U.S. Environmental Protection Agency

Region VIII

RECORD OF DECISION

Smuggler Mountain
Pitkin County, Colorado

September 1986

RECORD OF DECISION
SMUGGLER MOUNTAIN

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ONE DENVER PLACE — 999 18TH STREET — SUITE 1300
DENVER, COLORADO 80202-2413

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

SITE

Smuggler Mountain
Pitkin County, Colorado

DOCUMENTS REVIEWED

I am basing my decision primarily on the following documents describing the analysis of the cost and effectiveness of remedial alternatives for the Smuggler Mountain Site:

-Smuggler Mountain Remedial Investigation/Feasiblity Study
Fred C. Hart Associates, March 1986

-Smuggler Mountain Endangerment Assessment
Clement Associates, May 1986

-Smuggler Mountain Focused Feasibility Study
Fred C. Hart Associates, July 1985

-Smuggler Mountain Addendum to Remedial Investigation/Feasibilty Study
Camp, Dresser and McKee, May 1986

-Hunter Creek Soils Investigations and Corrective Measure Recommendations
Engineering Science, 1985

-Final Technical Oversight Report, Activities 11/84 - 3/86, for the Smuggler Mountain Site
Camp, Dresser and McKee, August, 1986

-Issues Abstract for Smuggler Mountain Record of Decision,
Clemmens, September 1986

DESCRIPTION OF SELECTED REMEDY

I have carefully reviewed and considered all the information, the alternatives analysis, and the public comments pertaining to the selection of a remedy for the Smuggler Mountain Site. Based on my review, I have determined that the following actions at the Smuggler Mountain Site will effectively mitigate and minimize damage to and provide acceptable protection of the public health, welfare, and the environment. This determination is made by the Regional Administrator of Region VIII consistent with the delegation of authority for remedy selection dated May 6, 1986.

SELECTED ALTERNATIVE:

The selected alternative is separated into two operable units. The first operable unit addresses the Smuggler site and does not include the reclamation of the actual Smuggler Mine portion of the site. A second operable unit will address the mine reclamation work and will consider ground- and surface-water response actions if the results of ground water monitoring during the first operable unit indicate that such actions are appropriate.

Operable Unit 1 - Site Remedy:

A. Source Isolation of High-Level Wastes.

Create an on-site repository on County-owned property to permanently dispose of the high-level wastes (over 5,000 ppm lead) excavated from the site. The repository will be under the perpetual care of a permanent entity, Pitkin County, to assure the permanent disposition of the contaminants. Consolidate all-high level wastes from the site (excluding the mine site) in the repository. Cap the repository with a multi-layer, stable cap that meets RCRA performance standards for in-place closure (40 CFR Part 264, Subpart N).

B. Source Isolation of Low-Level Wastes.

Isolate all low-level wastes (defined as areas with soil lead concentrations of between 1,000 and 5,000 ppm lead) by capping in place with 6-12 inches of clean topsoil and revegetating.

C. Increase Ground-Water Monitoring.

Monitor ground water quarterly on-site for a period of five (5) years to determine efficacy of the caps in enhancing ground-water quality. Quarterly reports to EPA will describe the results of monitoring and note any trends observed. Monitoring results and reports will be used to determine if further response actions are required.

D. Alternate Water Supply.

Provide a permanent, alternate, water supply by closing ground-water wells for 5-7 residences and connecting the residences to the existing public water supply.

E. Operation and Maintenance of Low- and High-Level-Waste Caps.

Periodically inspect caps to note and repair any deterioration, disturbance, or discontinuity to prevent cap failure. Weekly inspections are anticipated during the first year. Bi-monthly inspections will take place for the second year. After two years, inspections will be conducted monthly. From the beginning of the fourth year, quarterly inspections will be conducted for the next twenty-six years.

Operable Unit 2 - Mine Reclamation and Possible Ground-Water Corrective Action:

A. Addendum to Remedial Investigation and Feasibility Study (RI/FS).

An addendum to the existing RI/FS will be prepared to characterize the nature and extent of contamination and determine the appropriate extent of remedy at the Smuggler-Durant Mine site. This addendum will be prepared in accordance with the National Contingency Plan. The Smuggler Mine RI/FS will be subject to public comment prior to selection of a remedy.

B. Possible Ground-Water Corrective Action.

Current water quality data do not justify action, and ground-water conditions are expected to improve after operable unit one is implemented. However, ground-water monitoring results from the first operable unit will be used to determine if ground-water response actions need to be implemented. This determination will be made in a subsequent decision document.

C. Performance of Remedy.

Perform remedy as approved by EPA in a subsequent decision document. Such remedy will include reclamation of the mine site and, if determined to be necessary, ground-water corrective action.

DECLARATIONS

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. section 9601 et seq., and the National Contingency Plan (40 C.F.R. Part 300), I have determined that the selected remedy at Smuggler Mountain is cost-effective and consistent with a permanent remedy that provides adequate protection of public health, welfare, and the environment. I also have determined that the action being taken is a cost-effective alternative when compared to the other remedial options reviewed. The State of Colorado has been consulted on the selected remedy. The action will require future operation and maintenance activities to ensure the continued effectiveness of the remedy. These activities will be considered part of the approved action. EPA has not reached agreement with the responsible parties at the site to implement the selected remedy.

Ground water quality will continue to be monitored on site. Subsequent response action will be considered if the monitoring shows increasing contamination.

The EPA or the potentially responsible parties for the Smuggler-Durant Mine area of the site will conduct an additional RI/FS to further characterize the extent of contamination at that portion of the site, and will undertake further response actions as determined to be necessary by EPA in a subsequent decision document.

Alexander B. Smith — September 26, 1986

John G. Welles
Regional Administrator
Region VIII

Date

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

A. SITE LOCATION AND DESCRIPTION

The Smuggler Mountain Site is located immediately northeast of the City of Aspen in Pitkin County, Colorado. Beginning with the old Smuggler-Durant mine workings located at the base of the western side of Smuggler Mountain, the site grades into the gentler slopes and terraces to the west-southwest towards the City. See Figure 1. Site elevation ranges from 7,930 to 8,160 feet above mean sea level. The site has been significantly altered over the years by extensive commercial and residential development. Present site features are shown on Figure 2. Waste rock, tailings, and slag, cover much of the site. The wastes are exposed, covered, or mixed with native soil and contain high levels of lead and cadmium, among other constituents. Through the Endangerment Assessment (EA) process, EPA has established a site boundary based upon a 1,000 milligrams per kilogram (mg/kg) or parts per million (ppm) soil-contamination level in soils and mine wastes. This action level has been concurred upon by the Agency for Toxic Substances and Disease Registry (ATSDR) in their letter to EPA Region VIII of September 11, 1986. The State of Colorado had recommended an action level of 500 ppm lead, but such a level was determined by ATSDR not to be appropriate. Accordingly, the 110-acre site is defined by a 1,000 ppm lead isopleth which is shown on Figure 3.

The site, being in close proximity to the resort city of Aspen which has a year-round population of 4,500, is comprised of both developed and undeveloped properties. In many cases, development has taken place immediately on top of waste piles, or such piles have been moved to the sides of developed areas and remain as berms or mounds of contaminated soil. Portions of the contaminated soil have been excavated, used for fill, or otherwise disturbed by grading, significantly altering the topography of the site over the years.

The Roaring Fork River passes the site approximately 1,000 feet downgradient to the southwest. Site drainage occurs largely as surface runoff with channelization from mine discharge water (the Mollie Gibson Mine Shaft discharges to the Roaring Fork River, and the Cowenhoven Tunnel discharges to Hunter Creek). Drainage is also affected by two moderately sized basins: Hunter Creek to the north; and the Salvation irrigation ditch, which transverses the site at an elevation of approximately 8,000 feet. The ground-water system at the Smuggler site is complex and not clearly defined. Ground water has been found to be present in both the sedimentary bedrock and in the unconsolidated surficial deposits. Flow in the sedimentary bedrock is characterized by secondary permeability, i.e., fractures and fault systems. Current ground-water use in the area is limited to some private wells that tap the alluvial aquifer of the Roaring Fork River Valley. The City of Aspen does not use the alluvial aquifer but uses surface water from other sources. Accordingly, the importance of the hydrology of the underlying sedimentary strata is restricted to its role in recharging the Roaring Fork alluvial system.

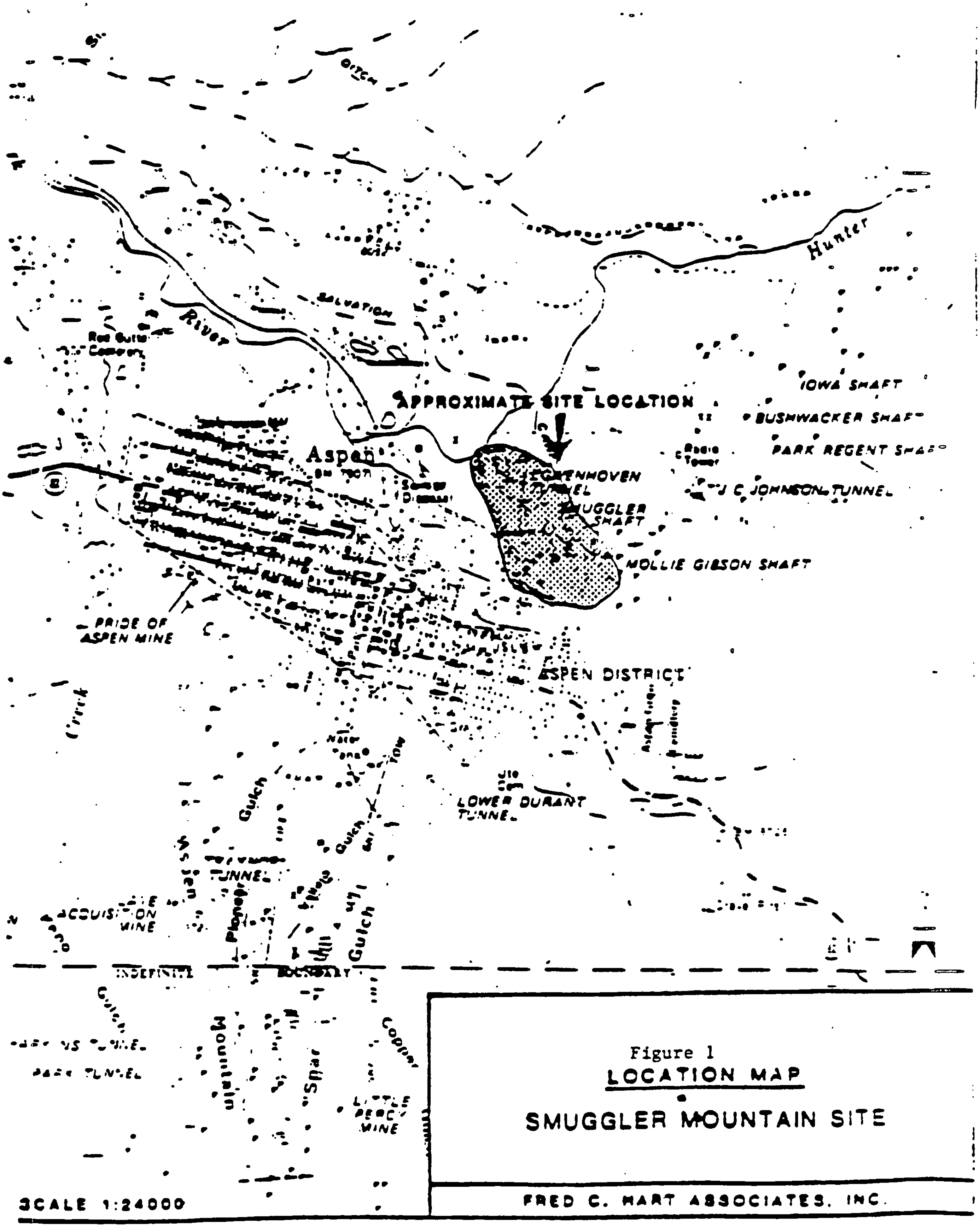


Figure 1
LOCATION MAP
SMUGGLER MOUNTAIN SITE

FRED C. HART ASSOCIATES, INC.

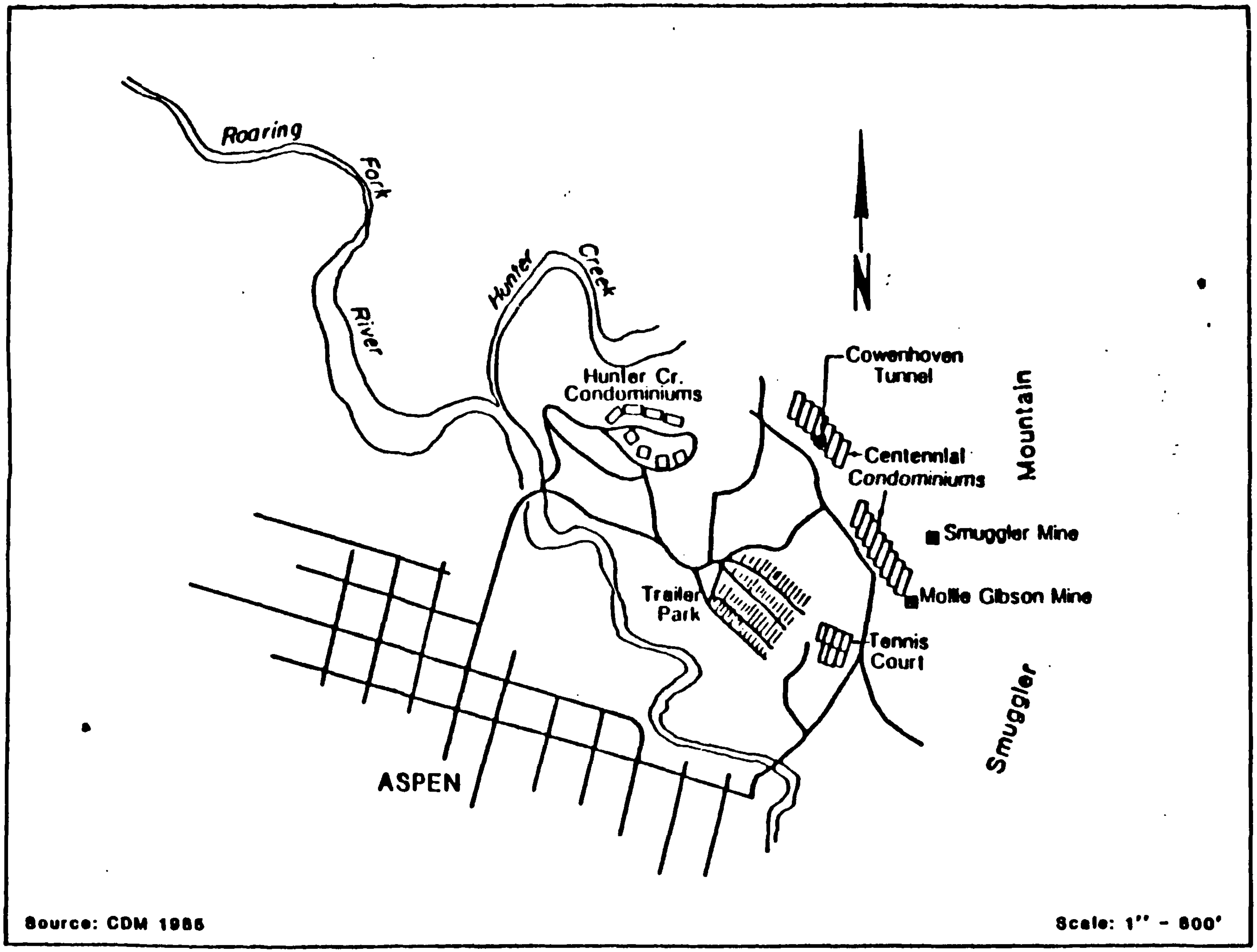


Figure 2 - Present Site Features

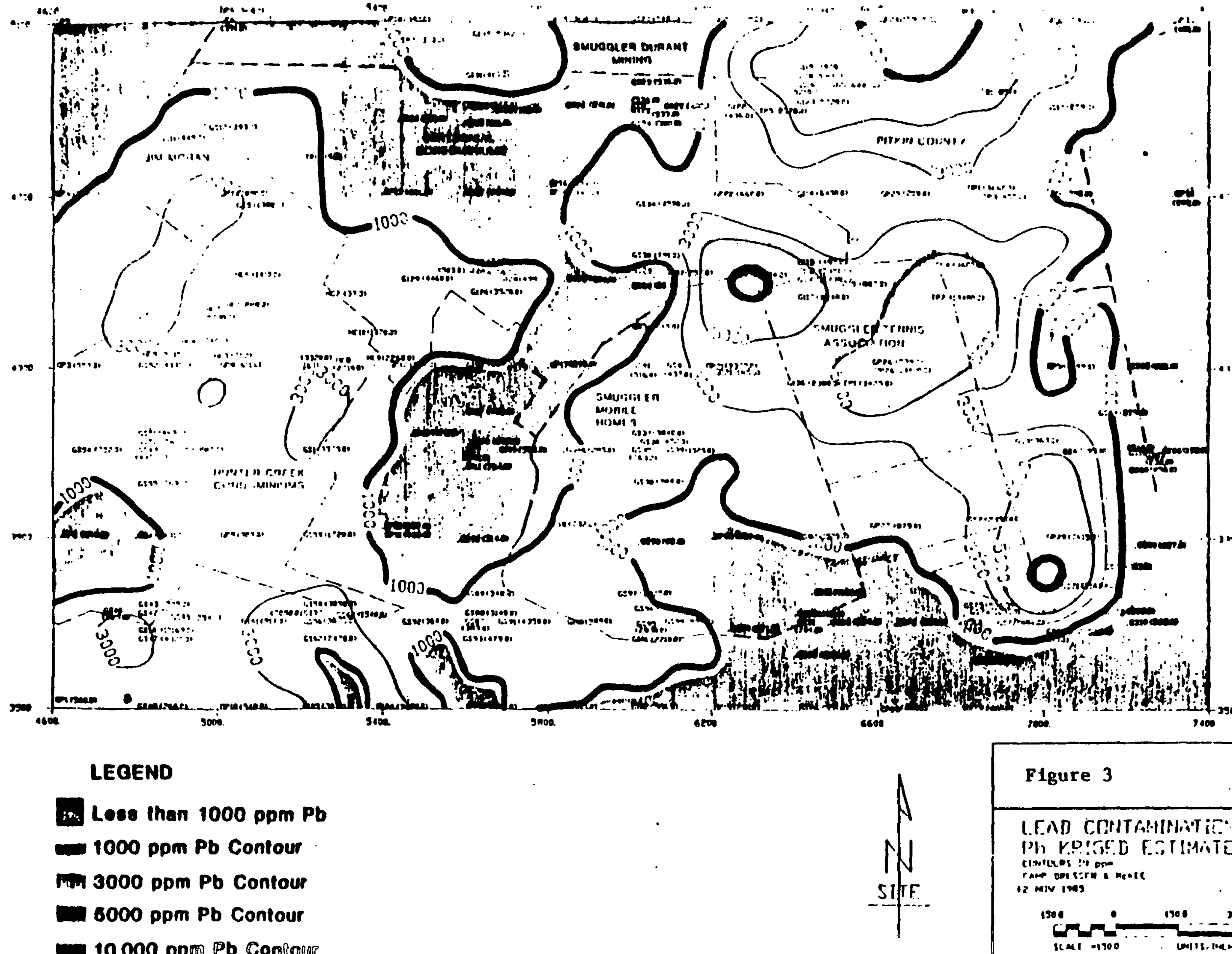


Figure 3

LEAD CONTAMINATION
Pb KRIGED ESTIMATES
CONTOURS IN ppm
CAMP DRESSER & McKEE
12 NOV 1985

B. SITE HISTORY

The mining wastes which characterize the site are the results of years of mining, milling, and smelting operations. Mining companies ran extensive silver, lead, and zinc mining operations on-site in the late 1800's and early 1900's. Although several small operations started and ceased on the site after 1930, records indicate that the bulk of the mining wastes at the site were placed from 1880 to 1915 on the steep slope of the western side of Smuggler Mountain near the Smuggler Mine shaft. In the mid-1960's, a reprocessing facility was run at the site, causing the dispersion of the wastes from the relatively distinct piles at the mine site to other locations in the vicinity. The reprocessing also spawned a number of settling ponds around the site. The wastes were dispersed further by subsequent residential development.

From the time of the generation of the mining wastes to the present, the materials have been strewn and dispersed over a wide area and at varying depths from 1 or 2 feet to 40 feet. The relative toxicity of the remnants of the waste piles varies with the degree to which they are mixed with or covered by other materials (native soil, topsoil, etc.). Since the waste piles have been randomly dispersed, much of their disposition is unknown. The site is underlain by relatively permeable strata. Ground water and, ultimately, surface water may be affected by the percolation of precipitation through the mineralized waste materials.

A number of investigations have taken place at the site. Air quality, stream sediment, surface- and ground-water quality and soil/tailings data were collected in the vicinity of the Smuggler site by EPA and the Potentially Responsible Parties (PRPs) from June 1982 through June 1986. Analyses of soil and plant samples taken from the area in 1982 indicated elevated levels of trace metals (lead, cadmium) and called the site to the attention of local, State, and Federal authorities. At the request of Pitkin County environmental officials, the EPA Field Investigation Team (FIT) performed a sampling investigation at the site in 1983. The data from these and other related studies are summarized on Table 1 and Figure 4. The Smuggler site was proposed for the National Priorities List (NPL) in October 1984 and became final on the NPL in May 1986. On several occasions during 1981-1983, news releases, meetings, and other publicity issued by the Aspen Public Health Department advised local residents against a) the use of garden soils suspected to be derived from tailings and b) children playing in tailings (Dunlop 1986). Following negotiations with the identified PRPs in early 1985, EPA approved the PRPs' proposal to conduct the Remedial Investigation/Feasibility Study (RI/FS) with EPA retaining an oversight role.

EPA issued three orders pertaining to the site during 1985. In June, EPA issued a unilateral Administrative Order which names the property owners, describes the site and potential hazards, and requires that EPA be notified of and give approval for any movement of the soils or mining wastes in excess of one cubic yard. An Administrative Order on Consent was negotiated and signed by EPA and the PRPs in July 1985. This Order accepts the PRPs' RI/FS work plans and sets forth other legally binding agreements to govern various site activities. EPA and the property owners also entered into a Consent Order in August to undertake a limited emergency action on the site in which the heavily contaminated area south of the mine and north of the tennis courts was isolated by installing a fence to prevent access, and signs were erected to warn the residents.

The final RI/FS as prepared by the PRPs was submitted to EPA in early 1986. EPA prepared an Endangerment Assessement based on the RI and an addendum to the RI/FS in May and June 1986, respectively.

C. CURRENT SITE STATUS

The total quantity of contaminated materials at the site has been estimated at approximately 410,000 cubic yards. The site is characterized by high concentrations of lead, cadmium, and zinc, as well as elevated concentrations of arsenic, barium, copper, manganese, silver, and mercury as found in tailings and other mining wastes. Three different media were sampled by the PRPs and EPA at the site to further define the extent of contamination. The results of the sampling are:

Soil Sampling. Field activities have concentrated on determining the extent of lead contamination. The initial site definition shown on Figure 5 was adopted as a FIT starting point for investigation when the site was proposed for the NPL in October 1984. The site definition was based on data from preliminary soil lead content values compiled by the FIT investigation. The emphasis of subsequent surface sampling programs conducted by the PRPs and EPA was to define the horizontal and vertical distribution of lead in the soil. A perpendicular grid system with 400-foot sampling intervals was adopted to provide field reference for sample locations, and soil sampling went as deep as 35 feet. The sampling grid is illustrated in Figure 6. A summary of the soil sampling activities is shown on Table 2. The initial FIT site definition was refined by the PRP efforts which distinguished the site by using four soil conditions, i.e., mine tailings, fill, man-made fill, and native soil. Both mine tailings and man-made fill were considered to be contaminated with lead at concentrations of over 1,000 ppm. Figure 7 illustrates the PRP site definition. The EPA contractor (Camp, Dresser & McKee) collected additional soil samples, conducted soil analyses, and defined the site in terms of the 1,000 ppm soil lead contour with the use of geostatistics. The resulting contour map (Figure 8), which also shows contours of higher levels of contamination, has been adopted as the site definition map by EPA and the PRPs.

Surface Water and Sediment Sampling. FIT conducted two surface water sampling efforts in the vicinity of the Smuggler Mine site. The sampling locations and the rationale for choosing them are shown on Table 3. A summary of the results of the surface water sampling efforts are shown on Table 4. Only barium, iron, manganese and zinc were detected in the river. In addition, the levels of these constituents found in the river

Table 1

OVERVIEW OF HISTORIC DATA COLLECTION ACTIVITIES

Location and Collector	Sampling Period	No. of Samplers or Samples	Remarks
<u>Air Quality/Meteorology</u>			
Site Vicinity, Ecology & Environment (FIT)	8-9/84	7-hi-vols for 19 days, 120 samples; 1 met station	Air quality samples analyzed for TSP, particle size, metals
Pitkin County Courthouse Roof & Site Vicinity, Colorado Department of Health/Aspen/Pitkin Env. Health	1982-84	2 hi-vols	Lead; sporadic data anlayses; heavy metals significantly below health criteria
Capitol Creek/Snowmass (background), Colorado Department of Health/Aspen/Pitkin Env. Health	1982-83	1 hi-vol	Background, lead
<u>Ground Water</u>			
Site Vicinity, Ecology & Environment (FIT)	9-11/83	6 domestic wells (1 resampled 11/83)	Elevated concentrations of Cd, Cu, Zn
Site Vicinity, Ecology and Environment (FIT)	3-4/85	4 wells (2 sampled, 2 dry); 4 domestic wells re-sampled	Data inconclusive; sampling of two saturated wells continuing by REM II
<u>Surface Water</u>			
Site Vicinity, Ecology & Environmental (FIT)	9-11/83	7 samples, quality only; some re-sampling 11/83	Generally good water quality; Fe and Mn exceeded health criteria, but not considered a problem
Site Vicinity, U.S. Geological Survey	1950s - present	Roaring Fork River above confluence with Hunter Creek; Hunter Creek above confluence with Roaring Fork River	Flow and quality records; generally very good water quality
Site Vicinity, REM II Team (preliminary site characterization)	3/85	7 stations for low-flow water quality	Data indicate from site to is negligible

Source: CDM 1986

Table 1 (Continued)
OVERVIEW OF HISTORIC DATA COLLECTION ACTIVITIES

Location and Collector	Sampling Period	No. of Samplers or Samples	Remarks
Sediment			
Site Vicinity, Ecology & Environment (FIT)	9/83	5 sites	No metals concentrations of note identified based on weak acid extraction analysis
Site Vicinity, REM II Team (preliminary site characterization)	3/85	5 sites	Data indicate that contamination from site to stream sediments in site vicinity is negligible
Soil/Tailings			
Site Vicinity, Ecology & Environment (FIT)	9/83	14 soil, 6 tailings	4000-8000 ppm Pb reported in soil/tailings; 26-56 ppm Cd
Site Vicinity, Aspen/Pitkin Env. Health	1984(?)	3 samples (1 composite)	Mine tailings materials near Smuggler Trailer Court, 3000-21,000 ppm Pb
Aspen Vicinity, Boon	1982	11 garden samples	Soil lead values as high as 11,000 ppm, in upper horizons
Site Vicinity, Boon	1983	27 soil/tailings samples taken throughout Centennial Development project area	AB-DPTA extraction; 40% of 25-acre site (northern 1/3) determined not to be Pb-contaminated; remaining contaminated area recommended to be controlled by surface covering
Hunter Creek Project, Engineering Science	1985	14 surface and subsurface soil/tailing samples taken throughout the Hunter Creek Condominium development	Total lead values up to 5,790 ppm, with an average of 1997 ppm; 9 samples exceeded 1000 ppm total lead

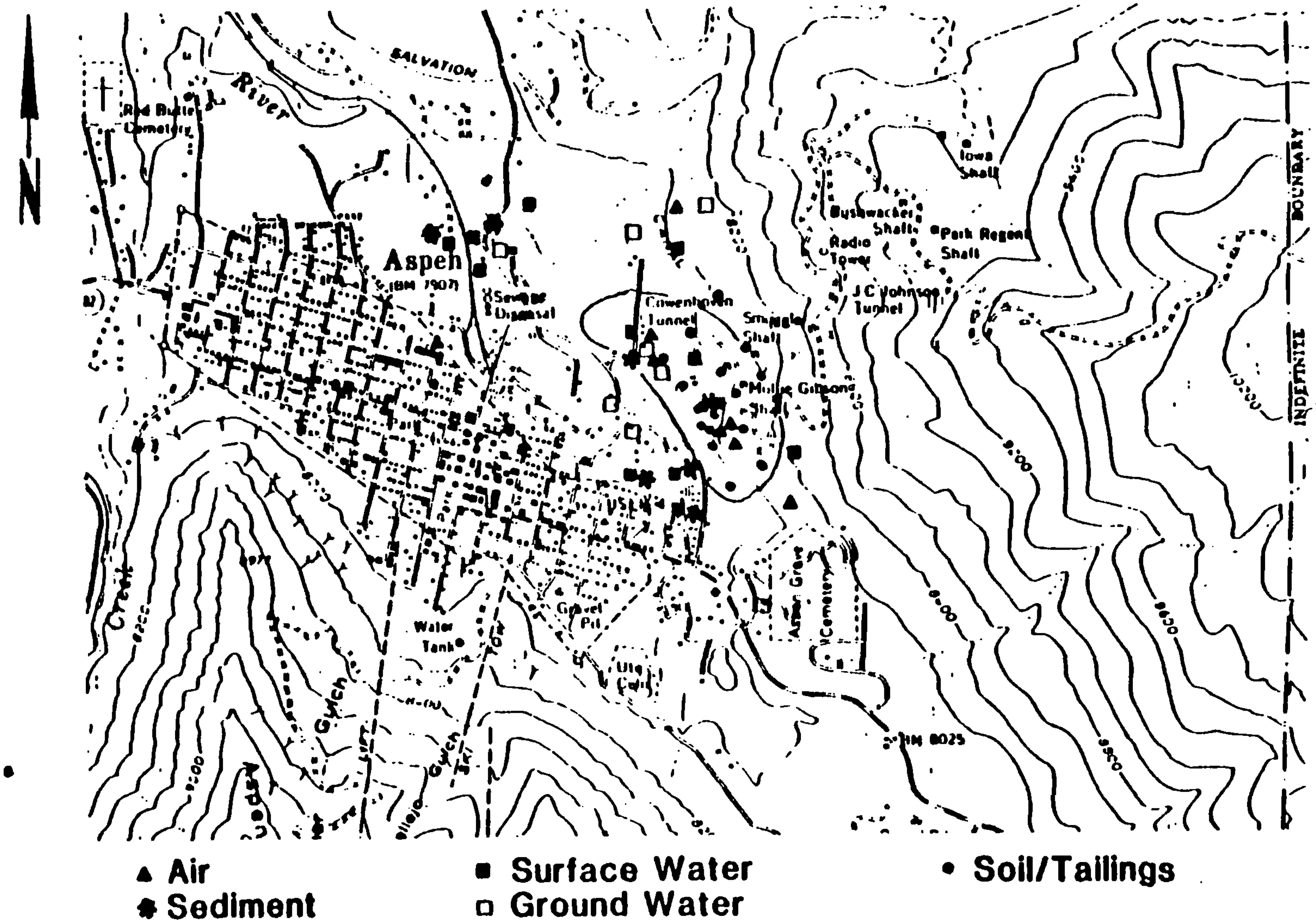


Figure 4
Overview of Data Collection Activities

Source: CDM 1986

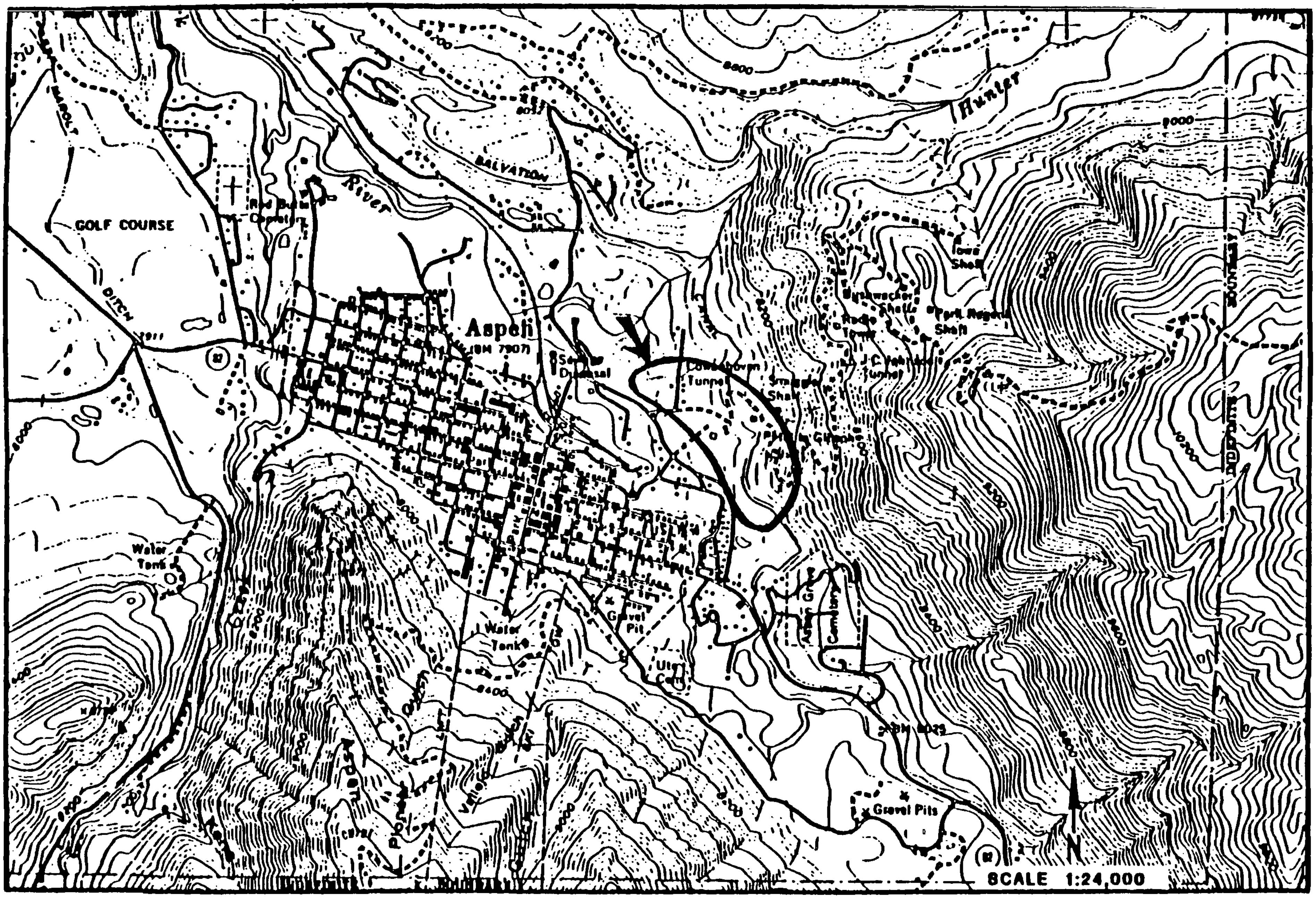


Figure 5

Initial Site Definition Map

Source: E & E 1984

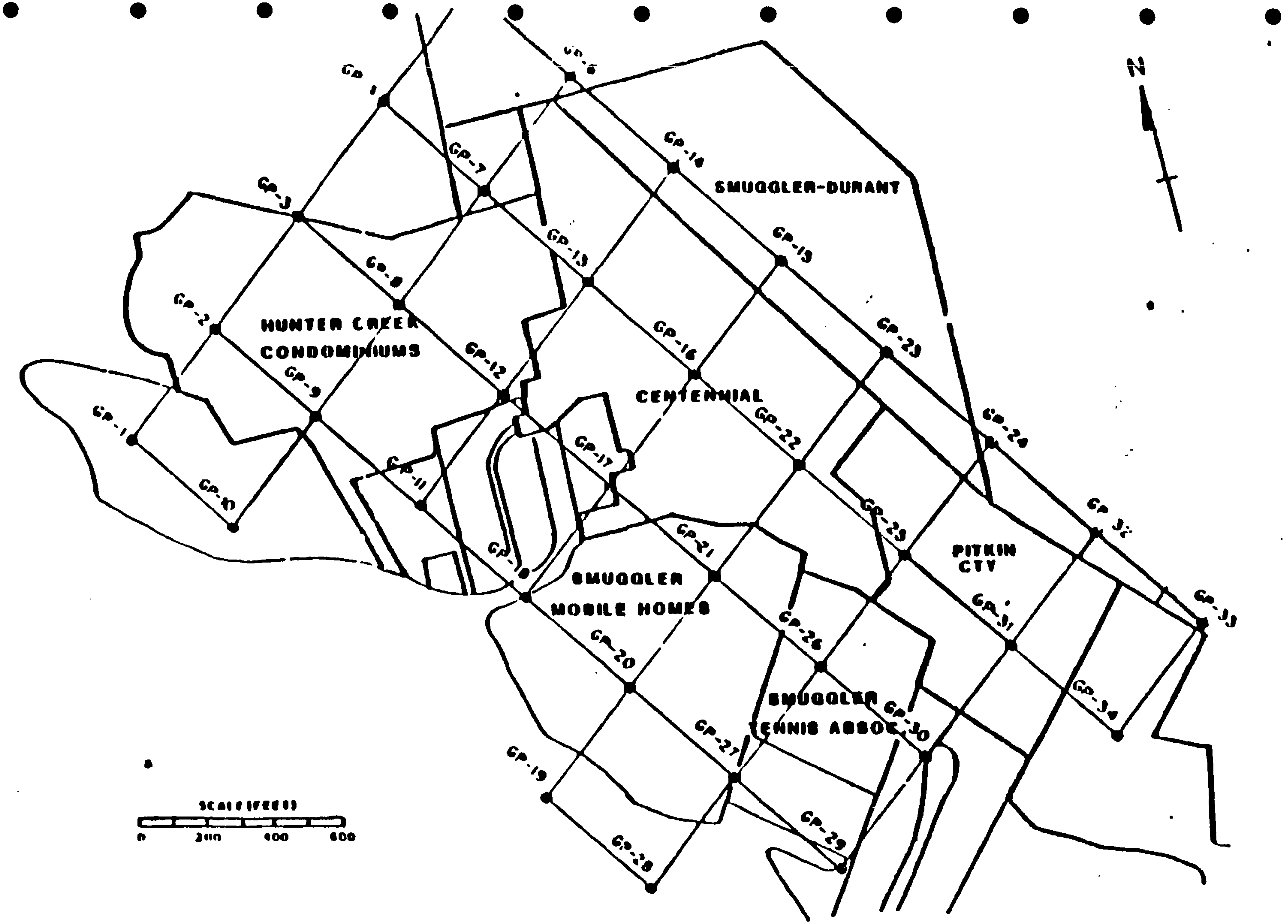


Figure 6

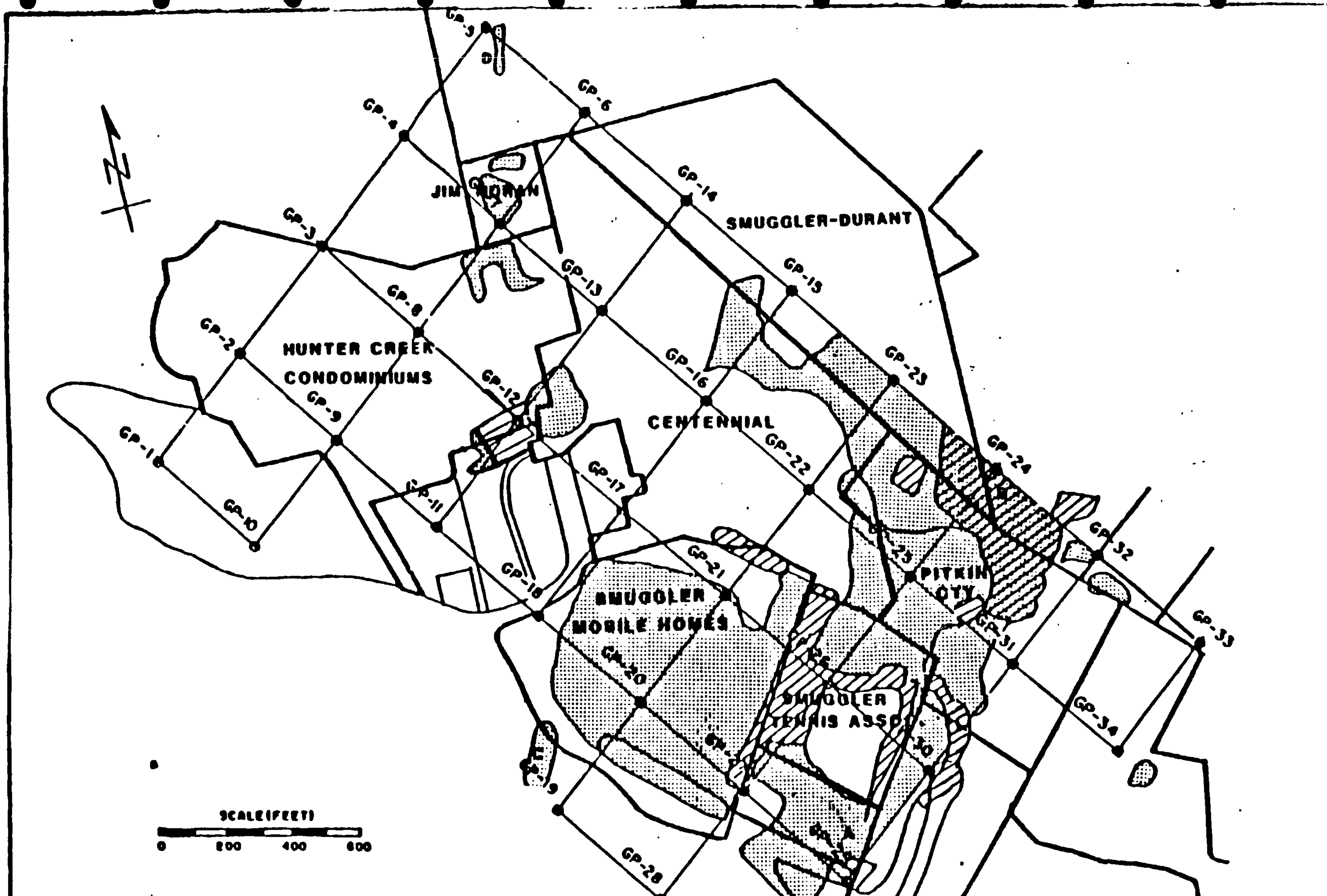
GRID SYSTEM SHOWING SURFACE
SAMPLING LOCATIONS

Table 2

SUMMARY OF SOIL SAMPLING ACTIVITIES
SMUGGLER SITE: JULY-AUGUST 1985

Sampling Procedure	Number of Samples Collected	Depth
Surface sampling	34 soil samples collected from each node of gridpoint	0-6 inches
Test pits	7 test pits 15 soil samples collected	10 feet (average) sample collected at each lithologic unit
Test boring	1 borehole 2 soil samples collected	35 feet Sample collected for each unit

Source: Fred C. Hart 1985



FOR DETAILED SOIL CONDITIONS, REFER TO PLATES 1-6, VOLUME III

Figure 7
MAP OF SURFACE SOIL CONDITIONS AT THE SMUGGLER MOUNTAIN SITE

(DOES NOT SHOW SOIL UNITS TYPICALLY UNDER 1000 ppm RANGE)

- Manmade Fill
- Mine Tailings
- Manmade Fill & Mine Tailings
- Surface Sampling Locations

SOURCE: RI/FS Smuggler Mountain Site, F.C. Hart, 9/86.

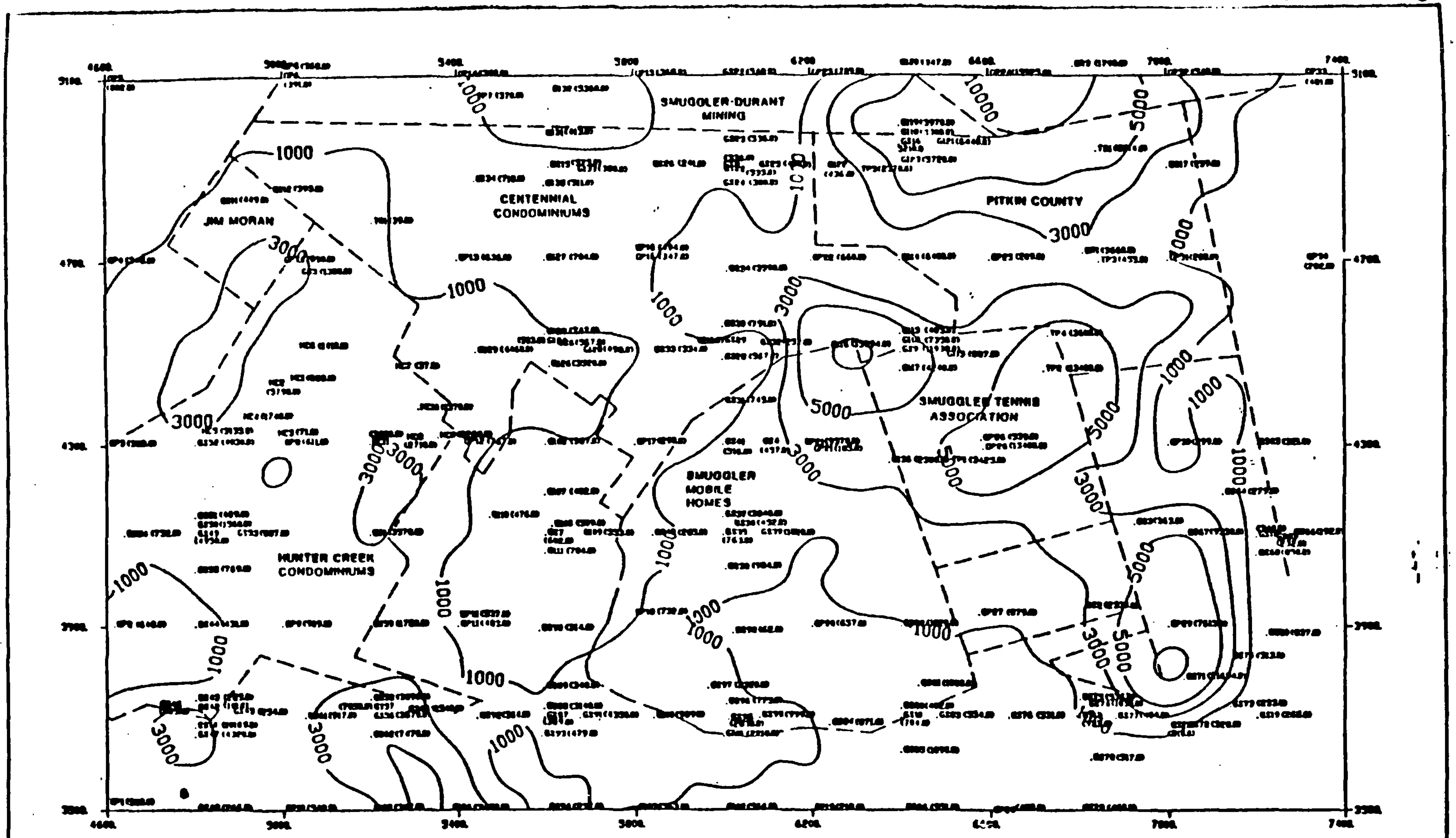


Figure 8
Current Site Definition Map

LEAD CONTAMINATION
Pb KRIGED ESTIMATES
CONTOURS IN ppm
CAMP DRESSER & McKEE
12 NOV 1985

SOURCE: Geostat/CDM 1985

Software by : Geostat Systems, Golden CO

Table 3
LOCATIONS AND RATIONALE FOR SURFACE WATER COLLECTION STATIONS

Station Designation	Locations	Rationale
Surface Water Samples		
SW-001	Hunter Creek above confluence with Roaring Fork River	Evaluate Hunter Creek water quality previous to influence of Roaring Fork River.
SW-002	Roaring Fork River below confluence with Hunter Creek	Evaluate Roaring Fork water quality after influence of Creek and Smuggler Mountain site.
SW-003	Roaring Fork River above confluence with Hunter Creek	Evaluate Roaring Fork water quality prior to influence of Hunter Creek and after influence of Smuggler Mountain site.
SW-004	Cowenhoven Tunnel Drainage prior to confluence with storm drainage	Evaluate Cowenhoven Tunnel drainage prior to discharge into storm water collection system.
SW-005	Mollie Gibson shaft drainage prior to confluence with Roaring Fork River.	Evaluate Mollie Givson drainage prior to influence of Roaring Fork River.
SW-006	Roaring Fork River above confluence of Mollie Gibson shaft drainage	Evaluate water quality of Roaring Fork River prior to the influence of any mining or milling operations from Smuggler Mountain site.

Source: CDM 1985.

Table 4
Concentrations of Dissolved Metals
in Surface Water Samples

Station	Dissolved Metals							
	Lead	Cadmium	Arsenic	Zinc	Mercury	Barium	Manganese	Iron
	(ug/l)							
SW-001 (Hunter Creek)	ND	ND	ND	ND	ND	ND	ND	78
SW-002 (Roaring Fork below Confluence with Hunter Creek)	ND	ND	ND	ND	ND	ND	17	193
SW-003 (Roaring Fork above Confluence with Hunter Creek)	11[a]	ND	ND	ND	ND	39	38	727
SW-004 (Cowenhoven Discharge)	2.7[a]	ND	ND	278	ND	41	1430	1880
SW-005 (Mollie Gibson Discharge)	ND	ND	ND	377	ND	41	96	150
SW-006 (Roaring Fork above Confluence with Mollie Gibson)	ND	ND	ND	ND	ND	ND	29	327

were within the compliance range for ambient water quality standards set by the State and EPA. Stream sediment samples were also collected in the vicinity of the site, the results of which are summarized on Table 5. Based on available data and in consideration of the reducing conditions of tailings piles, it was concluded that on-site contaminants were not mobile enough to lead to a substantial increase in the levels of metals in surface water and surface water sediments.

Ground Water Sampling. Seven existing private wells were sampled and eight monitoring wells were installed to obtain ground water data. Private wells PW-5 and PW-7 are considered to be down-gradient. EPA installed four monitoring wells, two of which were dry. EPA subsequently installed four more monitoring wells. EPA well GW-01 was established as an upgradient well. EPA well GW-05 was established as downgradient, and EPA wells GW-07, GW-08, GW-09, and GW-10 were established as on-site wells. All ground water well locations (private and EPA) are shown on Figure 9. The private wells were sampled by the EPA FIT in 1983, results from those tests are shown on Table 6. Ground-water samples were collected from the six operational EPA monitoring wells in November 1985, and February and May 1986. Results from the dissolved-metals analyses of these samples are presented on Tables 7, 8, and 9. Water-quality trends from these sampling data indicate that lead and arsenic are not present as ground water contaminants. However, elevated levels of cadmium were noted at two private well sampling locations (Table 6) and at two EPA monitoring well locations (Table 9).

Of particular importance to the selection of the recommended remedy was the absence of lead in the well samples and the variable occurence of cadmium in GW-07 near the Maximum Contaminant Level (MCL) of .01 mg/l as established by EPA. In addition, levels of uranium and gross alpha were found to be elevated in GW-07 and GW-09. Zinc concentrations were also found to be highest in PW-7. The PRPs have postulated that despite the abundance of calcium carbonate in the host rock, localized pockets of mineralized materials could produce leaching conditions if derived from the core of the mineralized zone. Using the results from the Focused Feasibility Study and ground water monitoring, EPA has determined that the potential ground water problem (as indicated by elevated levels of cadmium, zinc, uranium, and gross alpha in GW-07 and GW-09) would most likely be adequately addressed by the prevention of infiltration of surface water through the tailings. Continued long-term monitoring of the ground water was deemed necessary to evaluate the effects of the remedy on the ground water quality.

Air Sampling. EPA took 115 samples of air particulate matter from a background site and four on-site locations in 1985. A compilation of the resulting data is presented on Table 9. Analyses of these data revealed that levels of arsenic, cadmium, lead and zinc in the air on-site were elevated as compared to background. However, only cadmium and arsenic were found to be present at levels above the proposed National Environmental Standards for Hazardous Air Pollutants (NESHAPS).

Table 5
SEDIMENT SAMPLING RESULTS
(Values in mg/kg)

Parameter	Station SD-001 (Hunter Creek)	SD-002 (Roaring Fork Below Hunter Creek)	SD-003 (Roaring Fork Above Site)	SD-004 (Opportunistic Runoff Sample)
Aluminum	4,880	5,550	3,810	11,400
Antimony	ND	ND	ND	ND
Arsenic	10	ND	ND	8.6
Barium	1,990[1]	2,410[1]	73[1]	892[1]
Beryllium	ND	ND	ND	ND
Cadmium	ND	ND	ND	3
Calcium	26,400	19,800	2,990	32,600
Chromium	16[1]	8[1]	ND[1]	15[1]
Cobalt	ND	ND	ND	12
Copper	18	10	ND	33
Iron	15,600[1]	18,200[1]	13,100[1]	21,600[1]
Lead	1,070	1,950	18	1,400
Magnesium	13,800	11,000	1,680	10,300
Manganese	402[1]	336[1]	239[1]	609[1]
Mercury	ND	ND	22	ND
Nickel	ND[1]	ND[1]	ND[1]	12[1]
Potassium	ND	ND	714	2,880
Selenium	ND	ND	2.1	ND
Silver	ND	ND	ND	ND
Sodium	3,270	3,960	5,050	5,120
Thallium	ND[2]	ND[2]	ND[2]	ND[2]
Tin	ND[2]	ND[2]	ND[2]	ND[2]
Vanadium	ND	16	ND	19
Zinc	450[1]	462[1]	32[1]	538[1]

[1] Estimated due to matrix interference.
[2] Estimated - undetected.
ND: Not Detected.

Source: CDM 1985.

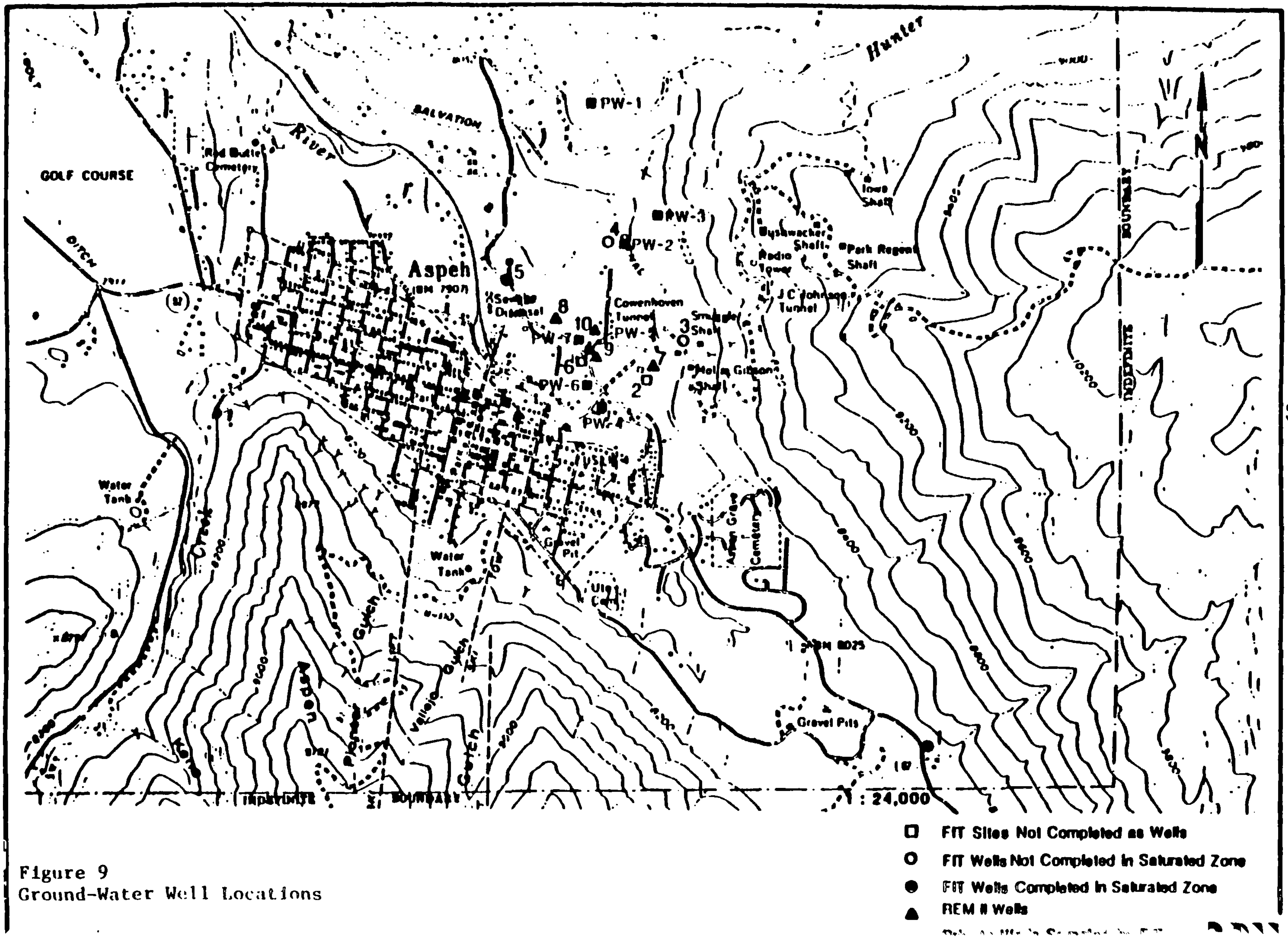


Figure 9
Ground-Water Well Locations

Table 6

RESULTS OF DISSOLVED METALS ANALYSIS FOR PRIVATE WELLS INCLUDED IN FIT SAMPLING EFFORT

Parameter	Drinking Water Standard Primary[a]	Drinking Water Standard Secondary[b]	Sampling Station PW-1	PW-2	PW-3	PW-4	PW-5 (9/83)	PW-5 (11/85)	PW-6
Aluminum			ND(30)	ND(30)	ND(30)	ND(30)[3]	ND(30)	ND(30)	ND(30)
Antimony			NA[2]	NA	NA	NA	NA	ND(100)	NA
Arsenic	50		ND(50)[3]	ND(50)	ND(50)	ND(50)	ND(50)	ND(50)	ND(50)
Barium	1,000		134	77	121	79	101	58	92
Beryllium			NA	NA	NA	NA	NA	ND(10)	NA
Cadmium	10		ND(5)	ND(5)	ND(5)	ND(5)	13	8	ND(5)
Calcium			NA	NA	NA	NA	NA	NA	NA
Chromium	50		ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	5
Cobalt			NA	NA	NA	NA	NA	NA	NA
Copper		1,000	35	ND(5)	6	ND(5)	84	168	ND(5)
Iron		300	12	185	34	29	2340	ND(10)	ND(10)
Lead			ND(30)	ND(30)	ND(30)	ND(30)	ND(30)	ND(30)	ND(30)
Magnesium			NA	NA	NA	NA	NA	NA	NA
Manganese		50	ND(5)	8	ND(5)	ND(5)	8	9	ND(5)
Mercury	2		ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
Molybdenum			NA	NA	NA	NA	NA	NA	NA
Nickel			NA	NA	NA	NA	NA	ND(30)	NA
Selenium	10		ND(50)	ND(50)	ND(50)	ND(50)	ND(50)	ND(50)	ND(50)
Silver	50		ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Sodium			NA	NA	NA	NA	NA	NA	NA

RESULTS OF DISSOLVED METALS ANALYSIS FOR PRIVATE WELLS
INCLUDED IN FIT SAMPLING EFFORT (cont.)

Parameter	Drinking Water Standard		Sampling Station						
	Primary[a]	Secondary[b]	PW-1	PW-2	PW-3	PW-4	PW-5 (9/83)	PW-5 (11/85)	PW-6
Thallium			NA	NA	NA	NA	NA	NA	NA
Tin			NA	NA	NA	NA	NA	NA	NA
Vanadium			ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Zinc		5,000	956	31	462	737	2717	2118	42

[1] All results in ug/l unless otherwise designated.
[2] Not analyzed.
[3] Concentration below minimum detection limits.

ND: Not detected, with detection limits shown in parentheses.
Source: E&E 1984.

(a) Primary Interim Drinking Water Standards (40 CFR 141; 40 FR 59565, December 24, 1975; Amended by 41 FR 28402, July 9, 1976; 44 FR 68641, Novem 1979; Corrected by 45 FR 15542, March 11, 1980; 45 FR 57342, August 27, 1980).

(b) Secondary Drinking Water Standards (40 CFR 143; 44 FR 42198, July 19, 1979, Effective January 19, 1981).

Table 7
GROUND WATER ANALYSES FOR NOVEMBER 1985

	Well No.					
Parameter	GW-1	GW-5	GW-7	GW-8	GW-9	GW-10
Arsenic	ND	ND	ND	ND	ND	ND
Cadmium	ND	0.004	0.007	ND	ND	ND
Calcium	4.59	136	143	20	119	128
Iron	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND
Magnesium	14.1	23.8	52.5	5.74	38.5	36.8
Manganese	0.017	ND	0.052	ND	ND	0.043
Potassium	ND	ND	1.92	ND	ND	ND
Sodium	20.5	9.69	6.68	4.16	ND	6.35
Zinc	0.062	0.060	1.00	0.018	0.413	0.053

Notes:

Concentrations in mg/L; metals are dissolved.

Validation criteria qualifiers pertain to some data; details are included in REM II files.

Source: CDM 1986.

Table 8
GROUND WATER ANALYSES FOR FEBRUARY 1986

		Well No.					
Parameter	Units	GW-1	GW-5	GW-7	GW-8	GW-9	GW-10
Arsenic	mg/l	ND	Dry	ND	ND	ND	ND
Cadmium	mg/l	ND	Dry	0.010	ND	ND	ND
Calcium	mg/l	46.5	Dry	168	22.3	120	136
Iron	mg/l	0.034	Dry	0.121	0.026	0.022	0.086
Lead	mg/l	ND	Dry	ND	ND	ND	ND
Magnesium	mg/l	14.5	Dry	53.9	6.2	41.2	39.5
Manganese	mg/l	0.025	Dry	0.226	0.05	ND	0.174
Potassium	mg/l	0.95	Dry	2.43	ND	1.49	1.64
Sodium	mg/l	19.4	Dry	4.95	0.93	3.97	6.19
Zinc	mg/l	0.020	Dry	1.44	0.065	0.460	0.066
Oil and Grease	mg/l	1.1	Dry	2.2	1.4	ND	ND
TOC	mg/l	15	Dry	2.1	4.6	4.9	1.7
Chloride	mg/l	29	Dry	ND	ND	ND	30
Sulfate	mg/l	111	Dry	215	30	313	220
Bicarbonate	mg/l	54	Dry	180	49	162	199
TDS	mg/l	280	Dry	905	95	625	625
Radium-226	pCi/l	0.45 ± 0.02	Dry	0.45 ± 0.02	0.21 ± 0.01	0.34 ± 0.02[a]	0.37 ± 0.02
Gross alpha	pCi/l	3	Dry	140	4	120[a]	17
Uranium	mg/l	0.0024	Dry	0.310	0.00021	0.230[a]	0.036

Validation criteria qualifiers pertain to some data and are included in REM II files.

[a]) Duplicate values:

Radium-236	0.36 ± 0.02
Gross Alpha	100
Uranium	0.210

Source: CDM 1986.

TABLE 9

GROUND WATER ANALYSES FOR METALS
MAY, 1986 SAMPLING

Parameter	Ground Water Wells						
	01	05	07	08	09	09	10
Aluminum	[40.]	[17.]	[36.]	[29.]	[18.]	17.u	[28]
Antimony	25.u	25.u	25.u	25.u	27.	25.u	25.u
Arsenic	10.u	10.u	10.u	10.u	10.u	10.u	10.u
Barium	[62.]	[81.]	[33.]	[40.]	[28.]	[30.]	[62.]
Beryllium	1.0u	1.0u	1.0u	1.0u	1.0u	1.0u	1.0u
Cadmium	4.0u	4.0u	18.*	4.0u	5.4	4.0u	4.0u
Calcium	47000.	124000.	29500.	192000.	138000.	137000.	131000.
Chromium	4.0u	4.0u	4.0u	4.0u	4.0u	4.0u	4.0u
Cobalt	3.0u	3.0u	3.0u	3.0u	3.0u	3.0u	3.0u
Copper	[11]	3.0u	[5.5]	3.0u	[5.2]	3.0u	3.0u
Iron	[17]	[7.7]	[72.]	[25.]	[9.8]	[5.8]	[8.2]
Lead	5.0u	5.0u	25.u***	5.0u	5.0u	5.0u	5.0u
Magnesium	146000	21800.	99800.	5540.	49200.	462000.	356000.
Manganese	[14.]	[4.6]	23	[6.1]	[3.5]	[4.7]	16
Mercury	0.2u	0.2u	0.2u	0.2u	0.2u	0.2u	0.2u
Nickel	8.0u	8.0u	8.0u	8.0u	8.0u	8.0u	8.0u
Potassium	[1030.]	[1730.]	[2190.]	[602.]	[1760.]	[1480.]	[1260.]
Selenium	7.9	7.9	25.u	5.0u	5.0u	2.5u	5.0u
Silver	3.0u	3.0	3.0u	3.0u	3.0u	3.0u	3.0u
Sodium	20600.	7920.	6210.	2250.]	5080.	[4730.]	5480.
Thallium	10.	10.u	10.u	10.u	10.u	10.u	10.u
Tin	17.u	17.u	170.u**	17.u	170.u	170.u	17.u
Vanadium	2.0	2.0u	2.0u	2.0u	2.0u	2.0u	2.0u
Zinc	87.	48.	2510.	25.	590.	596.	35.

[] = Result is value greater than or equal to the instrument detection limit but less than the contract required detection limit.

u = Element was analyzed for but not detected. Detection limit is reported.

* = Exceeds Maximum Contaminant Level (Primary Drinking Water Standards)

** = Estimated due to split recoveries outside limits.

***= Dilution Factor of 5

All values are expressed in micrograms per liter (ug/l)

Source: CDM 1986

Table 10

AIRBORNE CONCENTRATIONS OF HEAVY METALS AND PARTICULATES IN THE VICINITY OF THE SMUGGLER MOUNTAIN SITE ($\mu g/m^3$)

	Concentrations On site			Respirable Size Particulates (<10µ diameter)			Background Concentrations from Snowmass			Maximum Recommended Air Concentrations
	No. Sampled	Mean	Maximum	No. Sampled	Mean	Maximum	No. Sampled	Mean	Maximum	
Total suspended particulates	66	43.5	160	18	17	44	18	36	160	260[a]
Arsenic	37	0.0003	0.0071	18	<0.0001	0.0009	18	<0.0001	0.0002	0.0001[b]
Cadmium	37	0.0012		18	0.0014	0.0043	18	0.0002	0.0018	0.0004[b]
Iron	37	1.4	7.5	18	0.58	1.8	18	0.79	3.5	30[c]
Lead	37	0.19	0.81	18	0.10	0.20	18	0.057	0.10	1.5[a]
Manganese	37	0.054	0.22	18	0.023	0.067	18	0.026	0.091	1.1[c]
Zinc	37	0.14	0.54	18	0.090	0.29	18	0.076	0.36	35[c]

[a]USEPA primary air standard.

[b]Based on a 10^{-6} cancer risk (ICF 1985), assuming a 70-kg person inhales $20 m^3$ of air per day.

[c]Noncarcinogen: Allowable chronic intake level from the HEA (ICF 1985), assuming a 70-kg person inhales $20\ m^3$ of air per day.

SOURCE: E & E 1985

Investigations at the Smuggler site have established that the most important potential routes of human exposure to the major contaminants, lead and cadmium, at the Smuggler Mountain site are: the ingestion of contaminated soil; inhalation of airborne particulates (dust); ingestion and inhalation of household dust; ingestion of vegetables grown in contaminated soil; and ingestion of contaminated ground water. The large extent of residential development taking place at the site increases the potential for widespread exposure. Lead and cadmium were chosen as the key contaminants at the site based on the relative health and/or environmental risks. The Endangerment Assessment (Clement and Associates, 1986) identifies studies for lead contaminated environments that show blood lead levels of children increase proportionately with soil lead concentrations and when soil lead concentrations exceed 1,000 ppm, children's blood level concentration could exceed 25 ug/l, a level above which toxic effects of lead poisioning have been observed in children. The primary effect of lead exposure at toxic levels is the inhibition of hemesynthesis in the biosynthesis of hemoglobin. Cadmium is of concern for three reasons. First, it is reported in high concentrations in tailings and soils throughout the site. Second, some forms of cadmium are acutely toxic and potentially carcinogenic. Third, cadmium compounds are generally more bioavailable than lead. Increased cadmium uptake normally results in its accumulation in tissues, particularly the kidneys and liver. As levels of cadmium in tissues increase, dysfunction of the organs can occur. The Endangerment Assessment enabled EPA to establish 10 ppm as the action level for cadmium at the site. Due to the relatively neutral pH of the tailings host rock and the minerology of the ore deposit, metals in soils on-site are relatively insoluble. Such insolubility of metals renders them slightly less available, but also increases their persistence in the environment.

As discussed earlier, the site boundary is defined by a 1,000 ppm level of lead contamination in soils and tailings. This decision was based on EPA's sampling data indicating that the contaminated soils exceeded the action levels of lead (1,000 ppm) and cadmium (10 ppm). The EA showed that lead and cadmium levels in soil correlate quite well, i.e., that soil lead levels of 1,000 ppm would very likely be associated with a soil cadmium level of over 10 ppm. From this information, the recommended remedy was based upon the premise that remediating soils heavily contaminated with lead would also adequately address the high cadmium levels. Follow-up sampling is planned for the remedial action phase which will determine compliance with the design clean-up standards. EPA used the statistically based CDM/Geostat Systems map (Figure 5) as the basis for site definition and site remediation.

EPA has determined that the levels of lead and cadmium in the soils at the site, in its present state, pose an imminent and substantial endangerment to public health, welfare and the environment.

D. <u>ENFORCEMENT ANALYSIS</u> - Attorney Work Product. (See enforcement confidential attachment).

E. ALTERNATIVES EVALUATION

The selection of the remedy to be performed at the Smuggler Mountain site is governed by the requirement in 40 CFR Section 300.68(j) of the National Contingency Plan (NCP) that the selected cost-effective remedy effectively mitigate and/or minimize threats to and provide adequate protection of public health, welfare and the environment. The remedy must also attain or exceed all applicable or relevant and appropriate Federal public health and environmental requirements identified for the site by EPA.

The threats at the Smuggler site that must be mitigated have been identified by EPA as environmental exposure to heavy metals present in widely dispersed mine wastes. Three primary exposure pathways have been identified: 1) the ingestion of soil or vegetables grown in contaminated soil; 2) inhalation of contaminated soil particles or household dust; and 3) ingestion of contaminated ground water. With respect to the first and second exposure pathways, EPA has determined that direct ingestion or airborne exposure to all soils with lead concentrations in excess of 1,000 ppm must be minimized so that human health and the environment will be protected. Because of the greater threat posed by soils with lead concentrations in excess of 5,000 ppm lead, exposure must be eliminated entirely to the extent practicable. With regard to the third pathway, EPA has determined that infiltration of surface water to the aquifer system must be prevented or minimized for both the 1,000 and 5,000 ppm levels of contamination. The actions taken to mitigate releases from the contaminated soils is also anticipated to inhibit the leaching and the mobilization of contaminants into ground water. The elimination of the three human pathways is the primary objective of the recommended remedial action. The remedy is also expected to mitigate releases of cadmium and lead to the environment.

In accordance with 40 CFR Section 300.68(j), six remedial alternatives were developed to address the three contaminant pathways:

Alternative	Remedy
1	Increased Monitoring
2	Source Isolation
3	Replacement of Ground Water Supply
4	Plume Capture
5	Source Removal
6	EPA Alternative
7	No Action

These alternatives were developed using a two step procedure. First, in accordance with 40 CFR Section 300.68(g), fourteen alternatives were evaluated and screened for acceptable engineering practices, effectiveness and cost. These alternatives, and the reasons for their being retained or dropped from consideration are described below:

1. Incineration. Contaminated soils often can be remediated by excavation and incineration. The soils at the Smuggler Mountain site are contaminated with toxic metals which are not affected or decomposed by heat. Incineration would also release lead through exhaust gases into the environment. Resulting fly ash may also be hazardous and would necessitate regulated disposal. This alternative was eliminated because of its lack of effectiveness as well as its potential deleterious environmental effects.

2. Flood Control. As reported by Fred C. Hart Associates, in the RI/FS, The Smuggler site is above the floodplain of the Roaring Fork River. Flood control measures are not relevant or appropriate in development of the remedial action.

3. Ground Water Barrier. Ground water barriers are often used to physically contain contaminated ground water. Such a barrier at the Smuggler site is not considered to be effective or practical since the bedrock underlying the alluvium is fractured with secondary permeability, and is replete with mine workings, rendering it unfit as the lower confining level for the barrier. Consequently, vertical slurry walls will not provide adequate protection. A ground water barrier is not considered technically feasible or effective at the Smuggler site.

4. Soil Washing. This technology removes hazardous inorganics from soils by flooding the site with a solution. The solution is then collected and treated to remove the contaminants. This method was examined for potential use at the Smuggler site. However, due to the nature of the wastes and the low solubilities of the metal contaminants, it was determined that soil washing would be ineffective at the Smuggler site. In addition, soil washing could facilitate further dispersion of the wastes on and off-site. Consequently, this alternative was eliminated because of its lack of effectiveness as well as its potential deleterious environmental effects.

5. Reprocessing of wastes. The wastes contain potentially valuable quantities of lead, zinc and silver, so the option of reprocessing was examined. Three technical constraints limit the option. They are:

a. nature of the wastes, i.e. mineralogy and concentrations;

b. adequate available land on-site to process the "ore" and dispose of the tailings; and

c. technically feasible process to reduce the contaminants to a level that is protective of public health and the environment.

In the case of Smuggler Mountain, all three of these constraints limit the feasibility of this option. These "ores" are not rich by mining standards and the mineralology is not well defined. Land is not readily available for process buildings or tailings disposal. In addition, although present mining technology may be able to reduce the levels of lead and zinc to levels much below the present values in the wastes (as low as 500 ppm and 200 ppm respectively), these levels may still present a health threat. Consequently, further processing or extra precautions would have to be implemented to dispose of the reprocessing wastes to protect public health and the environment. This option was eliminated based on technical difficulties, cost considerations, and potential environmental/public health concerns.

6. Surface Sealing. Surface sealing refers to covering the contaminated areas with a physical barrier, such as soil, pavement, synthetic materials or a combination of materials. It is used to minimize air and water exposure pathways and was retained.

7. Grading. Grading is the general term used for reshaping the surface of an area to minimize slopes so as to prevent soil erosion and to control the flow of storm water. Grading provides stable sloped areas for residential use as well as controlling erosion and storm water and was retained.

8. Surface water diversion. There are three sources of surface water at the site: drainage from nearby mine shafts; storm water originating off-site and flowing onto the site; and rain falling directly on the site. Surface water flow that is controlled would not erode surface soils, but might contribute to some surface water percolating through contaminated soils to ground water. Consideration of this technology in the context of the Smuggler site would involve channelling the flow of surface water entering onto, or originating on the site away from contaminated areas. In addition, existing storm water channels, i.e., the Cowenhoven Tunnel Drainage, the Molly Gibson Ditch, and the Salvation Ditch already control the flow of run-off by channels and diversion berms. This alternative was retained.

9. Excavation and disposal. This would entail excavating contaminated soils on the site and transporting them by truck to a RCRA-approved facility for final disposal. Excavated areas would be backfilled with uncontaminated soil and regraded to meet adjacent surface contours and revegetated. This alternative was retained.

10. Permeable treatment beds. Permeable treatment beds are constructed by excavating a trench in the path of migrating contaminated ground water and filling the trench with permeable materials which treat or remove the contamination from the ground water passing through it. This alternative was not eliminated at this time, but does not comprise any of the final alternatives.

11. Subsurface collection drains. Subsurface collection drains are gravel-filled trenches that intercept shallow ground water aquifers and collect and transport the intercepted ground water to a holding area for treatment. This alternative was not eliminated at this time, but does not comprise any of the final alternatives.

12. Replacement of water supplies. This technology would involve the replacement of threatened or potentially threatened ground water supplies with a water source that is not threatened by contamination, i.e., city water supply. This alternative was retained.

13. Extraction and treatment of ground water. Ground water collected in subsurface collection systems may need to be treated to remove metal contaminants before discharge to surface or ground water. The treatment facility would be located on-site. This alternative was not eliminated at this time, but does not comprise any of the final alternatives.

14. Ground water monitoring. This technology involves the design of a ground water monitoring system that would follow the appropriate and relevant RCRA standards (40 CFR Section 264.97). The purpose of the monitoring system would be to detect any trends in ground water quality, and to serve as an indicator for further action. This alternative was retained.

After the preliminary screening, the second step in the development of remedial alternatives was to use the eight technologies remaining to develop the final six remedial alternatives. The following alternatives include some combinations of preliminarily screened alternatives and are described below:

Alternative 1. Increased monitoring

This alternative involves the collection of quarterly ground water samples from four existing on-site ground water monitoring wells installed in the alluvial aquifer by EPA (Alternative 14). Samples would be analyzed for constituents associated with mine waste. Quarterly data would be incorporated in an annual report and submitted to EPA. The report would summarize data and evaluate possible trends. This alternative was developed in accordance with 40 CFR Section 300.68(f)(iv). Because this alternative does not eliminate or mitigate any of the major pathways of contamination, EPA has been determined that Alternative 1 alone does not attain the applicable or appropriate and relevant public health and environmental requirements, but may be an integral component for verifying the efficacy of the final remedy.

Alternative 2. Source Isolation

This alternative combines three of the remedial alternatives mentioned previously to isolate the source of contamination from potential exposure pathways (Alternatives 6, 7, and 8). It includes surface capping with material of a certain reduced permeability, grading and surface water diversion. The capping component would call for covering most contaminated soils with impervious material (e.g., buildings, streets, paving, repository). The remaining areas would be covered with 6 inches of clean topsoil and revegetated. The second component, grading, would be used to minimize the slope of the capped soils to reduce erosion and prepare areas for capping. The final component, surface water diversion, would entail the adoption of storm water diversion measures designed to minimize contact of surface water with contaminated soils, and to reduce infiltration and runoff to the extent feasible. In accordance with 40 CFR Section 300.68(f)(iii), by mitigating the current threat to public health, this alternative attains all public health and environmental requirements, although it does not prevent future threat from the hazardous substances.

Alternative 3. Replace Water Supply

This alternative involves the extension of the city water supply to approximately five to seven additional residences (Alternative 12). Water samples taken from existing ground water supply wells on the site indicate that the Maximum Contaminant Level(MCL) of .01 mg/l for cadmium has been exceeded in one well (.018 mg/l). To prevent the threat of violation of EPA Drinking Water Standards, users of ground water possibly impacted by the site would be permanently supplied with treated municipal water from the City of Aspen. Pursuant to 40 CFR Section 300.68(f)(iv), because this alternative does not eliminate or mitigate any of the major pathways of contamination, EPA has been determined that it would not attain public health and environmental requirements, but would reduce the likelihood of present or future threats from hazardous substances in ground water.

Alternative 4. Plume Capture

This alternative addresses only ground water contamination by using subsurface collection drains and permeable treatment beds to treat the contaminated plume and discharge the water (Alt. # 10, 11, 13). Pursuant to 40 CFR Section 300.68(f)(iv),this alternative does not eliminate or mitigate any of the major pathways of contamination, EPA has determined that it would not attain public health and environmental requirements, but would reduce the likelihood of present or future threats from hazardous substances in ground water.

Alternative 5. Source Removal

This alternative involves the excavation and off-site disposal of all contaminated soils with lead levels of over 1,000 ppb (Alternative 9) and was developed in accordance with 40 CFR Section 300.68(f)(i) and (iii). The contaminated soils (approximately 410,000 cubic yards) would be excavated, consolidated and transported by truck to an off-site RCRA-approved land disposal facility. The excavated areas would then be backfilled and vegetated. Pursuant to 40 CFR Section 300.68(f)(iii), this alternative exceeds public health and environmental requirements.

Alternative 6. EPA Alternative

This alternative was developed by EPA and is a combination of several of the alternatives developed by the PRPs (Alternatives 6, 7, 8, 12, and 14). It involves: source isolation of low level waste by in-place capping, grading and surface water diversion; source isolation of high level waste by excavation and deposition in an on-site repository with an impermeable cap and surface water diversion; increased ground water monitoring (quarterly); alternate water supply for population currently using ground water; operation and maintenance of high and low-level waste caps; mine reclamation and source isolation of wastes; and possible ground water remedial action.

Alternative 7. No Action

In accordance with 40 CFR Section 300.68(f)(v), a no action alternative was developed. Under this alternative, no action would take place at the site. Ground water, surface soils, air contamination and surface water would be left virtually unchanged. This alternative would allow the continued exposure of the population to contaminated soils through direct contact and through airborne dispersal and therefore, would not mitigate or eliminate the threat to public health, welfare and the environment. This alternative was eliminated from further consideration since an unacceptable risk to public health and welfare remains.

Pursuant to 300.68(h) and (i), the remedial alternatives were screened and evaluated for acceptable engineering practices, effectiveness and cost, and an alternative is recommended. Table 11 presents a summary of the analysis and evaluation of each alternative for technical and institutional constraints, including costs, as established by the PRPs. Table 12 presents the critical advantages and disadvantages of each alternative. Table 13 presents a summary of the application of the seven proposed remedial alternatives to the alternatives required to be developed by 40 CFR Section 300.68(f). The EPA addendum to the PRP-sponsored RI/FS analyzed the cost estimates for each alternative presented by the PRPs. Table 14 presents the capital operation and maintenance costs and present worth costs for each remedial action alternative as adjusted by EPA. The present worth of annual operation and maintenance costs were based on a thirty year period and on a discount rate of seven percent.

The information on these tables was used by EPA to evaluate which alternative or alternatives should be selected as the recommended remedial action. In accordance with 300.68 (j), the selection of remedy is based on how each alternative meets the specific response objectives of the Smuggler site, and how cost-effective and feasible they are from both an engineering and administrative perspective. EPA determined through the endangerment assessment process that the critical remedial needs are: (1) the permanent prevention of direct contact with and wind dispersal of highly contaminated soils and (2) leachate management to restrict possible ground water pathways. Table 15 summarizes the effectiveness of each proposed remedial alternative in addressing the remedial response objectives. None of the alternatives alone developed by the PRPs adequately address all of the response objectives individually. Consequently, the EPA alternative (Alternative 6), a combination of several of the PRP's alternatives, is the only alternative that adequately addresses each response objective.

Table 11

SUMMARY OF ANALYSES OF REMEDIAL ALTERNATIVES
FOR TECHNICAL AND INSTITUTIONAL CONSTRAINTS

Alternatives	Technical and Institutional Constraints	Public Health and the Environment	Total Costs*
1: Increased Monitoring	TECHNICAL: No constraints INSTITUTIONAL: No constraints	This alternative would not eliminate or reduce the possibility of direct contact with or wind dispersal of contaminated soil, nor would it reduce the risk of groundwater contamination.	$ 129,064**
2: Source Isolation (Grading and surface water diversion)	TECHNICAL: - Performance and realiability are good - Typical civil engineer practices can be implemented without problems. - Safety concerns limited to typical construction risks and to inhalation of dust during construction INSTITUTIONAL: - Sediment and erosion control plans - Local building regulations - CERCLA requirements	This alternative prevents direct contact with and wind dispersal of contaminated soils and may reduce groundwater pollution pathways. Dust produced during construction is an adverse but short-term effect on public health and the environment.	1,239,531
3: Replacement of Water Supply	TECHNICAL: - Performance and reliability are very good - Implementability is relatively easy - Safety concerns limited to construction risks INSTITUTIONAL: - Building permits - Municipal Water Supply User Agreements - CERCLA Requirements	This alternative would not eliminate or reduce the possibility of direct contact with or wind dispersal of contaminated soil. This alternative (replacing water supply) prevents exposure of the public to the possible threat of contaminated groundwater.	16,750
4: Plume Capture (Permeable treatment beds; or subsurface collection and treatment)	TECHNICAL (Permeable Treatment Beds): - Lack of an impermeable bottom soil layer adversely impacts performance and reliability	This alternative would not eliminate or reduce the threat of direct contact with or wind dispersal of contaminated soil.	2,962,641

Table 12

CRITICAL ASSESSMENT OF REMEDIAL ALTERNATIVES

Alternative	Advantages	Disadvantages
1. Increased Monitoring	- Inexpensive - Provides early warning if potential ground-water contamination were to migrate off site	- Does not protect public health and the environment from on-site contamination (dust and direct contact)
2. Source Isolation	- Utilizes reliable, easy-to-implement civil engineering construction techniques to effect remedy - Protects public health and the environment from on-site contamination (dust and direct contact) - Reduces threat to ground water by reducing the amount of surface water allowed to percolate through contaminated soils	- Contamination may be released from site as dust during construction. - Existing groundwater contamination pathways will remain
3. Replacement of Water Supplies	- Inexpensive - Municipal water supply systems are safe and easy to extend - Protects public health from possibly contaminated ground water	- Does not protect public health and the environment from on-site contamination (dust and direct contact)
4. Plume Capture	- Alernative will reduce present ground-water contamination pathways	- The bedrock under the site is permeable, and ground water may be able to flow below (and by-pass) treatment beds or subsurface collection drains - Does not protect public health and the environment from on-site contamination (dust and direct contact)
5. Source Removal	- Permanently removes on-site contamination and attendant exposure pathways	- Requires demolition of existing homes and streets - Generates a significant amount of hazardous waste to be transported and disposed - Transportation is extensive (70 million total travel miles) - Uses a significant portion of RCRA-approved hazardous waste landfill capacity
6. EPA Alternative	- Utilizes reliable, easy-to-implement civil engineering construction techniques - Protects public health & environment from on-site contamination - Reduces risk to ground water by reducing the amount of surface water allowed to percolate through contaminated soils - Protects public health from contaminated ground water - Provides early warning of ground-water contamination - Soils with heaviest contamination will be completely and permanently isolated from surface	- Ground-water contamination pathways will remain, but cover and increased monitoring are expected to reduce risks - Raises the need for institutional controls on low level caps

Table 13

APPLICATION OF PROPOSED REMEDIAL ALTERNATIVES
TO ALTERNATIVES REQUIRED TO BE DEVELOPED BY 40 CFR SECTION 300.68(f)

Remedial Alternative	Response Objectives				
	Off-Site Disposal	Attain Stds.	Exceed Stds.	Reduce Threat	No Action
Alternative 1 Increased Monitoring	-	-	-	X	-
Alternative 2 Source Isolation	-	*	-	X	-
Alternative 3 Replace H_2O Supply	-	**	-	X	-
Alternative 4 Plume Capture	-	**	-	X	-
Alternative 5 Source Removal	X	X	X	X	-
Alternative 6 EPA Alternative	-	X	-	X	-
Alternative 7 No Action	-	-	-	-	X

*This alternative does not include provisions for ground water monitoring or replacement of water supply. Therefore, EPA is unable to make the determination that such remedy will meet the applicable or appropriate and relevant standards.

**This alternative would attain all SDWA standards, but would not attain or exceed all public health and environmental standards at the site.

Table 14

EPA Estimate of
Total Capital and Operation and Maintenance Costs
Remedial Action Alternatives

Alternative	Description	Capital Cost ($)	Annual O & M ($)	Total Cost ($)
1	Increased Monitoring	0	13,300	131,964*
2	Source Isolation	1,197,800	17,600	1,416,216
3	Replace H_2O	18,750	0	18,750
4	Plume Capture	479,400	200,100	2,962,641
5	Source Removal	62,740,000	0	62,740,000
6	EPA Alternative	1,816,550	30,900	1,847,450

*Estimate based on 30 years monitoring at 3% discount rate

Source: CDM 1986

Table 15

APPLICATION OF PROPOSED REMEDIAL ALTERNATIVES TO REMEDIAL RESPONSE OBJECTIVES

Remedial Alternative	Response Objectives			
	Air	Surface	Ground Water	Permanence
Alternative 1 Increased Monitoring	-	-	X	-
Alternative 2 Source Isolation	X	X	*	**
Alternative 3 Replace H_2O Supply	-	-	-	-
Alternative 4 Plume Capture	-	-	X	-
Alternative 5 Source Removal	X	X	X	X
Alternative 6 EPA Alternative	X	X	X	***
Alternative 7 No Action	-	-	-	-

*Ground water monitoring is not part of this alternative, therefore, there is no guarantee of its effectiveness on mitigating any observed ground water impacts.

**Permanence of this remedial alternative is contingent on institutional controls. Both the high and low-level wastes may be subject to future excavation, and exposure pathways may be reexposed.

***Permanence of this remedial alternative is contingent on institutional controls. Although the low level waste material may be exposed during excavation in the future, the high level wastes will be under the perpetual care of Pitkin County and subject to a permanent land use restriction.

F. COMMUNITY RELATIONS

In accordance with the NCP at 40 C.F.R. Section 300.67, a community relations plan was prepared by the REM II team member (ICF) and approved by the Region VIII RPM and Community Relations Coordinator. As specified in the plan, press releases and fact sheets were prepared and issued, and public meetings were held when major events occurred. Because Aspen, Colorado, is a well-known international resort, special care was taken by the Agency to provide accurate and timely information to the residents without unduly jeopardizing the tourist industry.

Because of past efforts by the Aspen/Pitkin County Environmental Health Department, the community was already knowledgeable about potentially adverse health effects from the mining wastes on the site. Consequently, most of the effort was geared towards informing the public about the Superfund process and the schedule which would lead to selection and implementation of the remedy. Citizens and PRPs are very interested in cleaning up as soon as possilbe for both public health and economic reasons. There is a smaller group of individuals in the local mining business which wants to develop the mineral resources in and near Aspen.

All the citizen comments were reviewed and considered prior to making the final selection of remedy. The recommended remedy meets the Agency's responsibility to protect public health, welfare, and the environment without foreclosing the development of mineral resources in the area.

G. CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS

Section 300.68(j) of the National Contingency Plan requires that the lead agency select a cost-effective remedy that effectively mitigates and minimizes threats to and that provides adequate protection of public health, welfare and the environment. This requires the selection of a remedy that attains or exceeds applicable or relevant and appropriate Federal public health and environmental requirements identified for each specific site. EPA has determined that the following applicable or relevant and appropriate requirements apply to the Smuggler Mountain site:

Applicable:

Safe Drinking Water Act: Maximum contaminant levels (MCLs).

Clean Water Act: *Non-point source control; water quality standards.*

Ground Water Protection Strategy: Protection and enhancement of Class II aquifers.

Off-Site Policy

Relevant and Appropriate:

Resource Conservation and Recovery Act (RCRA): Capping performance requirements; ground water monitoring and corrective action; site access restrictions; run-on, run-off controls; in-place closure of a landfill; waste piles.

National Historic Preservation and Antiquities Act

National Environmental Policy Act (NEPA): Requirements for preservation of National Historic Sites (Smuggler Mine).

Safe Drinking Water Act (SDWA): Maximum contaminant level goals (MCLG)

In addition, the following requirements may be found to be relevant and appropriate:

- State Statutes and Regulations on Water Supply Systems Additions.

- Colorado Mined Land Reclamation Act and Regulations.

- RCRA Guide to the Disposal of Chemically Stabilized and Solidified Wastes.

- RCRA Guidance Manual on Closure and Post-Closure Interim Status Standards.

In evaluating the alternatives, EPA has determined that the recommended alternative would comply with these standards as follows:

Safe Drinking Water Act: Planned monitoring and subsequent remedial action (if found to be necessary) for ground water contamination at the site use MCLs as action levels. (EPA retains the option of considering alternate contaminant levels (ACLs) when determining future action, if necessary, to remediate groundwater contamination.)

Clean Water Act: Non-point source controls were considered early on in the review of site characterization data, and in analysis of the low-flow sampling of surface water and sediment. In 1983, the Field Investigation Team determined that the Mollie Gibson mine Drainage and the Cowenhoven Tunnels are not permitted discharges. Surface water contamination is not at this time a problem at the site. Consequently, non-point source controls were not designed as part of the remedy. Additionally, surface water quality standards of the Clean Water Act and State water quality standards have not been exceeded in the site vicinity. However, if continued ground water monitoring indicates elevated contamination, action will be taken to assure the attainment of such surface water standards.

Ground Water Protection Strategy: No Federal or State standards for aquifer protection have been promulgated. Direct remediation of the aquifer appears to be unnecessary at this time since ground water contamination does not currently appear to present a serious risk to public health or the environment. However, if in the future, ground water is adversely impacted by contamination from the soils, RCRA ground water protection standards as set forth in 40 CFR Section 264.92 shall be considered to be applicable or relevant and appropriate at this site. In addition, the proposed remedy includes provisions to place all private well users (tapping the Roaring Fork alluvial aquifer) in the site vicinity on city water.

RCRA: Surface run-on controls (40 CFR Section 264.25(c) have been determined to be relevant and appropriate as part of the site remedy. Since surface water run-on and leaching of contaminants to ground water is a potential route for release of hazardous constituents at the site, surface water monitoring and subsequent response action may be recommended if further ground water monitoring demonstrates increasing contamination. EPA Monitoring Well Numbers 7, 9 and 10 are located on the facility boundary as defined by RCRA. Ground water monitoring would be implemented as Operable Unit number two of the recommended remedy. Capping requirements for landfills are being adopted for the high-level waste repository. Data generated by EPA and the PRPs indicate that the mine wastes to be placed in the repository are not highly susceptible to leaching. The data show that the mine waste host rock is a carbonate material and causes reducing conditions in the waste piles, thereby rendering the hazardous substances in the waste materials more stable and less mobile. Therefore, an impervious, multi-layer cap should be sufficient to prevent leaching of hazardous substances from the repository into ground water. RCRA standards for the in-place closure of landfills or waste piles do not require liners and leachate collection systems and are not considered to be relevant and appropriate to this situation. Periodic inspection and maintenance are appropriate (40 CFR Section 264.303), as are post-closure care requirements (40 CFR Section 264.117). RCRA standards for disposal of chemically stabilized and solidified waste would be relevant and appropriate only if plume capture becomes necessary and the attendant water treatment facility on-site produces sludge to be moved off-site.

H. RECOMMENDED ALTERNATIVE

Based on a comparison of the advantages and disadvantages of the five alternatives, EPA recommends that Alternative 6 be selected as the remedial action alternative. The recommended action would, if properly and expeditiously executed, accomplish a stable, low-maintenance, cost-effective remedy, and is designed to mitigate or eliminate the toxicity and mobility of the contaminants. All known existing sources and pathways of contamination would be eliminated, thereby minimizing or eliminating risks to human health and the environment. The Agency for Toxic Substances and Disease Registry (ATSDR), in their momorandum of Septmeber 11, 1986, to EPA Region VIII, stated, "The Smuggler Mountain Site represents a potential public health threat to area residents. The EPA action level for lead (1000 ppm) is acceptable for future remediation efforts." The chosen remedy is permanent to the extent practicable and is separated into two operable units. The first operable unit addresses the Smuggler site and does not include the portion of the site upon which the Smuggler Mine is located. The second operable unit addresses the Smuggler Mine. A detailed description of each operable unit follows:

Operable Unit 1: Site Remedy

Operable unit 1 is separated into five components as follow:

A. Source Isolation of High-Level Wastes. Isolate soils and tailings with levels of lead at or above 5,000 ppm by excavation and removal to a secure repository. This alternative could involve either the removal of such material by shipping it to a RCRA certified facility, or by depositing it in a secure repository on-site, as defined by EPA. EPA has identified a suitable repository on the site, the County-owned Mollie Gibson Park. If the repository is chosen for deposition of the high-level wastes, it will be excavated to the extent necessary to accomodate the entire volume of high level waste on the site. It will then be prepared to specifications set by EPA that adequately address the issues of surface run-on and stability. All high-level wastes from the site (other than the mine site, itself) will be consolidated and placed in the repository. The repository will be graded and capped in accordance with the appropriate and relevant RCRA standards for landfills (capped with a multi-layer cap possessing a permeability of at least 10^{-7}). A drainage system will be designed according to EPA specifications (designed to pass the 100-year runoff event with a minimum of erosion). The repository will be under the perpetual care of a permanent entity, Pitkin County, to assure the permanent disposition and zero mobility of the contaminants.

B. Source Isolation of Low Level Wastes. Confine soils with levels of lead below 1,000 ppm in such a manner that direct contact, surface water erosion, and wind dispersal are precluded. This operable unit involves the identification of the affected areas using the geostatistical isopleth map. After identification and possible further sampling to more clearly define the contaminated areas, the low level areas will either be covered by six inches of topsoil, graded, and revegetated, or covered with six inches clean fill plus six inches of topsoil and graded. Areas needing further identification will be defined by additional sampling. If such sampling is performed by the PRPs, EPA will verify such sampling. Areas already remediated by property owners will be examined by EPA to determine compliance with design standards.

C. Increased Ground Water Monitoring. Because the ground water system in the area of the site is so uncertain, groundwater monitoring is necessary to confirm the effectiveness of the remedy. Additional wells will be installed as deemed necessary by EPA. A monitoring grid and monitoring schedule will be established. Quarterly reports to EPA will describe the results of monitoring and any trends observed. Ground water in the vicinity of the site will be monitored for a period of five (5) years quarterly to determine efficacy of the capping in enhancing ground water quality. After the close of the monitoring period, the decision must be made by EPA to either implement plume capture and treatment, select alternate concentration limits, or take no further response action.

D. Alternate Water Supply. This operable unit involves the identification of domestic water wells immediately downgradient of the site. After identification, such wells will be replaced by hook-ups to the City water supply and will no longer serve as domestic-use wells.

E. Operation and Maintenance of Low and High Level Waste Caps. The purpose of cap inspections is to note and repair any deterioration, disturbance, or discontinuity before it can impact cap integrity. Weekly inspections are anticipated during the first year. Bi-monthly inspections will take place for the second year. After two years, inspections will be conducted monthly, and from the beginning of the fourth year, quarterly inspections will be conducted for the following twenty-six years.

Operable Unit 2: Mine Reclamation and Ground Water Corrective Action

A. Mine Reclamation. The Smuggler-Durant Mine site will be remediated separately from the remainder of the site. The current extent of toxicity and mobility of the contamination at the mine site is unknown. An addendum to the existing Remedial Investigation and Feasibility study will be prepared to characterize the wastes and determine the appropriate extent of remedy at the Smuggler-Durant Mine site in accordance with the National Contingency Plan and in accordance with the applicable or relevant and appropriate requirements necessary to meet Federal public health and environmental requirements. The Smuggler Mine RI/FS will be subject to public comment and a recommended remedy will be presented. The appropriate extent of remedy, consistent with the NCP, would address the possible historic value of the mine site. The plan for mine site remediation, consistent with the goals and objectives of the RI/FS and NCP, will be prepared by the owners of the mine site and submitted to EPA for approval, or would be prepared by EPA. In accordance with the requirements of the National Environmental Policy Act (NEPA), if the mine site is declared a National Historic Site, the buildings and other structures on the mine site would be adequately maintained for their historic value. Applicable and relevant or appropriate standards and requirements for the safety of workers and visitors to the mine site would be complied with. At the same time, wastes on the mine site will be treated or remedied so as to prevent and/or mitigate the present or future threat of release in a manner that is protective of public health, welfare and the environment. Such remedy would provide a level of protection of public health and environment comparable to the remedy on the remainder of the site.

B. Ground Water Corrective Action. If the results of ground water monitoring conducted during the first operable unit indicate that corrective action is necessary, alternatives will be developed to address the situation and possible response actions will be considered.

C. Performance of Mine Reclamation and Ground Water Corrective Action as Approved by EPA.

A conservative estimate of the total capital and operation and maintenance costs for the recommended remedial alternative is 1.5 to 2 million dollars.

I. OPERATION AND MAINTENANCE

Operation and maintenance at the site is separated into two components. The first component addresses the cap for the high level repository, the second component addresses the the low level waste cap. Both components are described in detail in the preceding discussion on the recommended remedy. Such maintenance includes monitoring of capped areas in accordance with a schedule to be set forth by EPA to detect and remedy any erosion of the cap, as well as land use restrictions imposed by Pitkin County on any subsequent development of capped areas.

J. SCHEDULE/FUTURE ACTIONS

4Q FY 1986 - Regional Administrator signs EDD.
X - Resolution of enforcement activity

[Operable Unit #1]*,**

X + 1 Month	- Provide alternate water supply
X + 2 months	- Initiate site sampling/verification
X + 3 months	- Initiate design of repository
X + 6 months	- Complete design of repository
X + 8 months	- Preparation of repository
X + 9 months	- Excavation and deposition of highly-contaminated soils
X + 12 months	- Capping of repository
	- In-place capping of low-level soils
	- verificatiion of areas capped previously
	- 26 years operation & maintanence of caps

[Operable Unit #2]*

X + 1 month	- RI/FS workplan complete
X + 3 months	- Draft RI/FS submitted to or prepared by EPA
X + 6 months	- Final RI/FS and recommended remedy
	- Public comment
X + 7 months	- Start design
X + 9 months	- Complete design
X + 12 months	- Start construction
X + 20 months	- Complete construction
X + 60 months	- Review ground-water data, determine if future response is necessary
X + 62 months	- Start design if necessary
X + 66 months	- Public comment
	- Complete design
X + 72 months	- Start construction
X + 80 months	- Complete construction

* All dates subject to restraints imposed by short construction season in Aspen

** Grounawater monitoring continues quarterly since 4Q 1985

LIST OF FIGURES

LIST OF TABLES

Table 11 (Continued)

SUMMARY OF ANALYSES OF REMEDIAL ALTERNATIVES
FOR TECHNICAL AND INSTITUTIONAL CONSTRAINTS

Alternatives	Technical and Institutional Constraints	Public Health and the Environment	Total Costs*
4 (Cont)	- There is no operating history - Safety concerns limited to construction risks (especially open trenches) TECHNICAL (Collection and Treatment): - No impermeable bottom soil layer impacts performance and reliability, adversely INSTITUTIONAL (Permeable Treatment Beds): - Local building codes - CERCLA requirements - Surface water discharge permits	This alternative provides a limited barrier to migration of contaminated groundwater Dust from excavation of contaminated and uncontaminated soil would have an adverse but short-term effect on public health and the environment.	
5: Source Removal	TECHNICAL: - Excavation of all contaminated soils would require demolition of on-site buildings - Secure landfills have reported some limited leachate problems (reliability) - Disposal of 1.3 x 10^6 cy would consume a considerable volume of secure landfill space; capacity in a secure landfill could become scarce (implementability) - Safety concerns related to construction practices and the risk of accidents during transportation INSTITUTIONAL: - CERCLA requirements - RCRA requirements - Sediment and erosion control plans	LONG-TERM: - Prevents direct contact with and wind dispersal of contaminated soils and eliminates potential groundwater pollution pathways at the site. - Contaminated soil could affect groundwater if the secure landfill which the waste is to be disposed in generates leachate which is allowed to migrate off-site. SHORT-TERM: - Dusts from contaminated soil can be dispersed by wind during construction - Increase of accident and exposure risk during transportation (see safety, technical constraints)	$66,750,000
6: EPA Alternative	TECHNICAL: - Performance & reliability are good - Safety concerns limited to period of construction - No constraints for ground-water monitoring INSTITUTIONAL: - Sediment & erosion control plans - Water supply user agreements		

*As estimated by PRP's
**Estimate based on 30 years monitoring with a 7% discount rate.