

CSMRI Site Flood Plain Characterization Work Plan

1. Introduction

The S.M. Stoller Corporation (Stoller) prepared this work plan on behalf of Colorado School of Mines (School). This work plan is an addendum to the Site Final Site Characterization Work Plan dated May 12, 2006, and will address work to be conducted in the Clear Creek flood plain, which was not addressed in the original Site work plan. The scope of work includes vegetation removal, access road construction, and segregation of contaminated soil to existing stockpiles.

This work plan will be submitted to the Colorado Department of Public Health and Environment for approval prior to conducting the characterization work described in this work plan.

The CSMRI Site has a Radioactive Materials License (Number 617-01). The CSMRI site characterization work will be completed under the Stoller Radioactive Materials License (Number 1094-01) and the Stoller Radiation Safety Officer, Stacey Alderson.

The Site is bounded on the north by Clear Creek and consists of an upper and lower terrace. The lower terrace is the active flood plain of Clear Creek and the focus of this characterization effort. The upper terrace was the subject of a characterization effort in June through August 2006, under which segregated soils impacted with metals and radioisotopes were placed into stockpiles located on the southern portion of the site. A settling pond formerly located on the west side of the flood plain was cleaned up and closed by the U.S Environmental Protection Agency in 1997 as part of an Emergency Removal Action under CERCLA.

In the vicinity of the site, the 100-year flood elevation is 5,682 feet. The elevation of the lowest point of the site is approximately 5,670 feet (former settling pond area next to Clear Creek), which is in the flood plain. Figure 1 shows the location of the flood plain portion of the Site.

Stoller conducted a Wetlands Delineation Study in July 2006. The report from that study is included in Appendix A. The study was conducted to determine if the area qualifies for wetland status and would therefore need additional controls, possibly including a U.S. Army Corps of Engineers' Section 404 permit, to conduct soil segregation. The results indicated that based on soil, vegetation, and hydrology, some of the flood plain is categorized as a wetland. However, based on Section 404 Permit guidance, provided in Appendix B, no permit will be required, because the following guidelines will be followed:

- No fill material will be placed within the wetlands.
- Soil to be excavated will be scooped out rather than pushed or bulldozed.
- The temporary access road will not be constructed in the wetlands.

2. Existing Flood Plain Characterization Data

Data collected during the original RI/FS in 2004 indicated elevated concentrations of Ra-226 on the flood plain east of the former settling pond. All other site COPCs were below the regulatory

limits. The sample numbers are CSM155 through CSM161. Additional samples were collected in September 2006 at 15 locations in the flood plain. At 10 of these locations, surface samples were collected, and at five locations samples were collected at the surface and at 6-inch intervals until rock, roots, or water was encountered. These sample locations are shown in Figure 2, and the sample results are shown in Table 1. Samples were analyzed by a shielded-sodium iodide detector, identical to that used for site characterization activities in June through August 2006.

Table 1
Flood Plain Sample Results

Sample Location	Depth (Inches)	Sample Number	Ra-226 (pCi/g)
1	0	1207	3.81
2	0	1208	4.00
3	0	1211	5.70
4	0	1212	2.29
4	6	1213	2.50
4	12	1214	2.60
4	18	1229	4.65
4	24	1230	3.69
4	36	1231	2.18
5	0	1216	3.05
5	6	1217	3.04
5	12	1218	2.99
5	18	1219	3.23
6	0	1215	2.93
7	0	1209	4.19
8	0	1225	3.68
9	0	1202	8.23
10	0	1203	5.15
10	6	1204	6.27
10	12	1205	6.60
10	18	1206	7.18
10	24	1226	3.14
10	36	1227	3.90
10	48	1228	2.61
11	0	1201	4.81
12	0	1197	9.71
12	6	1198	8.60
12	12	1199	6.32
12	18	1200	5.07
13	0	1210	4.72
14	0	1224	2.36
15	0	1220	1.11
15	6	1221	3.73
15	12	1222	2.67
15	18	1223	3.07
CSM155			4.90
CSM156			20.00

Table 1
Flood Plain Sample Results

Sample Location	Depth (Inches)	Sample Number	Ra-226 (pCi/g)
CSM157			4.70
CSM158			9.30
CSM159			28.00
CSM160			5.00
CSM161			8.60

3. Objectives and Approach

The characterization effort described herein focuses on determining the extent of Ra-226 impacts to the eastern flood plain area and relocating impacted soil to the existing soil stockpiles located to the south. This effort will follow procedures detailed in the Site characterization work plan.

4. Field Preparation

Stoller will work with the City of Golden to ensure appropriate storm water controls are in place prior to disturbing soil on the flood plain. A modification to the existing site stormwater permit will be prepared that details the controls, inspection schedule, revegetation, and site stabilization. At a minimum, silt fencing will be installed around the perimeter of the work area.

Vegetation within the limits of the planned soil excavation as well as vegetation impeding access will be removed from the Site and disposed of properly. Every effort will be made to preserve large native trees. None of this activity requires a 404 permit.

Access to the flood plain will be established to provide truck access for the vegetation removal and soil segregation. Impact to the area will be minimized as much as possible to reduce potential storm water runoff concerns. Underground utilities will be located, and the access road will be sited to avoid underground utilities. The lower-most portion of the flood plain is wetlands. Because of this status, no fill will be placed on this portion of the site during road construction, and no part of the road will be built in the wetlands. The specific location of the access road will be determined by the contractor, taking into account ease of installation and road stability, while keeping the road out of the wetlands. A

After activities are completed, the access road will either be removed and the area stabilized or it will be left in place.

5. Soil Segregation

Soil segregation will be completed following the procedures described in the Site characterization work plan. Because existing data for the floodplain indicate only Ra-226 exceeds regulatory guidelines as well as site tentative DCGLs, Ra-226 will be the only compound analyzed for during segregation work. A shielded sodium iodide detector set up in the onsite trailer will be used to count every field sample collected during this effort.

The tentative extent of initial soil excavation is shown in Figure 3. The initial soil segregation is based on existing data. After this soil is segregated into the appropriate stockpile as described in the Site characterization work plan, field testing will determine the need for further segregation

of soil. Soil excavated from the site, based on existing data, will be transported to stockpile B, unless field data indicate that is not appropriate. Due to the sensitive nature of the wetlands area, soil will be removed from the site by scooping it up. No dozer work or other soil pushing will be allowed within the wetlands.

Initially, a GPS will be used to locate the previous sample points and approximate boundaries of the areas with elevated Ra-226 shown in Figure 3. These areas will be marked on the ground with paint. The field gamma instrument will then be used to locate the area(s) of highest activity within and near the boundaries of these marked areas. Soil samples will be collected from the highest activity areas and from areas of lower activity surrounding the high activity areas, in an attempt to delineate the material requiring segregation to the stockpile. Based on the onsite lab sodium iodide results exceeding the site action level for Ra-226, areas requiring excavation will be marked on the ground with paint, and the material will be excavated in approximately 6-inch lifts and placed in the stockpile.

Following initial soil sampling, onsite lab sodium iodide analysis, and subsequent soil segregation to the stockpile, each area will be resurveyed using the field gamma instrument. If any readings exceed the site field gamma action level (approximately 40,000 counts per minute), then soil samples will be collected from the highest activity areas and from areas of lower activity surrounding the high activity areas, in an attempt to delineate the material requiring segregation to one of the stockpiles, as before. If no readings exceed the site field gamma action level, then one or more samples will be collected to confirm whether or not the area meets the site action level. Soil will continue to be excavated in approximately 6-inch lifts based on the field lab sodium iodide results, followed by subsequent rounds of sample collection conducted in the same manner. This procedure will be repeated until field lab sodium iodide readings are below the site action level for Ra-226 of 4.14 pCi/g.

6. Confirmation Sampling

After soil requiring segregation is removed from the flood plain, confirmatory samples will be collected using VSP to guide sample locations and frequency. Approximately 25 percent or a minimum of eight confirmatory samples will be sent to an offsite laboratory for analysis of Ra-226.

7. Health and Safety Control

Health and safety control will be conducted in accordance with the Site characterization work plan. The only deviations from this plan are the two permanent site air monitoring stations that have been relocated to near the soil stockpile, and they will remain there during the flood plain characterization. No temporary air monitors are planned for the flood plain area. The air monitoring conducted during June through August 2006 indicated that the results were an order of magnitude below the Colorado effluent concentration limits for the radionuclides of concern on the Site. The maximum Ra-226 observed in the flood plain area is well below the maximum observed on the rest of the Site, and the flood plain soil has higher moisture content. Additional water from fire hydrants will be applied as necessary for dust control.

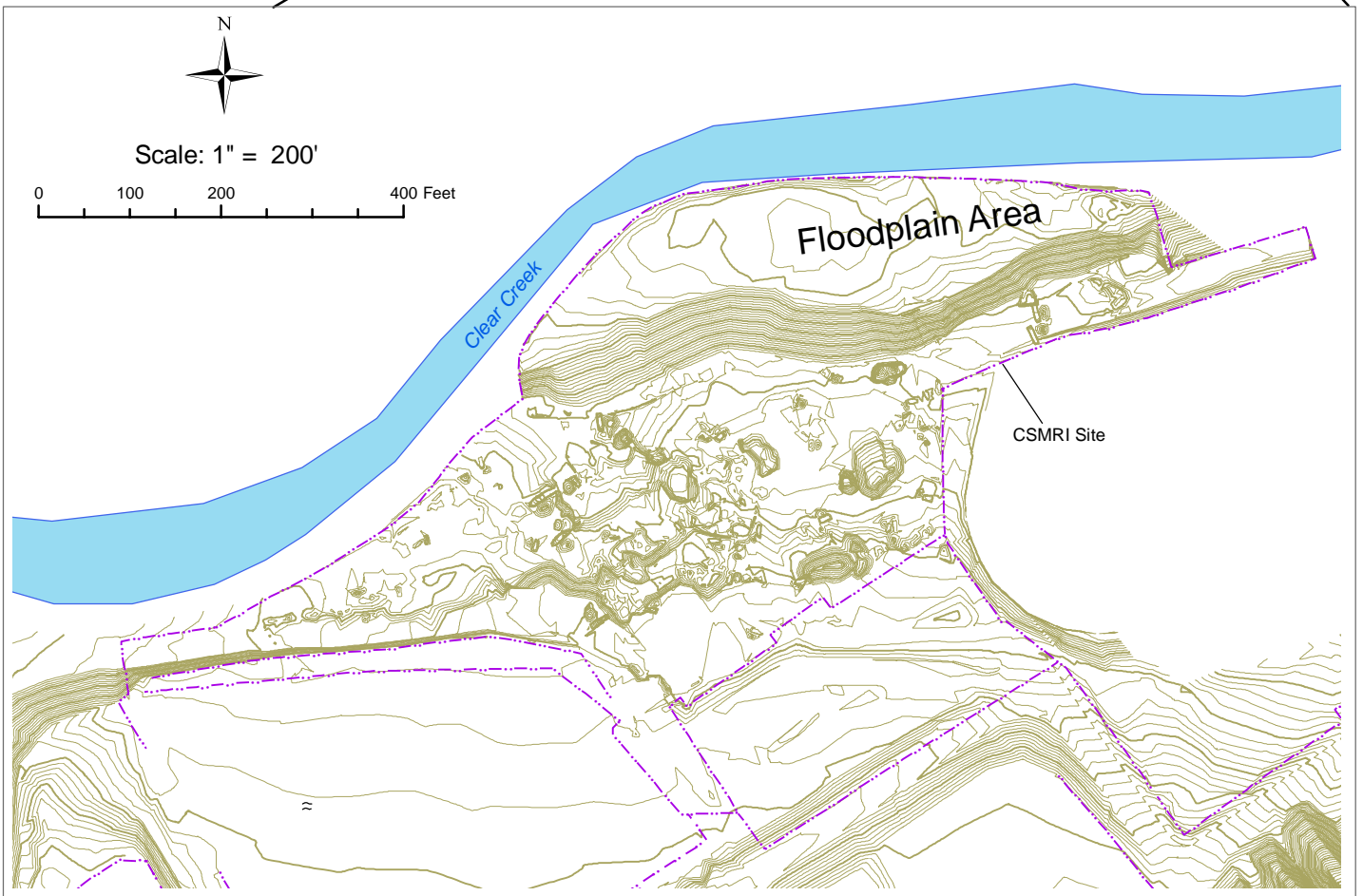
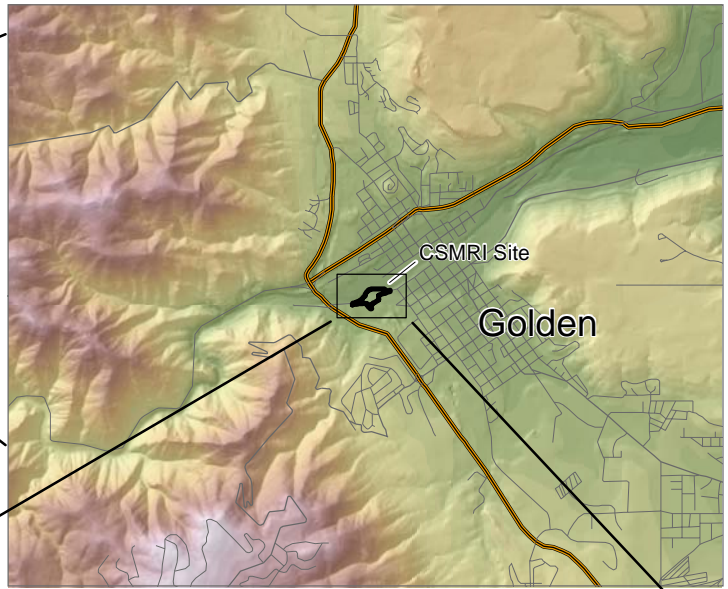
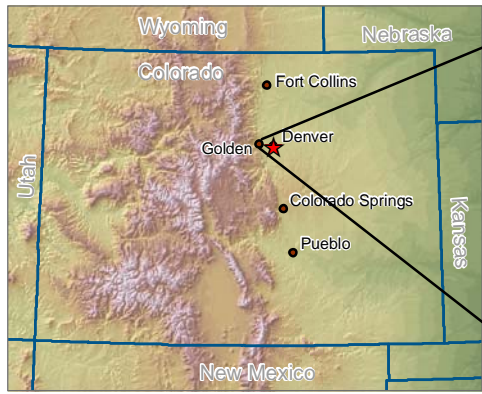


Figure 1

Flood Plain Area
Location Map

Explanation

-  CSMRI Site
-  Fences
-  Topography (1 ft Intervals)
-  Topography (5 ft Intervals)



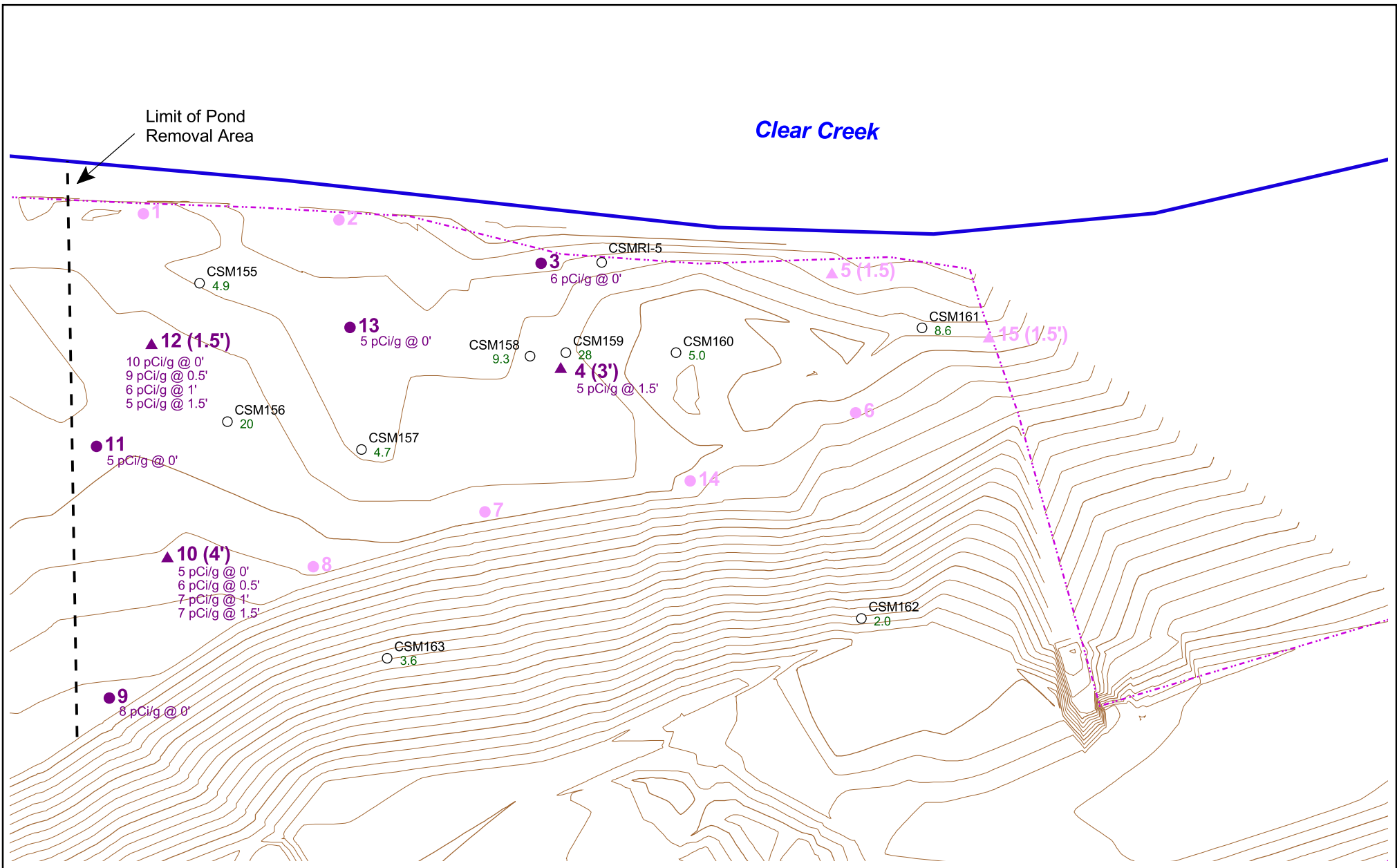
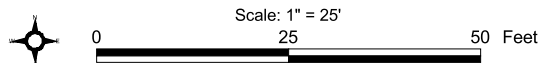


Figure 2

Flood Plain Sample Locations

Explanation

- ▲ Surface and Subsurface Sample Location
- Surface Sample Location
- ▲ Surface and Subsurface Sample Location Ra-226 >= 5 pCi/g
- Surface Sample Location Ra-226 >= 5 pCi/g
- New Horizons Sample Location with Ra226 Concentration
- ⋄ Fences
- Topography (1 Foot Contour Interval)
- ⚡ Riverbank



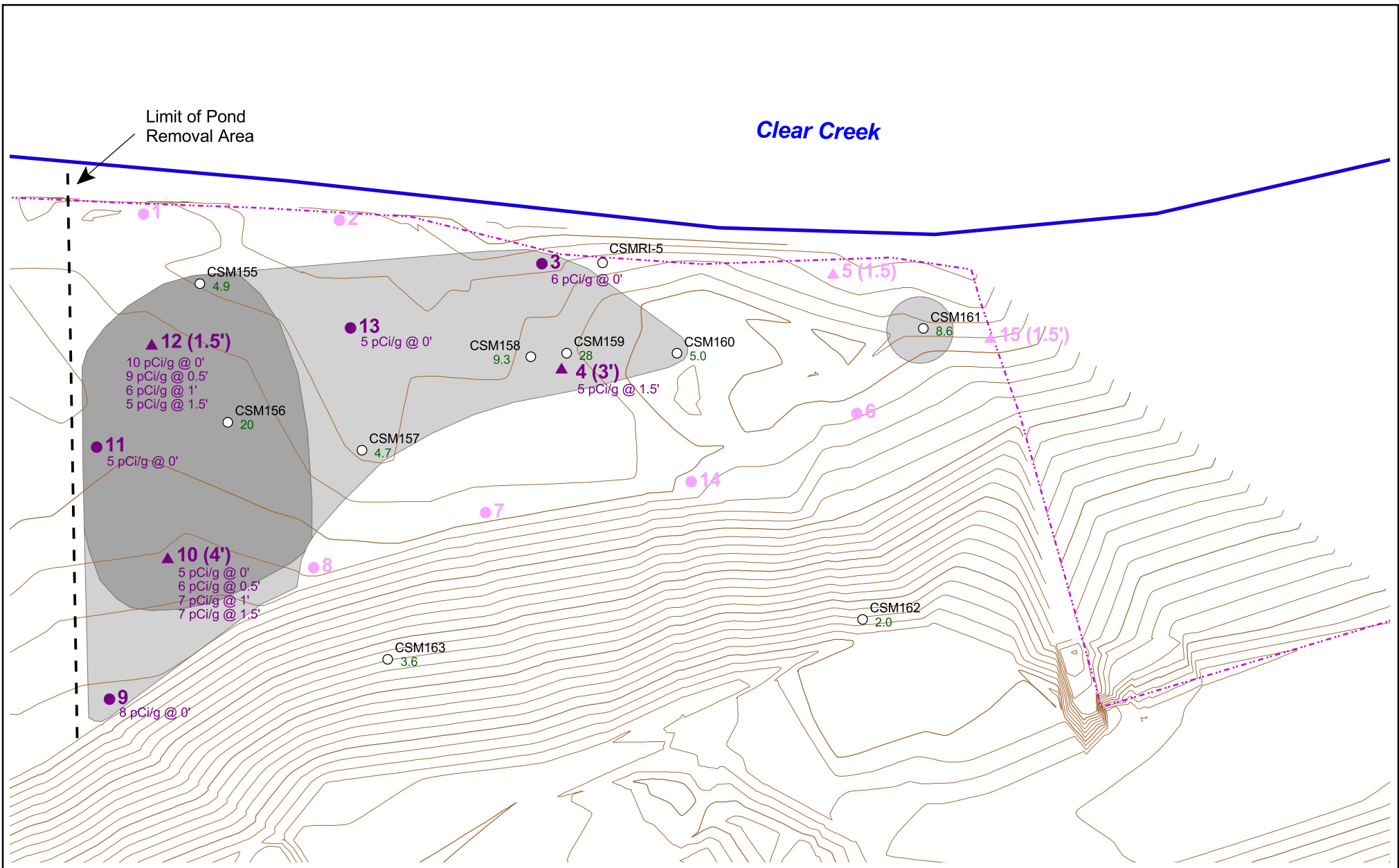
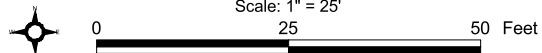


Figure 3

Initial Soil Removal

Explanation

- ▲ Surface and Subsurface Sample Location
- Surface Sample Location
- ▲ Surface and Subsurface Sample Location Ra-226 \geq 5 pCi/g
- Surface Sample Location Ra-226 \geq 5 pCi/g
- New Horizons Sample Location with Ra226 Concentration
- ▨ Fences
- Topography (1 Foot Contour Interval)
- ▬ Riverbank
- Initial Soil Removal 0-6"
- Initial Soil Removal 0-18"



APPENDIX A

**Wetland Delineation Report
July 6, 2006**

Wetland Delineation, Golden, CO
July 6, 2006

The S.M. Stoller Corporation requested a wetland delineation to be conducted on a small rad-contaminated area in Golden, Colorado to decide whether or not the area qualified for wetland status and would therefore need permitting from the U.S. Army Corps of Engineers to continue soil removal on the site. On July 6, 2006, the survey was conducted and findings are as follows:

Wetland delineation is based on three different parameters: soil, vegetation, and hydrology. Hydrologic characteristics of wetlands are periodic inundation or saturated conditions near to the soil surface during a portion of the growing season. Both conditions persist in the area where sample point B is located. GPS points E, F, and G are also located in saturated soil conditions (Appendix A). GPS points A, D, and C may have saturated conditions at some point during the season or in wet years but not for long enough duration to facilitate wetland soil or vegetation.

Three soil pits were dug in the area, as shown on Appendix A. Typically, a county soil survey will show if the soil is a wetland or possible wetland soil before the site is visited. In this case, the area has been altered a number of times due to its proximity to the town of Golden, Colorado and Clear Creek, and being a part of the Colorado School of Mines. At least one soil removal exercise was conducted by the state to extract heavy metals in the area. The soil in pits A and C is lacking structure partially because it has been disturbed in the recent past. Pit B has a mucky texture in part because it is inundated or saturated to the soil surface for much of the year. The wetland status is indicated by a matrix chroma of 2 or less and the presence or absence of mottles.

Table 1
Soil pit information

Soil Point	Depth	Texture	Body Color	Mottles	Wetland Soil
A	10 in.	Crumbly	10 YR 3/2	Few, small	Possibly
B	6 in. to water	Mucky	2.5 YR 4/1	5 YR 4/4	Yes
C	8 in.	Crumbly	10 YR 3/2	No	No

The principal area of concern is that around sample point C. There is evidence in that area that surface water has been present at some point this spring. However, it hadn't lasted long enough for any wetland vegetation growth in the inundated area. The matrix color indicates that the soil could be a wetland soil based on the matrix chroma (2); however, there was no evidence of redoximorphic features, aka mottles in the examined sample. The soil would have to have a matrix chroma of 1 with no mottles or 2 with mottles. This sample demonstrated a 2 with no mottles and will not qualify as a wetland soil in most average conditions.

Wetland vegetation is any plant that grows in conditions that are periodically deficient in oxygen as the result of excess water content (WTI, 2003). The most common species are documented and the wetland indicator status is reviewed for each species in the correct region for the area in question. Golden, Colorado lies right on the border between wetland regions 8 and 5. In this case, both regions as well as a general community type description were used in making the

wetland determination. The following tables represent the most dominant species at each point where the soil was also sampled (Sample points A, B, and C).

Many of the plants listed in the tables are listed as either NA or NI or NO. NA refers to there being no available information pertaining to the wetland status of the species. Most often that is because the plant is an upland species in every region. NI refers to no indication. Whether or not the plant lives in wetland conditions has not been documented in this case. NO means the plant is not a wetland species. The indicator categories of those plants with a wetland status follow in Table 2 (WTI, 2003).

Table 2
Plant indicator status

Indicator Category	Symbol	Probability of Occurrence in Wetlands
Obligate	OBL	>99%
Facultative Wetland	FACW	67-99%
Facultative	FAC	34-66%
Facultative Upland	FACU	1-33%
Obligate Upland	UPL	<1%

Each symbol may carry a plus or minus behind the code to further narrow the preferred habitat of each species dependant on the region.

Table 3
Dominate vegetation for sample point A

Scientific Name	Common Name	Strata	Wetland Indicator Status Region 8	Wetland Indicator Status Region 5
<i>Populus deltoides</i>	Eastern cottonwood	Tree	FACW	FAC
<i>Salix amygdaloides</i>	Peachleaf willow	Tree	FACW	FACW
<i>Salix calcicola</i>	Woolly willow	Shrub	NA	NA
<i>Salix exigua</i>	Narrowleaf willow	Shrub	OBL	OBL
<i>Glycyrrhiza lepidota</i>	American licorice	Herb	FAC-	FACU
<i>Hordeum jubatum</i>	Foxtail barley	Herb	FAC	FACW
<i>Thinopyrum intermedium</i>	Intermediate wheatgrass	Herb	NA	NA
<i>Calamagrostis rubescens</i>	Pinegrass	Herb	NA	NA
<i>Juncus balticus</i>	Baltic rush	Herb	FACW	OBL

Sample point A was located on a borderline area between obvious wetland (inundation) and a questionable upland. Some of these species overlap into sample point B that is a definite wetland. Sample point A is the dividing line between two community types and is showing some overlap.

Table 4
Dominate vegetation for sample point B

Scientific Name	Common Name	Strata	Wetland Indicator Status Region 8	Wetland Indicator Status Region 5
<i>Populus deltoides</i>	Eastern cottonwood	Tree	FACW	FAC
<i>Salix amygdaloides</i>	Peachleaf willow	Tree	FACW	FACW
<i>Salix exigua</i>	Narrowleaf willow	Shrub	OBL	OBL
<i>Schoenoplectus acutus</i>	Hardstem bulrush	Herb	OBL	OBL
<i>Eleocharis obtusa</i>	Blunt spikerush	Herb	OBL	OBL
<i>Agrostis gigantean</i>	Redtop	Herb	NI	NI

Sample point B was located in the saturated soil area. The soil indicated a wetland and the vegetation is also indicative of a wetland. Sample point B plus the GPS points E, F, and G all fall in this wetland area. It will lend itself to a topographic line on a map and should have fairly distinct borders based on the presence of the bulrush and spikerush.

Table 5
Vegetation for sample point C

Scientific Name	Common Name	Strata	Wetland Indicator Status Region 8	Wetland Indicator Status Region 5
<i>Populus deltoides</i>	Eastern cottonwood	Tree	FACW	FAC
<i>Salix amygdaloides</i>	Peachleaf willow	Tree	FACW	FACW
<i>Ulmus pumila</i>	Siberian elm	Tree	NA	NA
<i>Ribes aureum</i>	Golden current	Shrub	FACW	NO
<i>Rubus parviflorus</i>	Thimbleberry	Shrub	FAC	NO
<i>Prunus virginiana</i>	Choke cherry	Shrub	FACU	FACU
<i>Clematis ligusticifolia</i>	Western white clematis	Vine	FACU	FACU
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Vine	NO	FAC
<i>Bromus inermis</i>	Smooth brome	Herb	NA	NA
<i>Calamagrostis rubescens</i>	Pinegrass	Herb	NA	NA
<i>Cirsium ssp.</i>	Unknown thistle	Herb	NA	NA
<i>Saxifraga ssp.</i>	Unknown saxifrage	Herb	NA	NA

Two of the species listed in the table for sample point C are unknown. The thistle is likely a noxious weed as it was only dominate in the disturbed areas. Most thistles do not have a wetland indicator status because they are considered invasive and very few are native and even fewer are wetland species. The *Saxifraga ssp.* is unknown because it was not mature enough to key to a specific species. None of the plants were flowering or had set seed which is necessary in order to select a species. Because they are unknown, the indicator status is NA.

Sample point C is located within about 20 feet of Clear Creek. The water level in a well in the close vicinity (within 10 feet of the soil pit) shows the water table to be located at about 2 feet below the surface. Many of the facultative wetland and obligate wetland species have root depths easily accessing the two foot water table. This water table is probably stable for most of the growing season as Clear Creek flows through Golden, Colorado and is channelized to prevent flooding in most cases. If the herb and vine species were wetland species, the area

would still be a borderline wetland as the soil did not reach wetland parameters. However, since the vegetation is about 50/50 wetland species to upland species, the area would not be considered a wetland.

The topography of the area is going to make soil extraction from sample point C very difficult without disturbing the wetland associated with sample point B. Another concern for the area surrounding point C is the proximity to Clear Creek and the depth to ground water. A permit from the U.S. Army Corps of Engineers may be required in order to remove soil that is below the water table connected to the Clear Creek hydrology. However, sample point C is not itself a wetland but could become one with the removal of enough soil to change the hydrology of the area.

REFERENCES

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APPENDIX B

U.S. Army Corps of Engineers' Section 404 Guidance

**US Army Corps of Engineers' Section 404 Guidance
Sediment and Vegetation Removal in Colorado Stream Channels and Floodplains
May 2005**

As part of the Clean Water Act, the US Army Corps of Engineers regulates the placement of dredged or fill material in jurisdictional waters of the U.S. Removal of vegetation or sediment from streams and floodplains may require a Section 404 Permit from the US Army Corps of Engineers as follows:

1. Any work that includes the placement of dredged or fill material (such as dirt, rocks, concrete, etc.) in the stream or in adjacent wetlands.
2. Any work that requires placement of a temporary access road in the stream or adjacent wetlands.
3. Any use of bulldozer or other plowing/pushing type equipment in the stream or wetlands.

Section 404 Permits may not be required for activities related to the removal of vegetation and/or sediment as follows:

1. Cutting of vegetation and removal to an upland site. This can include use of brush hogs or mowers, or hand cutting of vegetation.
2. Scooping and removal of vegetation/sediment material with a front-end loader or other scooping equipment, as long as material falling out of the scoop into the stream or drainage is minimal.
3. Hauling vegetation/sediment material to an upland site or hauling the material to adjacent uplands, as long as material falling into the stream or drainage is minimized.
4. Burning vegetation on site does not require a Section 404 Permit.

Contact and other permitting information from your local US Army Corps of Engineers Regulatory Office within Colorado can be found at <https://www.nwo.usace.army.mil/html/od-tl/coloreg-home.htm>.