# APPENDIX C

September 2009 Final RAW

# Final Removal Action Workplan
# Niven Nursery
## 2 Ward Street
## Larkspur, California

Prepared for:
**Larkspur Housing Partners, LLC**
**Walnut Creek, California**

Prepared by:
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Date:
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Project Number:
**03-21512A**

# Signature

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I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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Senior Manager
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# Acronyms

| | |
|---|---|
| AST | Aboveground Storage Tank |
| bgs | Below Ground Surface |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes |
| Cal/EPA | California Environmental Protection Agency |
| CIH | Certified Industrial Hygienist |
| CFR | Code of Federal Regulations |
| COPC | Chemical of Potential Concern |
| DDD | 4,4'-Dichorodiphenyldichloroethane |
| DDE | 4,4'-Dichorodiphenyldichloroethene |
| DDT | 4,4'-Dichorodiphenyltrichloroethane |
| DTSC | Department of Toxic Substances Control |
| H&A | Holman & Associates |
| HRA | Health-Based Risk Assessment |
| kg | Kilogram |
| LHP | Larkspur Housing Partners, LLC |
| LLC | Limited Liability Corporation |
| mg/kg | Milligrams per Kilogram |
| $mg/m^3$ | Milligrams per Cubic Meter |
| MRL | Method Reporting Limit |
| MSL | Mean Sea Level |
| MTBE | Methyl tent-Butyl Ether |
| NA | Not Applicable |
| ND | Not Detected |
| NR | Not Reported |
| NS | Not Sampled |
| PCB | Polychlorinated Biphenyl |
| PRG | Preliminary Remediation Goal |
| RAW | Removal Action Workplan |
| RCRA | Resource Conservation and Recovery Act |
| TPH | Total Petroleum Hydrocarbon |
| TPH-diesel | Total Petroleum Hydrocarbon as Diesel |
| TPH-gasoline | Total Petroleum Hydrocarbon as Gasoline Total |
| TPH-residual | Petroleum Hydrocarbon as Residual |
| USEPA | United States Environmental Protection Agency |
| UST | Underground Storage Tank |
| VCA | Voluntary Cleanup Agreement |
| VOC | Volatile Organic Compound |
| WET | Waste Extraction Test |

# EXECUTIVE SUMMARY

This Removal Action Workplan (RAW) was prepared for the Niven Nursery property located at 2 Ward Street in Larkspur, California (the "Site") in accordance with the Voluntary Cleanup Agreement (VCA), Docket No. HAS-A99/00-135, between Larkspur Housing Partners, LLC (LHP) and the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC). The purpose of the RAW is to describe the proposed procedures and protocols for remediation of chemicals of potential concern (COPCs), in soils associated with the historical use of the property as a nursery. The primary purpose of the RAW is to present a remedial measure to mitigate COPC-impacted soils identified at the Site to allow for the planned residential development.

A RAW is a remedy selection document that can be prepared for a hazardous substance release pursuant to Health and Safety Code Section 25356. It is prepared when a non-emergency action or a remedial action is projected to cost less than $2,000,000 (California Health and Safety Code section 25356.1(h)(1)).

For the past 78 years, the Niven family has owned and operated a commercial nursery at the Site. Over the years, certain pesticides have been used at the Site in conjunction with the nursery operation and were kept in storage areas located in each nursery complex. Pesticides were mixed in small quantities as they were being applied and were applied by backpack sprayer and pushcart type applicators. Currently, the nursery has reduced operations to cultivation of orchids in the southern greenhouse area.

Based on the available soil, sediment, and groundwater sampling results and based on risk assessment assumptions and methods recommended by the Cal/EPA, ENVIRON found that, while pesticide residue levels varied somewhat across the site, the health risks attributable to pesticides and metals in surface soils at the Site do not pose a human health risk greater than the acceptable risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ used by the Cal/EPA and the United States Environmental Protection Agency (USEPA) (ENVIRON 2002). Two drainage areas, identified as the Northwest Drainage Area and Southern Drainage Area, were shown to have COPCs in the soil that merited remediation. Lead levels ranging from 23 mg/kg to 3,800 mg/kg were detected in the sediment of the Southern Drainage Area, and lead levels ranging from 620 mg/kg to 1,800 mg/kg were detected in the sediment of the Northwest Drainage Area. The lead-impacted soils in these two drainage areas will be excavated.

In addition, COPCs were identified in four areas within the Western Nursery Area that merit remediation: lead, arsenic and 4,4'-dichorodiphenyltrichloroethane (DDT) were detected in soil samples W-1 (A-C), W-4 (A-C), W-6 (A-B) and W-7. The top foot of soil in the footprint of the structure represented by these Western Nursery Area samples will be excavated. Because the amount of COPC-impacted soil in the Western Nursery Area is estimated at approximately 19,844 cubic feet and the amount within the Northwest and Southern Drainage Areas is estimated at approximately 4,563 cubic feet, the overall total amount of soil that has been

targeted for excavation and removal is estimated at approximately 24,407 cubic feet, which equates to 904 cubic yards.

This RAW evaluates the implementability, effectiveness, and cost of three remedial alternatives to address lead-impacted soils in the two drainage areas and the Western Nursery Area. The three alternatives are:

- Alternative 1 - No Action;
- Alternative 2 - Excavation, Consolidation and Soil Washing; and
- Alternative 3 - Excavation and Off-Site Disposal.

Based on a comparative analysis, Alternative 3 (Excavation and Off-Site Disposal) is the recommended alternative for addressing the impacted Site soils. Alternative 3 involves the following elements:

- Excavation of approximately 904 cubic yards of COPC-impacted soils;
- Temporary stockpiling of midden-containing soil and screening for culturally-significant resources;
- Off-site disposal of COPC-impacted soils; and
- Backfill of the excavated area with clean fill.

In addition, Alternative 3 has been modified slightly from the version of the Draft RAW that was made available for public comment based on archaeological investigations that were conducted after completion of the public comment period. Archaeological investigations were conducted by Holman & Associates (H&A) on the Site in November 2006. The H&A studies revealed evidence that portions of the Site may contain archaeological deposits. Although it likely that large portions of the "middens" have been disturbed during the past 140 years, the presence of human bone recovered during the H&A investigations suggests that there is the potential for human graves and unassociated bones within the Site. ("Middens" are mounds or deposits containing shells, animal bones, and other refuse that indicates the site of a human settlement). Because of these findings and as required by law, an agreement between the Federated Indians of Graton Rancheria and the City of Larkspur, and LHP to formalize procedures for the protection and treatment of Native American human remains, funerary objects, cultural and religious landscapes, ceremonial items, and cultural items, in the event that any are discovered in conjunction with the Site's development and use, (including archaeological studies, excavation, geotechnical investigations, grading, and any ground-disturbing activity). This agreement (called "the Treatment Plan") also formalized procedures for Tribal Monitoring during archaeological studies, grading, and ground disturbing activities. Under the Treatment Plan, it is important for non-human, cultural resources and artifacts to be left at the Site to the greatest degree possible consistent with the location and configuration of the future Site.

As a result of the Treatment Plan, offsite disposal of culturally significant resources (such as Native American human remains, funerary objects, cultural and religious landscapes, ceremonial items, etc.), that may be present in excavated soil,is prohibited. If midden is encountered in excavated soils, the soil containing midden will be stockpiled separately and screened for culturally significant resources by appropriately-trained archaeologists and Tribal representatives. If culturally significant resources are identified, then these resources will be recovered from the midden and reburied on the Site. Prior to reburial onsite, these resources will be evaluated for the presence of lead. If it is likely that a significant amount of lead may be present, these resources will be tested for lead. If lead is present above the soil cleanup level or other applicable screening level, the resources will be reburied in an encapsulation area. If lead is not present above the soil cleanup level or other applicable screening level, then the resources will be reburied with any other resources recovered from non-COPC impacted areas at the Site. Excavated soil, including midden that is screened and found not to contain culturally significant resources, will be disposed of offsite.

Implementation of this RAW, centered upon the excavation of COPC-impacted soils from the two drainage areas and the Western Nursery Area, should mitigate health-based risks posed by COPCs at the Site and allow for proposed development of the property as residential housing consisting of single family detached homes, cottage homes and a multi-family senior housing project. Additionally, to improve surface drainage at the site, LHP is planning on adding surface soil across the site to raise the site grade. The presence of this clean fill would substantially decrease any potential exposure and risk to people and wildlife that would be on the property in the future.

# 1 Introduction

On behalf of Larkspur Housing Partners, LLC (LHP), and consistent with the Voluntary Cleanup Agreement (Docket No. HAS-A99/00-135) with the Department of Toxic Substances Control (DTSC), ENSR prepared the Draft Removal Action Work Plan (RAW) for the Niven Nursery property located at 2 Ward Street, Larkspur, California (the "Site") in March 2002. The purpose of the Draft RAW was to describe the proposed procedures and protocols for removal of chemicals of potential concern (COPCs), in soils associated with the historical use of the property as a nursery. The Draft RAW was prepared consistent with the DTSC Guidelines (1998).

From December 26, 2003 to February 9, 2004, DTSC held a public comment period on the Draft RAW for the Site. The purpose of the public comment period was to provide the public with an opportunity to comment on the proposed cleanup for the Site. No public comments were received during the public comment period.

To comply with the California Environmental Quality Act (CEQA), and to assess the potential environmental impacts of the RAW, DTSC relied upon the City of Larkspur's Central Larkspur Specific Plan certified Environmental Impact Report (EIR). The Final EIR was completed in September 2006.

After the public comment period was over and the Final EIR was completed, the ENSR Draft RAW was provided to ENVIRON to finalize.

Data gathered during three previous environmental investigations (GeoPacific 1996, Harza 1998, ENSR 2002) and a Health-Based Risk Assessment (HRA) for Niven Nursery (ENVIRON 2001) provided the basis for determining the areas of the Site which required mitigation. Two drainage areas, identified as the Northwest Drainage Area and Southern Drainage Area, were shown to have lead concentrations in soils at levels that warranted remediation. In addition, four areas within the Western Nursery Area were shown to have lead at concentrations in surficial soils at levels that warranted remediation, as well as arsenic and DDT residues. The total amount of soil affected in the Western Nursery Area is estimated at 19,844 cubic feet and that within the Northwest and Southern Drainage Areas is estimated at 4,563 cubic feet. The total amount of soil from the areas at issue that are targeted for remediation is estimated to be approximately 24,407 cubic feet, which equates to 904 cubic yards.

LHP is planning for the removal of soil from these areas and off-site disposal of the lead-impacted soil[1] under DTSC supervision, consistent with the procedures and methodology presented in this RAW. Implementation of this RAW should mitigate health-based risks posed by COPC-impacted soil at the Site and allow for proposed development as residential housing.

## 1.1 Organization of Report

Section 1.0 Introduction: Provides a summary of the RAW scope.

Section 2.0 Site Characterization: Presents a description of the Site and summary of previous environmental investigations performed at the Site.

Section 3.0 Identification of Removal Action Goals: Contains a summary of removal action goals for lead-impacted soils.

Section 4.0 Identification and Analysis of Removal Action Alternatives: Presents a summary of remedial alternatives and screening criteria.

Section 5.0 Comparative Analysis of Removal Action Alternatives: Offers a comparison of alternatives based on screening criteria.

Section 6.0 Recommended Removal Action Alternative: Presents the preferred remedial alternative.

Section 7.0 References: Lists references used in preparation of this document.

Section 8.0 Administrative Record List: List of documents in the Record List.

[1] Except for offsite disposal of culturally-significant Native American resources. These resources will remain on onsite as discussed further below.

# 2 Site Characterization

## 2.1 Site Description and Background

### 2.1.1 Site Location

The Site is located at 2 Ward Street in Larkspur, California, as shown on the attached Figure 1 (Site Location Map). The Site is currently developed as the Niven Nursery, with numerous greenhouses, storage and maintenance buildings, several residences, and associated roadways and parking areas. Site development is concentrated in the western, northern and southern sections of the Site. The eastern portion of the Site is undeveloped.

The approximately 16.8-acre Site is bordered on the east by Larkspur Creek; to the south by Larkspur Creek and Ward Street; to the west by a commercial shopping center; and to the north by Doherty Drive, beyond which is Hall Middle School. The Site is generally flat, with surface drainage to the southeast, except in the northwest corner of the Site, where drainage is directed north via a channel under Doherty Drive.

### 2.1.2 Geology and Hydrogeology

The Site is located near the center of the Coast Range geomorphic subprovince on the northwest margin of the San Francisco Bay subregion basin at the base of the surrounding hills (Harza 1998). This area is generally comprised of fine-grained sediments of the Holocene-Epoch age and estuarine clay that consists of fine to medium-grained colluvium derived from erosion of nearby hills.

Based on recent investigations, shallow site soils generally consist of three to five feet of artificial fill overlaying Bay Mud to a maximum depth explored of about 30 feet below ground surface (bgs). Fill at the Site appeared to be comprised of fine-grained sand with clay and gravel and fine-grained sand mixed with organics and shell fragments (SFB 2008).

The U.S. Geologic Survey (USGS) topographic map of the San Rafael Quadrangle (1979) shows the Site within an area developed for residential and commercial use in the City of Larkspur. Average ground surface elevations at the Site range from 5 to 15 feet above mean sea level (MSL), which includes fill placed across the Site (Harza 1998). Local drainage is generally to the east/southeast of the Site, with the exception of the northwest corner of the property, which drains to the north, under Doherty Drive, in a conveyance channel.

Due to the close proximity of Corte Madera Creek and San Francisco Bay, groundwater at the Site is encountered at varying depths across the Site, and groundwater depth appears to vary seasonally. In addition, local groundwater depth and gradient at the Site may fluctuate as they are influenced by tidal cycles, and groundwater may move toward the nearby surface waters during ebb tides (Harza 1998). Based on prior geotechnical borings in the Western Drainage Area, which were drilled at the Site in March 1998 (during the rainy season), groundwater was

encountered at depths ranging from 3 to 4 feet bgs and quickly rose to depths of 6 inches to 1 foot bgs (SFB 2008). However, in borings drilled near the Western Drainage Area in October 2007 (the dry season), groundwater was encountered at depths between 8 and 21 feet bgs. In the northeastern portion of the Site, groundwater was not encountered in geotechnical borings that extended between 12 and 21 feet bgs in March 1998 and October 2007 (SFB 2008).

### 2.1.3 Site History

For the past 78 years, the Niven family has owned and operated a commercial nursery at the Site. An interview with a representative of the Site owner, indicated that the Site has been used by the Niven family as a nursery since approximately 1920, and that it was undeveloped vacant land prior to that date. Review of aerial photographs performed as part of Harza's Phase I Assessment indicated that as of 1946, the earliest available photograph date, the Site appeared to contain several greenhouse buildings located on the west/southwest corner. In subsequent years, aerial photographs appeared to show more nursery buildings located on the northern and southern areas of the Site, and the addition of what appeared to be several residential buildings. The Site was noted as being developed to its current level in the 1996 photograph.

### 2.1.4 Owner/Employee Interviews

Representatives of ENSR and ENVIRON have spoken with Ms. Cynthia Niven, who represents the current owner of the Site and is the great-granddaughter of the original Site owner. Ms. Niven indicated that the Site had been used for nursery operations by the Niven family for approximately 78 years and that prior to this, it was vacant land. Ms. Niven explained that the western greenhouses have been in operation the longest and that the nursery produced many different types of flowers (roses, camellias, orchids, etc.). Over the years, various pesticides have been used at the Site in conjunction with the nursery operation and were kept in storage areas located in each nursery complex (see Figure 2). According to Ms. Niven, pesticides were mixed in small quantities as they were being applied and were applied by backpack sprayer and pushcart type applicators. Currently, the nursery has reduced operations to cultivation of orchids in the southern greenhouse area.

In addition to the greenhouses, Ms. Niven indicated that several underground storage tanks (USTs) had been present on the Site and described where they had been located. These locations are shown in Figure 2. Ms. Niven indicated that all of the USTs were removed in about 1990, and confirmation soil sampling was conducted at that time. A magnetometer survey performed by Harza in 1998 supports the conclusion that no USTs are present on the Site. Similar to the removal of the USTs, Ms. Niven indicated that metal drums, formerly located on the eastern side of the property, had been removed in recent years for metal recycling.

Currently, two aboveground storage tanks (ASTs) are located on the property. According to Ms. Niven, the AST located on the north end of the property has never been used, and the AST located on the southern end of the property has only been used for water storage (Harza 1998).

Boilers located in each of the greenhouse areas were previously used to provide adequate heating for cultivation. Ms. Niven indicated that she was not aware of any other hazardous materials storage area other than the pesticide storage areas and former UST locations (ENVIRON 2001).

### 2.1.5 Current Site Use

The Site currently consists of numerous greenhouse buildings along with several small, residential-type structures, storage/maintenance buildings, offices, and associated roadways, which are primarily located on the western, northern and southern areas of the property. Greenhouses in the western and northern nursery areas are no longer in use, while the southern greenhouse complex of the nursery is currently operating in a reduced capacity for orchid cultivation. The eastern area remains undeveloped with several large fill material piles and miscellaneous debris. The northeast corner of the Site is currently used by a tenant as a retail nursery outlet, and is referred to below as the Sloat Nursery Area. Due to the use of pesticides, the Site is listed as a Resource Conservation and Recovery Act (RCRA) small quantity generator (SQG) of hazardous waste, which is defined as a business which generates more than 100 kilograms (kg) per month but less than 1,000 kg per month of non-acutely hazardous waste (Harza 1998). Figure 2 presents the general locations for the areas described above.

### 2.1.6 Potential Future Use

LHP intends to develop the Site as single-family residential housing. The planned development will be comprised of up to 85 residences, including single-family detached homes, cottage homes and a multi-family senior housing project. The limited development of the Site is in keeping with the City's standards for low growth and protection of the environment. The planned project will entail limited environmental remediation that is addressed in Section 4.0, Identification and Analysis of Removal Action Alternatives.

## 2.2 Source Nature and Extent of Impact

### 2.2.1 Summary of Previous Site Investigations

Three environmental investigations have been conducted at the Niven Nursery Site to assess the presence of COPCs in soil and groundwater, delineate the extent of COPCs, and identify site geologic and hydrogeologic conditions. These investigations entailed review of historical property use, interviews with property owners and employees, and sampling of soil, groundwater and sediments for COPCs at the Site. The following summary of these investigations is based upon the information contained in reports documenting the three environmental investigations and the Health-Based Risk Assessment, which was submitted to the DTSC on October 26, 2001.

In 1996, GeoPacific conducted an initial site investigation to assess the presence of COPCs throughout the Site related to site use as a nursery. In 1998, Harza performed a subsequent investigation to update issues identified during the initial investigation by assessing conditions or activities on or near the Site that appeared to indicate a potential release of hazardous materials to the shallow soil, surface sediments, or groundwater.

The most recent investigation was conducted by ENSR in 2001 (Soil and Groundwater Investigation, ENSR 2001) as part of a Voluntary Cleanup Agreement (Docket No. HAS-A99/00-135) with the DTSC. The purpose of the investigation was to:

- Confirm that residual hydrocarbon impacts from the former UST/AST locations were not present;
- Confirm that surface water runoff at the Site has not affected Larkspur Creek sediments;
- Further delineate the lateral and vertical extent of lead and chlorinated pesticide impacts in the nursery areas, particularly in the Western Nursery Area; and
- Confirm the low lead and chlorinated pesticide concentrations in the areas between the greenhouses.

Soil samples collected as part of the Harza 1998 site investigation were analyzed for total petroleum hydrocarbons (TPH)-gasoline using United States Environmental Protection Agency (USEPA) Method 5030; TPH-diesel and TPH-motor oil using USEPA Method 8015M; purgeable aromatic compounds (e.g., benzene, toluene, ethylbenzene, and xylenes, collectively referred to as BTEX) using USEPA Method 8020; organochlorine pesticides using EPA 8080; and select metals (lead, arsenic, and mercury) using USEPA Method Series 6000 (Harza 1998).

Groundwater samples collected during the Harza 1998 investigation were analyzed for TPH-gasoline, TPH extractables (i.e., TPH-diesel and TPH-residual), BTEX constituents, select metals (arsenic, lead, and mercury), and chlorinated pesticides (Harza 1998).

Soil and sediment samples collected as part of the ENSR 2001 site investigation were analyzed for arsenic and lead using USEPA Method series 6000/7000 and chlorinated pesticides (sediment samples only analyzed for DDT) using USEPA Method 8080 (ENSR 2001). Groundwater samples collected in the vicinity of former UST locations during the ENSR investigation were analyzed for TPH-gasoline, methyl tent-butyl ether (MTBE), and BTEX constituents using USEPA Method 8015M and USEPA Method 8020 (MTBE and BTEX), respectively (ENSR 2001). Soil and groundwater sampling locations associated with the Harza 1998 and ENSR 2001 investigations are shown on Figure 2.

Based upon the known distribution of nursery-related chemicals at the Site, and the historical use information for individual portions of the Niven Nursery property described above, the Site has been divided into the following areas and media to evaluate potential risk and hazard:

- Greenhouse Areas (Western Nursery Area, Northern Nursery Area, Southern Nursery Area);
- Sloat Nursery Area;
- UST/AST Areas;
- Larkspur Creek and Drainage Areas (Northwest Drainage and Southern Drainage Areas); and
- Site Groundwater.

The results of investigations conducted in each area of the Site are described in the following sections.

### 2.2.2 Greenhouses

At the time of the Harza and ENSR site investigations, approximately 30 greenhouse buildings, totaling approximately 240,000 square feet, were located on the Western, Northern, and Southern Nursery Areas of the Site, occupying about 6 acres. In Harza's investigation soil samples were collected at depths of 0.5 to 1 foot bgs from two to three locations per greenhouse (depending on the size of the greenhouse) (Harza 1998). Soil samples from each greenhouse area were composited by the laboratory into one sample and analyzed for organochlorine pesticides and selected metals (lead, arsenic, and mercury) (Harza 1998).

To more accurately delineate the lateral and vertical extent of lead and chlorinated pesticide impacts in the greenhouse areas, 18 sample borings were installed in and around the greenhouses as part of the ENSR 2001 investigation. Eight borings were installed in the Western Nursery Area (samples W-1 through W-8), nine borings were installed in the Northern and Southern Nursery Areas (samples N-1 through N-5 and S-1 through S-4, respectively), and two borings were installed in the Sloat Nursery Area (samples SN-1 and SN-2). Soil samples were collected at depth intervals of approximately 0-6 inches bgs, 2-3 feet bgs, and 4-5 feet bgs from each of the borings. Soil samples collected as part of the ENSR 2001 investigation were discrete samples. The results of these investigations are described in the following sections.

#### 2.2.2.1 Western Nursery Area

The Western Nursery Area greenhouses were the first buildings on the property and have been in operation the longest. Currently, these greenhouses are not used for nursery operations and consist mainly of vacant structures. Based on laboratory analytical results of all soil samples collected from the Western Nursery Area during the Harza 1998 and ENSR 2001 investigations (see Figure 2 for sampling locations), arsenic concentrations range from 6 to 26 mg/kg, lead concentrations range from 8.7 to 920 mg/kg, DDD concentrations range from 0.017 to 0.31 mg/kg, DDE concentrations range from 0.013 to 0.9 mg/kg, DDT concentrations range from 0.017 to 10 mg/kg, and dieldrin concentrations range from 0.015 to 0.3 mg/kg.

All of the detected results associated with DDD, DDE, DDT, and dieldrin were detected at depths ranging from 0 to 1 foot bgs. Lead was detected in every sample collected at depths ranging from 0 to 5 feet bgs; however, all elevated detections except one, in reference to risk-based target concentrations, were detected at depths ranging from 0 to 1 foot bgs; one detection of lead (290 mg/kg) at one location (W-1) was detected slightly above risk-based target concentrations at a depth of two feet bgs. Refer to Table 1 for a summary of analytical results.

#### 2.2.2.2 Northern Nursery Area

At the time of the Harza 1998 and ENSR 2001 investigations, the Northern Nursery Area consisted of about 10 greenhouse structures that were no longer in use. According to Site personnel, this area was formerly used for rose cultivation and production. Attached to some greenhouses are rooms with concrete floors which were used for rose production and shipping, and still contained potting and packing materials and had two small refrigerated storage areas.

Based on laboratory analytical results of all soil samples collected from the Northern Nursery Area during the Harza 1998 and ENSR 2001 investigations, lead concentrations range from 7.2 to 200 mg/kg, DDD concentrations range from 0.011 to 0.4 mg/kg, DDE concentrations range from 0.049 to 0.98 mg/kg, DDT concentrations range from 0.01 to 2.2 mg/kg, and dieldrin concentrations range from 0.01 to 0.28 mg/kg. Arsenic was only detected in one sample at a concentration of 14 mg/kg (at 1 foot bgs).

Virtually all of the detected results associated with DDD, DDE, DDT, and dieldrin were detected at depths ranging from 0 to 1 foot bgs. Lead was detected in every sample collected at depths ranging from 0 to 5 feet bgs; however, no elevated, in reference to risk-based target concentrations, detections were detected in the Northern Nursery Area. Refer to Table 2 for a summary of analytical results.

#### 2.2.2.3 Southern Nursery Area

The Southern Nursery Area is the only portion of the Site currently in use; the greenhouses located in this area are used for orchid cultivation. This area consists of about 11 greenhouses and an attached concrete-floor building that is currently used for preparation and production of orchids.

Based on laboratory analytical results of soil samples collected from the Southern Nursery Area during the Harza 1998 and ENSR 2001 investigations, lead concentrations range from 1.5 to 270 mg/kg, DDD concentrations range from 0.02 to 0.29 mg/kg, DDE concentrations range from 0.02 to 1.5 mg/kg, DDT concentrations range from 0.014 to 7.1 mg/kg, and dieldrin concentrations range from 0.029 to 0.61 mg/kg. Arsenic and mercury were not reported as being present above laboratory method reporting limits (MRLs) in any of the samples.

Virtually all of the detected results associated with DDD, DDE, DDT, and dieldrin were detected at depths ranging from 0 to 1 foot bgs. However, DDE and DDT were detected at concentrations of 0.06 mg/kg and 0.04 mg/kg, respectively, in sample S-3 collected at a depth of 4 feet bgs. Lead was detected in every sample collected at depths ranging from 0 to 5 feet bgs, however, only one detection of lead (270 mg/kg) at one location (S-1) was detected slightly above risk-based target concentrations at a depth of 0 to 6 inches. Refer to Table 3 for a summary of the analytical results.

### 2.2.3 Sloat Nursery Area

A retail nursery, the Sloat Nursery Area occupies buildings on the northeastern corner of the Niven Site. The land is leased from the Niven Company to the Sloat Nursery. This area is entirely paved.

Based on laboratory analytical results of soil samples collected from the Sloat Nursery Area, lead concentrations range from 9.4 to 46 mg/kg. Lead was the only metal analyzed for in soil samples collected from this area of the Site. Lead was detected in every sample collected at depths ranging from 0 to 2 feet bgs. Chlorinated pesticides were not detected in any of the samples collected at the Sloat Nursery Area. Refer to Table 4 for a summary of the analytical results.

### 2.2.4 Former UST and Current AST Areas

Ms. Niven has been continuously and actively engaged in the nursery business on the Site for approximately 20 years, and through her knowledge of the Site was able to identify the locations of the former USTs (see Figure 2). In addition to this information, a magnetometer survey conducted by Harza in 1998 did not detect any USTs. Based on this information, ENSR concluded that all of the former USTs have been identified and removed. Regarding the ASTs, one of the two existing ASTs has never been used and the other one has been used exclusively for water storage.

Ms. Niven informed ENSR that she was present during the UST removals and to the best of her knowledge, there was no indication of hydrocarbon impact (e.g., stained soil or presence of liquid fuel). Laboratory test results from soil samples collected at the time the USTs were removed indicated that there had been no leaks. As part of the Harza 1998 investigation, soil samples were collected at four sampling locations (UST1, UST2, AST1, and AST2) to characterize potential soil impacts at three areas of the Site that were assumed to be former locations of USTs/ASTs. In response to a request from DTSC to provide additional confirmation that significant impacts from petroleum hydrocarbons from former USTs/ASTs are not present, soil samples were collected from six additional borings (T-1 through T-6) located near former UST/AST locations at depths of 2 feet and 5 feet bgs as part of the ENSR 2001 Site investigation.

Based on all laboratory analytical associated with the samples discussed above TPH-gasoline, TPH-diesel, and TPH-residual were each detected once at concentrations of 1.6 mg/kg, 6 mg/kg, and 18 mg/kg, respectively. Toluene, ethylbenzene, and xylenes were detected at concentrations ranging from 0.007 to 0.033 mg/kg, 0.006 to 0.01 mg/kg, and 0.02 to 0.075 mg/kg, respectively. Table 5 depicts the laboratory data for soil samples collected from the former UST/AST areas.

### 2.2.5 Larkspur Creek, Southern Drainage Area and Northwest Drainage Area Sediments

As shown in Figure 2, Larkspur Creek runs along the southern and eastern property boundary. As part of the Harza 1998 and ENSR 2001 investigations, several shallow sediment samples (0-6 inches bgs) were collected from the banks of Larkspur Creek along the southern property boundary and one sediment sample was collected from the creek/canal bordering the eastern portion of the Site. These samples were collected to evaluate potential impacts to the creek from historical water runoff from the Site (refer to Table 6). These samples were analyzed for arsenic, lead, and chlorinated pesticides. Laboratory analytical results detected lead at concentrations of 13 to 19 mg/kg. Arsenic was detected once at a concentration of 2.4 mg/kg. No chlorinated pesticides were detected.

Sediment samples were also collected from the bottom of two drainage ditches on the property. One ditch is located in an area referred to herein as the Southern Drainage Area; water flowing in this ditch during periods of runoff flows south, just to the east of the water tanks located south of the Southern Nursery Area, and then drops down into the section of Larkspur Creek that runs through the southern-most section of the Site. One sediment sample (sample SS-1) was collected from this ditch during the ENSR 2001 investigation, and analyzed for arsenic, lead, and DDT (refer Table 6). Laboratory analytical results detected arsenic, lead, and DDT at concentrations of 3.6 mg/kg, 3,800 mg/kg, and 0.041 mg/kg, respectively.

The second drainage ditch, located in an area referred to herein as the Northwest Drainage Area, drains into the cement-lined drainage ditch that also collects surface runoff from the shopping center to the west of the Site and runs north off the property. As shown in Table 7, five sediment samples were collected from this ditch during the Harza 1998 and ENSR 2001 investigations, and analyzed for arsenic, lead, chlorinated pesticides, and PCBs. Laboratory analytical results detected arsenic, lead, and DDT at concentrations ranging from 4.1 to 13 mg/kg, 620 to 1,800 mg/kg, and 0.013 to 0.22 mg/kg, respectively.

### 2.2.6 Summary of Groundwater Quality

To provide an evaluation of groundwater quality across the Site, five borings (GW-1 through GW-5) were installed using direct-push methods for collection of "grab" (i.e., unfiltered) groundwater samples during the Harza 1998 investigation. Groundwater was not encountered in boring GW-5; therefore, no groundwater samples were collected at this location. Additionally,

groundwater samples were collected from two on-site water wells (E-Well and W-Well) located along the southern end of the property. During the ENSR 2001 investigation, six additional "grab" groundwater samples (T-1 through T-6) were collected at former UST/AST locations. Based on their location within the Site, groundwater samples were analyzed for TPH-gasoline, TPH extractables (i.e., TPH-diesel and TPH-residual), BTEX constituents, select metals (arsenic, lead, and mercury), and/or organochlorine pesticides (Harza 1998). Approximate groundwater sampling locations are shown in Figure 2.

As shown in Table 8, a total of 12 groundwater samples were collected during the Harza 1998 and ENSR 2001 site investigations. Based on the laboratory analytical results of these samples, lead and mercury were detected at concentrations ranging from 0.23 to 5.9 mg/L and 0.0005 to 0.0022 mg/L, respectively. TPH-gasoline was detected once at a concentration of 0.11 mg/L; TPH-diesel was detected at concentrations ranging from 0.082 to 1.6 mg/L, respectively. Benzene, toluene and xylenes were detected at concentrations ranging from 0.00056 to 0.00175 mg/L, 0.00057 to 0.0071 mg/L, and 0.0006 to 0.014 mg/L, respectively. Ethylbenzene was detected once at a concentration of 0.0021 mg/L.

## 2.3 Summary of Risk Evaluation

### 2.3.1 Human Health Risk Assessment

Based on the available soil, sediment, and groundwater sampling results and based on risk assessment assumptions and methods recommended by the Cal/EPA, ENVIRON found that while the pesticide residue levels varied somewhat across the Site, the health risks attributable to pesticides and metals in surface soils at the Site do not pose a human health risk greater than the acceptable risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ used by the Cal/EPA and USEPA. More specifically, calculated cancer risks associated with the Western Nursery Area, Northern Nursery Area, Southern Nursery Area, and Sloat Nursery Area are $5 \times 10^{-5}$, $2 \times 10^{-5}$, $1 \times 10^{-5}$, and $2 \times 10^{-7}$ respectively. Similarly, the Hazard Indices (Hls) calculated for each designated nursery areas are all below the target HI of 1 used by the Cal/EPA and USEPA (ENVIRON 2002).

In the HRA, ENVIRON noted that lead residues detected in sediment samples collected from the bottom of the Northwest and Southern Drainage Area ditches exceeded levels considered safe across a residential lot. Based on the results from this HRA, LHP has planned for the removal of impacted sediment from those ditches.

### 2.3.2 Soil

Lead residues detected in soil samples collected from select areas within the Western Nursery Area and the sediment of two drainage ditches, identified as the Northwest Drainage and Southern Drainage Areas, exceeded levels that would be considered safe across a residential lot. Within the Western Nursery Area, lead was found in surficial levels within one greenhouse

area (Figure 3: Area 1A) at a level of 740 mg/kg, within another greenhouse area (Figure 3: Area 1B) at a level of 920 mg/kg, within another greenhouse area (Figure 3: Area IC) at a level of 460 mg/kg and within another greenhouse area (Figure 3: Area 1 D) at a level of 670 mg/kg. Lead was also found in surficial levels in one sample outside the footprint of a greenhouse area (Figure 3:Area 1E) at a level of 350 mg/kg. In addition, other COPCs (arsenic and DDT) were identified within areas 1A and 1B of the Western Nursery Area. Lead was found in sediment samples in the Northwest Drainage Area ranging from 630 to 1,800 mg/kg, and lead was detected within sediment samples in the Southern Drainage Area ranging from 23 to 3,800 mg/kg.

#### 2.3.2.1 Western Nursery Area Soil

Area IA of the Western Nursery Area is comprised of one greenhouse building estimated at approximately 25 feet by 112.5 feet by 1 foot deep for a total of approximately 2,812 cubic feet, and another greenhouse building estimated at 18.75 feet by 125 feet by 1 foot deep for a total of approximately 2,344 cubic feet. Area 1B of the Western Nursery Area is comprised of one greenhouse building estimated at 25 feet by 125 feet by 1 foot deep for a total of approximately 3,125 cubic feet, another greenhouse building estimated at 25 feet by 62.5 feet by 1 foot deep for a total of approximately 1,563 cubic feet, and part of a third building estimated at 50 feet by 75 feet by 1 foot depth for a total of approximately 3,750 cubic feet. Area 1C of the Western Nursery Area is comprised of one greenhouse building estimated at 50 feet by 25 feet by 1 foot depth for a total of approximately 1,250 cubic feet, and another building estimated at 50 feet by 25 feet by 1 foot depth for a total of approximately 1,250 cubic feet. Area ID of the Western Nursery Area is comprised of a part of one greenhouse building estimated at 50 feet by 75 feet by 1 foot depth for a total of approximately 3,750 cubic feet. The total volume of COPC-impacted soil within the Western Nursery Area is estimated at approximately 19,844 cubic feet, which equates to 735 cubic yards.

#### 2.3.2.2 Drainage Area Soil

The areal extent of the proposed Northwest Drainage Area impact is represented by one area estimated at approximately 175 feet by 6 feet by 1 foot deep totaling approximately 1,050 cubic feet (Figure 3: Area 2A), and a second area of 225 by 12.5 feet by 1 foot deep totaling 2,813 cubic feet (Figure 3: Area 2C). In addition to these areas, the concrete storm culvert on the Northwest portion of the Site will be cleaned of sediment (Figure 3: Area 2B). The area of the proposed Southern Drainage Area impact is estimated at approximately 56 feet by 12.5 feet by 1 foot deep, totaling approximately 700 cubic feet (Figure 3: Area 3). The total area within the Northwest and Southern Drainage to be removed and disposed of at an appropriate off-site facility is estimated at approximately 4,563 cubic feet, which equates to 169 cubic yards.

#### 2.3.2.3 Total COPC-impacted soil

The overall total amount of COPC-impacted soil in the Western Nursery Area and the Northwest and Southern Drainage Areas is estimated at approximately 24,407 cubic feet, which equates to 904 cubic yards.

Confirmation soil sampling will be performed in the excavated areas to ensure that the identified COPC-impacted soils have been removed. Additional excavation and confirmation sampling will be performed as required.

Based largely on the results of the HRA and previous soil and groundwater sampling at the Site, LHP is planning for the removal of COPC-impacted soil from the affected areas. The planned removal of this COPC-impacted soil by LHP under Cal/EPA supervision will reduce health risks to levels that are protective of future residents. Additionally, it should be noted that, as part of the development plan, LHP plans to add surface soil across the Site to raise the grade. The presence of clean fill would substantially decrease any potential risk to future populations.

#### 2.3.2.4 Groundwater

The low levels of hydrocarbons found in shallow groundwater near some of the old fuel tanks did not exceed the residential groundwater risk-based target concentrations and therefore, do not pose a health risk to future residents (ENVIRON 2002).

### 2.4 2006 Archaeological Investigation

During November 2006 (after completion of the public comment period for the Draft RAW for the Site), archaeological investigations were conducted by Holman & Associates (H&A) on the Site (Holman 2007). Investigations centered on locations believed to formerly contain two previously recorded archaeological sites, Shellmounds CA-MRN-67 and MRN-68, recorded by N.C. Nelson in 1907. The H&A studies revealed evidence that portions of these archaeological deposits are intact and undisturbed. Although it likely that large portions of the “middens” have been disturbed during the past 140 years, the presence of human bone recovered during the H&A investigations suggests that there is the potential for human graves and unassociated bones within the Site. (“Middens” are mounds or deposits containing shells, animal bones, and other refuse that indicates the site of a human settlement).

Artifact types recovered indicate occupancy of the Site as early as 2200 years ago and show affinities with other archaeological sites in the Bay Area.

Because of these findings and as required by law, an agreement between the Federated Indians of Graton Rancheria and the City of Larkspur, and LHP to formalize procedures for the protection and treatment of Native American human remains, funerary objects, cultural and religious landscapes, ceremonial items, and cultural items, in the event that any are discovered in conjunction with the Site's development and use, (including archaeological studies,

excavation, geotechnical investigations, grading, and any ground-disturbing activity). This agreement (called “the Treatment Plan”) also formalized procedures for Tribal Monitoring during archaeological studies, grading, and ground disturbing activities.

Under the Treatment Plan, it is important for non-human, cultural resources and artifacts to be left at the Site to the greatest degree possible consistent with the location and configuration of the future Site. In addition, the Treatment Plan specifies the procedures to be implemented if human remains are encountered.

# 3 Identification of Removal Action Goals

The results of previous environmental investigations have indicated the presence of lead within select areas of the Western Nursery Area and in the vicinity of two drainage ditches, referred to herein as the Northwest Drainage Area and the Southern Drainage Area, at levels above state and federal risk guidelines that merit remediation. In addition, other COPCs (arsenic and DDT) have been identified in two areas within the Western Nursery Area. Therefore, surficial soil is the only medium of concern considered for removal action. Groundwater is not a medium of concern at this Site.

## 3.1 Lead

Lead was found in surficial levels within four areas within the Western Nursery Area that merit remediation with maximum concentrations in each area ranging from 460 to 920 mg/kg. Lead was found in sediment samples in the Northwest Drainage Area ranging from 630 to 1,800 mg/kg. Lead was detected within sediment samples in the Southern Drainage Area ranging from 23 to 3,800 mg/kg. This is above the 150 mg/kg California Human Health Screening for residential land use. Therefore, removal action is necessary in these areas to allow the proposed residential development of the Site. It is estimated that approximately 904 cubic yards of soil will be addressed by this removal action.

## 3.2 Removal Action Objectives

The goal of any removal action is to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threatened release that may result in the threat to human health or environment. The overall removal action goal for the Site is to prevent human exposure to the elevated levels of COPCs in surficial soils. Removal action objectives were identified to achieve this overall goal at the Site under the assumed future residential land use for the property. A Site-specific lead soil cleanup level for residential land use was derived using LeadSpread, an Excel spreadsheet used by DTSC to evaluate exposure and potential adverse health effects resulting from exposure to lead. The cleanup level for lead in surficial soil at the Site was calculated using the LEADSPREAD model, the DTSC default exposure assumptions (except for the exposure pathway of ingestion of homegrown produce where 3 percent was used instead of the default value of 7 percent), and using the goal of having 99% of the population below a blood lead level of 10 micrograms per deciliter. Using this model, the residential lead soil cleanup level for the Site is defined as 260 mg/kg.

# 4 Identification and Analysis of Removal Action Alternatives

## 4.1 Removal Action Alternatives

This RAW identifies and evaluates two removal action alternatives, in addition to a No Action alternative that serves as a baseline for comparison with the other alternatives. The EPA Document *Presumptive Remedy for Metals-in-Soil Sites, September 1999* served as a source for guidance in developing these alternatives.

Three removal action alternatives, including the No Action alternative, have been developed for analysis.

- Alternative 1: No Action;
- Alternative 2: Excavation and Soil Washing; and
- Alternative 3: Excavation and Off-Site Disposal (with Possible On-Site Encapsulation of Lead-Impacted Culturally Significant Resources) .

These alternatives were developed considering factors such as impact to the Site, implementability, cost, archaeological concerns, and future land use of the Site. In addition, there may be other potential federal and state action and cleanup standards that could apply to each alternative. These requirements may be triggered by removal actions, specific chemicals, or the physical location of the sites of removal action. Potential Federal and State action and Cleanup Standards are listed in Tables 9 and 10.

A brief description of each alternative and the rationale for selection or rejection of each is presented below.

### 4.1.1 Alternative 1 - No Action

Alternative 1 is the No Action Alternative. In this alternative, it is assumed that no removal action occurs. This alternative is included to provide a reference with which to compare the other alternatives that are developed.

### 4.1.2 Alternative 2 - Excavation, Consolidation and Soil Washing

Alternative 2 consists of excavating soils which are above the residential lead soil cleanup level from select areas of the Western Nursery Area and the Northern and Southern Drainage Areas (as described in Figure 3). Approximately 904 cubic yards of soil are expected to be excavated from these areas. After excavation, confirmatory samples would be collected to demonstrate that in-place concentrations are below the cleanup level. Per an agreement with the DTSC, confirmation sampling will include an evaluation of the CAM 17 metals. If needed, soil excavation and confirmatory sampling would continue until in-place concentrations are below the cleanup level. The excavated material would be isolated in a separate containment area on

the property. The soil would then be washed with a chemical solution designed to leach the lead from the soil. It is anticipated that the soil washing will concentrate the lead into a much smaller volume. Confirmation sampling of the treated soil would be used to determine the effectiveness of this alternative. Based on these laboratory results, the soil would either be used as backfill material, or would be disposed of at an off-site permitted landfill.

### 4.1.3 Alternative 3 – Excavation and Off-Site Disposal (with Possible On-Site Encapsulation of Lead-Impacted Culturally Significant Resources)

Alternative 3 consists of excavating soils which are above the residential lead soil cleanup level from select areas of the Western Nursery Area and the Northwest and Southern Drainage Areas (as described in Figure 3). Approximately 904 cubic yards of soil are expected to be excavated from these areas. After excavation, confirmatory samples would be collected to demonstrate that in-place concentrations are below the lead soil cleanup level. Per an agreement with the DTSC, confirmation sampling will include an evaluation of the CAM 17 metals. If needed, soil excavation and confirmatory sampling would continue until in-place concentrations are below the lead soil cleanup level.

As a result of the Treatment Plan, offsite disposal of culturally significant resources (such as Native American human remains, funerary objects, cultural and religious landscapes, ceremonial items, etc.), that may be present in excavated soil, is prohibited. If midden is encountered in excavated soils, the soil containing midden will be stockpiled separately and screened for culturally significant resources by appropriately-trained archaeologists and Tribal representatives. If culturally significant resources are identified, then these resources will be recovered from the midden and reburied on the Site. Prior to reburial onsite, these resources will be evaluated for the presence of lead. If it is likely that a significant amount of lead may be present, these resources will be tested for lead. If lead is present above the soil cleanup level or other applicable screening level, the resources will be reburied in an encapsulation area. If lead is not present above the soil cleanup level or other applicable screening level, then the resources will be reburied with any other resources recovered from non-COPC impacted areas at the Site. Excavated soil, including midden that does not contain culturally significant resources, will be isolated in a separate area of the Site pending coordination of disposal. Following acceptance by the off-site disposal facility, the excavated soil would then be transported to the off-site disposal facility.

The potential encapsulation area for culturally significant resources will be located in the northern portion of the future Camellia Drive at the northeast corner of the Site in an area beneath the street up to 40 feet long and 26 feet wide. The encapsulated culturally significant resources will be placed deep enough to be below all future utilities. The lead-impacted culturally significant resources that are to be encapsulated will be mixed with water and 8 to 10% cement by wet weight to immobilize lead. The top of the final lift of the encapsulation cell will be a minimum of 6 feet below the street subgrade (approximately 7 feet from the top of

pavement). Based on geotechnical borings, which have been drilled near the encapsulation area, the bottom of the encapsulation cell will be between 5 and 10 feet above the water table.

If any lead-impacted culturally significant resources are encapsulated onsite, a land use covenant (or deed restriction) may be implemented if deemed necessary by the DTSC to place restrictions on the disturbance of soil in the area of the Site with the encapsulated resources. The land use covenant will incorporate the requirements under California laws concerning disclosure of environmental conditions during property transfers, public and agency notification requirements, and annual inspection/reporting requirements. The land use covenant may include the following restrictions on the encapsulation area:

- The area shall not be used for a residence, a hospital for humans, a public or private school for persons under 21 years of age, or a day care center for children;
- No activities that will disturb the soil at or below approximately 7 feet below grade[2] shall be allowed without a Soil Management Plan approved by the DTSC in advance; and
- Any contaminated soils brought to the surface by grading, excavation, trenching or backfilling shall be managed in accordance with all applicable provisions of state and federal law.

The excavated areas within the Western Nursery, Northwest and Southern Drainage Areas would be backfilled with clean soil.

## 4.2 Screening Criteria

Each alternative is evaluated on the basis of three screening criteria: effectiveness, implementability and cost.

### 4.2.1 Effectiveness

The criterion examines the ability of each alternative to meet the removal action objectives, which are based on future site uses as residential housing. In this evaluation, the following criteria are considered:

- Overall protection of human health and the environment;
- Compliance with potential action and cleanup standards;

[2] Exact depth and elevation to be determined following encapsulation.

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment; and
- Short-term effectiveness (including protection of public health during implementation).

### 4.2.2 Implementability

This criterion examines the technical and administrative feasibility of implementing the removal action alternative. Items to be considered include the availability of various services and materials required during the implementation of the action, institutional or social concerns that could preclude the action, and State concerns that could impact implementation. In this evaluation, the following factors are considered:

- Technical feasibility: the ease or difficulty of implementing the alternative and the reliability of the technology;
- Administrative feasibility: activities needed to coordinate with other offices and agencies;
- State acceptance; and
- Community acceptance.

### 4.2.3 Cost

This criterion evaluates the estimated total cost of each alternative.

## 4.3 Alternative Evaluation

### 4.3.1 Alternative 1 - No Action

**Effectiveness**

This alternative is included to provide a baseline for evaluating the other alternatives. For this alternative, no further work would be performed at the Site. Because no removal action would be implemented as part of Alternative 1, overall human health and environmental risks in the near-term would remain the same if there were no development. Since the Site is proposed for residential land use, this is not an effective alternative. Moreover, impacted soil would remain in place indefinitely. Further evaluation of this alternative is not necessary.

### 4.3.2 Alternative 2 - Excavation, Consolidation, and Soil Washing

**Effectiveness**

This alternative is considered effective if high removal efficiencies are maintained. The process involves concentrating the COPCs into a much smaller volume. Though this process is effective, it may activate regulatory permitting requirements due to its on-site treatment component. Additionally, proper precautions must be taken to protect workers during the excavation and treatment of the soils. This process permanently reduces toxicity and mobility by removing metals from the soil. Soil washing concentrates the contaminants into a smaller volume. Because soil washing is more effective when metal concentrations are relatively high, it may not be viable for use in some cases.

**Implementability**

This process is applicable to a relatively narrow range of soil types and COPC combinations. Soils with high percentage of small particles (clay, silt, fines) are difficult to treat. Additionally, most extraction solutions are effective only for narrow range of metals and matrix combinations, and high removal efficiencies can be difficult to achieve.

This process also requires specialized equipment and properly trained labor. Washing fluids and vapors would need to be collected and treated properly to minimize the impact to workers and the surrounding environment.

**Cost**

An estimated 904 cubic yards of soil would be excavated from the affected areas. The estimated costs for this alternative include:

- Health and Safety Plan is estimated at $3,000;
- Excavation and consolidation is estimated at $9,000;
- Soil washing and disposal of the washing fluids is estimated at $180,000;
- Clean backfill material is estimated at $13,500;
- Confirmation sampling and analysis is estimated at $10,000; and
- Final reporting is estimated at $7,500.

The total estimated cost for this alternative is estimated at $223,000.

In addition, if soil washing fails to result in adequate COPC removal, the soil would need to be disposed of at an off-site permitted landfill or encapsulated onsite. The appropriate Class of landfill would be determined by samples collected for waste profiling.

- Off-site disposal to a Class I landfill is estimated at $226,000.

In this event, the total estimated cost for this alternative is estimated at $449,000.

### 4.3.3 Alternative 3 - Excavation and Off-Site Disposal (with Possible On-Site Encapsulation of Lead-Impacted Culturally Significant Resources)

**Effectiveness**

Alternative 3 would provide overall protection of human health and the environment and comply with environmental guidelines. This alternative would meet the removal action objective of being protective of human health and the environment with respect to chemicals present in soil and would provide long term effectiveness. It must be noted however, that although the contaminated soil is removed from the subject Site, by transferring the soil to a landfill, the overall volume of contamination is not reduced through this alternative.

Implementability

The techniques used to excavate and dispose of the soil are well established and the equipment, materials, and labor are readily available. In addition, dust control equipment and air monitoring equipment and procedures are well established and readily available to ensure that the work can be done safely. There would be no technical restrictions to implementation because the soil is shallow and there are no above-ground obstacles.

Permits may be required for excavation and grading. There are no known administrative restraints to the implementation of this alternative.

**Cost**

Approximately 904 cubic yards of soil would be excavated from the affected areas. The estimated costs for this alternative include:

- Health and Safety Plan is estimated at $10,000;
- Excavation is estimated at $25,000;
- On-site encapsulation, if needed, is estimated at $15,000;
- Air and archaeological monitoring is estimated at $60,000;
- Off-site disposal to a Class I landfill is estimated at $150,000
- Confirmation sampling and analysis is estimated at $10,000;
- Clean backfill material is estimated at $13,500; and

- Final reporting is estimated at $15,000.

The total estimated cost for this alternative is estimated at $ 298,500.

# 5 Comparative Analysis of Removal Action Alternatives

The comparison of removal action alternatives is described below.

## 5.1 Effectiveness

Alternative 3 is considered the most effective removal action choice for protecting the health of future construction workers, business employees and residents from the COPC-impacted soils found at the Site. Alternative 2 could be effective, but it would require special precautions to protect human health and the environment from the soil washing vapors. Moreover, Alternative 2 may not be effective at washing the COPCs from this soil, due to the soil type and relatively low COPC levels.

## 5.2 Implementability

There are no administrative or technical requirements precluding implementation of Alternative 3, Excavation and Off-Site Disposal (with Possible On-Site Encapsulation of Lead-Impacted Culturally Significant Resources). Excavation and construction equipment is readily available to remove, dispose of lead-impacted soil and encapsulate, if necessary, COPC-impacted culturally significant resources. It is estimated that the excavation would be completed within a one to two week period. The implementability of Alternative 2 may be impacted by the type of soil at the Site. Additionally, the high removal efficiency needed to properly remove the COPCs from the impacted soil may be difficult to achieve with Alternative 2.

## 5.3 Cost

Costs for each Alternative are summarized above. Alternative 2 is estimated at $223,000-$449,000 and Alternative 3 is estimated at $155,500.

# 6 Recommended Removal Action Alternative

Removal Action Alternative 3, Excavation and Off-Site Disposal (with Possible On-Site Encapsulation of Lead-Impacted Culturally Significant Resources), is the selected removal action alternative for this Site. This alternative was selected based upon its ability to meet the removal action objectives and address archaeological concerns, ease of implementation and cost. This alternative is protective of human health and the environment, and complies with regulatory cleanup criteria including archaeological concerns.

After approval of the final Removal Action Workplan, LHP will submit a detailed Implementation Workplan and schedule for implementation of the recommended removal action alternative. This Workplan will include a site specific Health and Safety Plan which will set forth procedures to be followed during earthmoving activities at the Site. Additionally, a site-specific Sampling and Analysis Plan (SAP) will be prepared outlining confirmation soil sampling activities.

# 7 References

Code of Federal Regulations (CFR). 1997. Title 40, *Environmental Protection Agency (EPA). National Oil and Hazardous Substances Pollution Contingency Plan.* July 1, 1997, Parts 261-268, (40 CFR S 261 et. seq.).

ENSR International (ENSR). 2001. *Niven Nursery, 2 Ward Street, Larkspur California. Soil and Groundwater Sampling and Analysis Report.*

ENVIRON International Corporation (ENVIRON). 2002. *Health-Based Risk Assessment for Niven Nursery, Larkspur, California,* February.

Geopacific Corporation. 1996. *Environmental Site Assessment Report, 2 Ward Street, Larkspur, California.* January.

Harza Engineering Company, Inc. (Harza). 1998. *Phase I Site* Assessment *and Initial* Phase *II* Assessment, Oakland, CA. October.

Holman, Miley Paul. 2007. *Results of Preliminary Archaeological Investigations at CA-MRN-67 and CA-MRN-68 on the Niven Nursery Property, 2 Ward Street, Marin County, California*. January.

Stevens, Ferrone & Bailey (SFB). 2008. *Updated Geotechnical Investigation, Rose Garden Residential Development, Larkspur, California*. January 17.

United States Environmental Protection Agency (USEPA). 1999. *Presumptive Remedy for Metals-in-Soil Sites.* November.

USEPA. 2000. *Region 9 Preliminary Remediation Goals (PRGs) 2000.* San Francisco, CA.

USEPA Department of Toxic Substances Control (DTSC). 2001. *Information Advisory Clean Imported Fill Material.* October.

# 8 Administrative Record List

| | |
|---|---|
| DocDate: | 1998 |
| DocType: | Report |
| Title/Summ: | Phase I Site Assessment and Initial Phase II Assessment, Niven Nursery, Larkspur, California |
| Author/Aff: | Harza Engineering Company, Inc. |
| Recip/Aff: | Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2000 |
| DocType: | Memorandum |
| Title/Summ: | Voluntary Cleanup Agreement for Niven Nursery, Docket No. HSA-A99/00-135 |
| Author/Aff: | California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) |
| Recip/Aff: | Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2000 |
| DocType: | Report |
| Title/Summ: | Quality Assurance Project Plan, Niven Nursery, Larkspur, California |
| Author/Aff: | ENSR Corporation |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2000 |
| DocType: | Report |
| Title/Summ: | Sampling and Analysis Plan, Niven Nursery, Larkspur, California |
| Author/Aff: | ENVIRON Corporation |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2001 |
| DocType: | Report |
| Title/Summ: | Soil and Groundwater Sampling and Analysis Report for Niven Nursery, Larkspur, California |
| Author/Aff: | ENSR Corporation |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2002 |
| DocType: | Report |
| Title/Summ: | Health-Based Risk Assessment for Niven Nursery, Larkspur, California |
| Author/Aff: | ENVIRON Corporation |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |

| | |
|---|---|
| DocDate: | 2002 |
| DocType: | Report |
| Title/Summ: | Draft Removal Action Work Plan (Draft RAW) for Niven Nursery, Larkspur, California |
| Author/Aff: | ENSR Corporation |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2003 |
| DocType: | Fact Sheet |
| Title/Summ: | Fact Sheet, Comment Period, Niven Nursery Draft Removal Action |
| Author/Aff: | Workplan (Draft RAW) |
| Recip/Aff: | DTSC |
| FileLoc: | DTSC/Interested Parties |
| | DTSC |
| | |
| DocDate: | 2003 |
| DocType: | Public Notice |
| Title/Summ: | Notice of Public Comment Period, Draft Removal Action Workplan (Draft RAW), Niven Nursery Project Site, 2 Ward Street, Larkspur, California |
| Author/Aff: | DTSC |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2007 |
| DocType: | Report |
| Title/Summ: | Results of Preliminary Archaeological Investigations at CA-MRN-67 and CA-MRN-68 on the Niven Nursery |
| Author/Aff: | Holman And Associates |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |
| | |
| DocDate: | 2008 |
| DocType: | Report |
| Title/Summ: | Updated Geotechnical Investigation, Rose Garden Residential Development, Larkspur, California |
| Author/Aff: | Stevens, Farrone & Bailey |
| Recip/Aff: | DTSC |
| FileLoc: | DTSC |
| DocDate: | 2009 |
| DocType: | Memorandum |
| Title/Summ: | Responsiveness Summary for Draft Removal Action Workplan, Niven Nursery Site, Larkspur, California |
| Author/Aff: | DTSC |
| Recip/Aff: | DTSC/Interested Parties |
| FileLoc: | DTSC |

**Appendix A:**
**Draft Removal Action Workplan**
**Niven Nursery, 2 Ward Street, Larkspur, California,**
**Prepared by ENSR Corporation**
**dated March 14, 2002**

# Appendix B:
# Responsiveness Summary
# For Draft Removal Action Workplan
# Niven Nursery Site, Larkspur, California
# prepared by DTSC

# Appendix C:
## California Environmental Quality Act Statement of Findings