA	1 ,022 (n, r)	NA	48.8 (n,r)	NA	1803 (n,r)	NA	86.2 (n,r)	NA	**50**	**N**
Cobalt	7440-48-4	3	3	0.14		0.16		SW-7	NA	**0.16**	NA	NA	NA	NA	120 (cc)	NA	19 (cc)	NA	NA	NA	NA	NA	**19**	**N**
Copper (tot)	7440-50-8	3	3	0.84		1.1		SW-7	NA	**1.1**	NA	NA	NA	NA	7.3 (r)	NA	5.16 (r)	NA	14.0 (r)	NA	9.33 (r)	NA	**5.16**	**NA**
Iron	7439-89-6	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	1 ,000 (b)	NA	NA	NA	1,000	NA	**1000**	**NA**
Lead (tot)	7439-92-1	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	33 .8 (r)	NA	1.32 (r)	NA	81.6 (r)	NA	3.18 (r)	NA	**1. 32**	**NA**
Magnesium	7439-95-4	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	82000 (dd)	NA	NA	NA	NA	NA	**82000**	**NA**
Manganese	7439-96-5	3	3	18.7		23.1		SW-7	NA	**23.1**	NA	NA	NA	NA	1680 (cc)	NA	93 (cc)	NA	NA	NA	NA	NA	**93**	**N**
Mercury (tot)	7439-97-6	3	0	<0.20		<0.20		NA	0.20	**0.20**	NA	NA	0 .012	NA	1.4 (b,s)	NA	0.77 (b,s)	NA	1.4	NA	0.77 (s)	NA	**0.012**	**N**
Nickel (tot)	7440-02-0	3	3	0.21	J	0.23	J	SW-7	NA	**0.23**	NA	NA	NA	NA	261 (r)	NA	29.0 (r)	NA	469 (r)	NA	52.2 (r)	NA	**29**	**N**
Potassium	7440-09-7	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	53000 (dd)	NA	NA	NA	NA	NA	**53000**	**NA**
Selenium	7782-49-2	3	3	0.10	J	0.12	J	SW-5	NA	**0.12**	NA	NA	5	NA	20 (cc)	NA	5 (cc)	NA	12.82 (t)	NA	5 (t)	NA	**5**	**N**
Sodium	7440-23-5	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	NA	NA	680000 (dd)	NA	NA	NA	NA	NA	**680000**	**NA**
Strontium	7440-24-6	3	3	81.3		86.7		SW-7	NA	**86.7**	NA	NA	NA	NA	48000 (cc)	NA	5300 (cc)	NA	NA	NA	NA	NA	**5300**	**N**
Thallium	7440-28-0	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	54 (cc)	NA	6 (cc)	NA	NA	NA	NA	NA	**6**	**NA**
Vanadium	7440-62-2	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	79 (cc)	NA	27 (cc)	NA	NA	NA	NA	NA	**27**	**N**
Zinc (tot)	7440-66-6	3	NA	NA		NA		NA	NA	**NA**	NA	NA	NA	NA	67 (r)	NA	67 (r)	NA	120 (r)	NA	120 (r)	NA	**67**	**N**
pH	PH	3	3	7.61		7.86		SW-5	NA	**7.86**	NA	NA	6.0 - 9 .0	NA	NA	NA	6.5 - 9.0 (b)	NA	NA	NA	6.5 - 9.0	NA	**NA (ii)**	**NA**

Table C10
Ecological Screening - Sediment (Downgradient) - Bolin Creek
Chapel Hill, North Carolina

Analyte	CAS	Number of Samples	Frequency of Detection	Range of Detection				Location of Maximum Concentration	Range of Detection Limits	Concentration Used for Screening (mg/kg)	USEPA Region 4 Sediment Screening Values (g) (mg/kg)		Screening Value Used (mg/kg)	COPC?
				Min.	Q	Max.	Q				ESV	RSV		
Aluminum	7429-90-5	NR	NR	NR		NR		NR	NR	**NR**	25000 (x)	58000 (x)	**25000**	**NA**
Antimony	7440-36-0	3	NA	NA		NA		NA	NA	**NA**	2 (y)	25 (y)	**2**	**NA**
Arsenic	7440-38-2	3	3	1.35		1.96		SED-6	NA	**1.96**	9.8 (z)	33 (z)	**9.8**	**N**
Barium	7440-39-3	3	3	16.4		24.3		SED-5	NA	**24.3**	20 (z)	60 (z)	**20**	**Y**
Beryllium	7440-41-7	3	3	0.179	J	0.247	J	SED-6	NA	**0.247**	NA	NA	**NA**	**NA**
Boron	7440-42-8	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Cadmium	7440-43-9	3	0	0.617	<	0.643	<	NA	NA	**0.643**	1 (z)	5 (z)	**1**	**NA**
Calcium	7440-70-2	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Chromium (Total)	7440-47-3	3	3	17.4		60.4		SED-7	NA	**60.4**	43.4 (z)	111 (z)	**43.4**	**Y**
Chromium, Hexavalent	18540-29-9	3	3	0.517	J	0.995	J	SED-7	NA	**0.995**	NA	NA	**NA**	**NA**
Chromium, Trivalent	16065-83-1	3	3	16.8		59.4		SED-7	NA	**59.4**	NA	NA	**NA**	**NA**
Cobalt	7440-48-4	3	3	5.90		6.57		SED-6	NA	**6.57**	50 (aa)	NA (aa)	**50**	**N**
Copper	7440-50-8	3	3	8.39		20.2		SED-3	NA	**20.2**	31.6 (z)	149 (z)	**31.6**	**N**
Iron	7439-89-6	NR	NR	NR		NR		NR	NR	**NR**	20000 (aa)	40000 (aa)	**20000**	**NA**
Lead	7439-92-1	3	NA	NA		NA		NA	NA	**NA**	35.8 (z)	128 (z)	**35.8**	**NA**
Maqnesium	7439-95-4	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Manqanese	7439-96-5	3	3	262		399		SED-5	NA	**399**	460 (bb)	1100 (bb)	**460**	**N**
Mercury	7439-97-6	3	2	0.0025	J	0.0058		SED-6	NA	**0.0058**	0.18 (z)	1.1 (z)	**0.18**	**N**
Molybdenum	7439-98-7	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Nickel	7440-02-0	3	3	4.86		9.04		SED-7	NA	**9.04**	22.7 (z)	48.6 (z)	**22.7**	**N**
Potassium	7440-09-7	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Selenium	7782-49-2	3	0	0.617	<	0.643	<	NA	NA	**0.643**	11 (bb)	20 (bb)	**11**	**N**
Sodium	7440 - 23- 5	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Strontium	7440- 24-6	3	3	6.2		8.4		SED-6	NA	**8.4**	NA	NA	**NA**	**NA**
Thallium	7440- 28-0	3	NA	NA		NA		NA	NA	**NA**	NA	NA	**NA**	**NA**
Titanium	7440-32-6	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Vanadium	7440-62 -2	3	NA	NA		NA		NA	NA	**NA**	NA	NA	**NA**	**NA**
Zinc	7440-66-6	3	NA	NA		NA		NA	NA	**NA**	121 (z)	459 (z)	**121**	**NA**
Alkalinity	ALK	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Bicarbonate Alkalinity	ALKBICARB	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Carbonate Alkalinity	ALKCARB	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Chloride	7647-14-5	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Methane	74- 82-8	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Nitrate	14797-55-8	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
loH	PH	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Sulfate	7757- 82-6	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Sulfide	18496- 25 -8	NR	NR	NR		NR		NR	NR	**NR**	39 (bb)	61 (bb)	**39**	**NA**
Total Dissolved Solids	TDS	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Total Orqanic Carbon	TOC	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**
Total Suspended Solids	TSS	NR	NR	NR		NR		NR	NR	**NR**	NA	NA	**NA**	**NA**

Table C11
Ecological Screening Notes - (Downgradient) - Bolin Creek
Chapel Hill, North Carolina

Notes:

(a) - USEPA Regional Screening Levels (June 2015). Values for Residential Soil, Industrial Soil, and Tap Water. HI = 0.2. Accessed November 2015. http:// www2 .epa.gov/risk/risk-based-screening-table-generic-tables

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed April 2015. http: / / water. epa.gov/scitech / swguidanee/standards/ criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. Accessed April 2015. http: // water.epa.gov/action /adviso ries/d rinking / upload/dwstandards2012.pdf

(d) - DHHS Screening Levels. Department of Health and Human Services, Division of Public Health, Epidemiology Section, Occupational and Environmental Epidemiolo y Branch. http: //po rta l.ncdenr.org /c/doc ument _library /ge t_file?p_U d= 1169848&folderid=24814087&name=DLFE-112704.pdf

(e) - North Carolina 15A NCAC 02L .0202 Ground wate r Standards & IMACs. http: // porta l.ncdenr.org /c/doc ument _library /ge t_file7uuid= l aa3fa13-2 c0f-45b7-ae96-5427fb1d25b4 &groupi d= 38364 Amended April 2013.

(f) - North Carolina 15A NCAC 02B Surface Water and Wetland Standards. Amended January 1, 2015.
http: // report s.oah.state.nc.us / ncac/ title%2015a%20-%20environmental%20quality /chapter%2002%20-%20en vironmental%20management /su bchapter%20b/subchapter%20b%20rules .pdf WS standards are applicable to all Water Supply Classifications. WS standards are based on the consumption of fish and water.
Human Health Standards are based on the consumption of fish only unless dermal contact studies are available.
For Class C, use the most stringent of freshwater (or, if applicable, saltwater) column and the Human Health column.
For a WS water, use the most stringent of Freshwater, WS and Human Health. Likewise, Trout Waters and High Quality Waters must adhere to the most stringent of all applicable standards.

(g) - USEPA Region 4. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. August.
http :/ /www 2.epa.gov/ sites/production/ files/ 2015-09 /document s/ r4 _era_guidance_document_draft_final_8-25-2015.pdf

(h) - Value applies to inorganic form of arsenic only.

(i) - Value is the Secondary Maximum Contaminant Level.

(j) - Value for Total Chromium.

(k) - Copper Treatment Technology Action Level is 1.3 mg/L.

(I) - Lead Treatment Technology Action Level is 0.015 mg/ L.

(m) - RSL for Antimony (metallic) used for Antimony.

(n) - Value for Chromium (III), Insoluble Salts used for Chromium.

(o) - RSL for Mercuric Chloride used for Mercury.

(p) - RSL for Nickel Soluble Salts used for Nickel.

(q) - RSL for Thallium (Soluble Salts) used for Thallium .

(r) - Criterion expressed as a function of total hardness (mg/L). Value displayed is the site-specific total hardne ss of mg/L.

(s) - Value for Inorganic Mercury.

(t) - Acute AWQC is equal to 1/[(fl/CMCl) + (f2/CMC2)] where fl and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMCl and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate, a likely overly conservative assumption.

(u) - Criterion expressed as a function of total hardness (mg/L). Value displayed is the site-specific total hardness of mg/L.

(v) - Chloride Action Level for Toxic Substances Applicable to NPDES Permits is 230,000 ug/L.

(w) - Applicable only to persons with a sodium restrictive diet.

(x) - Los Alamos National Laboratory ECORISK Database. http: // www. lanl.gov/ commu nity-en vironment /environmen tal-ste wardship/pro tection /e co-risk -assessment.php

(y) - Long, Ed ward R., and Lee G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Used effects range low (ER-L) for chronic and effects range medium (ER-M) for acute.

(z) - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G.; and T. Bernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters . Florida Department of Environmental Protection, Tallahassee, FL. Used threshold effect concentration (TEC) for the ESV and probable effect concentration (PEC) for the RSV.

(aa) - Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. (bb) - Washington State Sediment Management Standards, Cleanup Objections. http: // www.ecy.wa.gov/ programs/ tcp/smu/sed _standards.htm

(cc) - Great Lakes Initiative (GLI) Clearinghouse resources Tier II criteria revised 2013. http: // www.ep a.gov /g liclearinghouse/

(dd) - Suter, G.W., and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. ES/ER/ TM-96 / R2. http: // www .esd.o rnl.gov/ programs/eco risk/documents /t m96r2. pdf

(ee) - USEPA. 2015. Interim Ecological Soil Screening Level Documents. http: // www2.epa.gov/chem ical-research/i nter im-ecological- soil-screening-level-documents

(ff) - Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997a. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/ TM-126 / R2. (Available at http: // www.esd.o rnl.gov/ programs/ecorisk/doc uments /t m126r21.pdf)

(gg) - Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ ER/TM-85 /R3. (Available at http:// www.esd.o rnl.go v/ programs/ecorisk/doc uments / tm85r3.pdf)

(hh) - North Carolina Preliminary Soil Remediation Goals (PSRG) Table. HI= 0.2. September 2015. http://po rta l.ncdenr.org /c/ document _library/get _file7uuid= Of 601ffa-574d-4479-bbb4-253a f0665bf5&groupi d=38361