Early Cleanup Up Action for Elizabeth Mine
Public meetings scheduled for March and April 2002

Elizabeth Mine Superfund Site, Strafford/Thetford, Vermont

The Cleanup Proposal...

After careful study of the impacts of acid mine drainage (AMD) from the Elizabeth Mine on the surface water, sediment, and aquatic organisms of the West Branch of the Ompompanoosuc River (WBOR) and Copperas Brook, EPA proposes the following early cleanup plan:

- **Divert clean surface water and groundwater flow around the tailing piles (TP-1, TP-2, and TP-3).**
- **Capture and treat the acid mine drainage flowing from TP-3 using a combination of natural treatment systems.**
- **Capture and treat the acid mine drainage flowing from seeps along the toe of TP-1 using a combination of natural treatment systems.**
- **Preserve a portion (up to 100%) of the copper waste rock and copperas heap leaching piles adjacent to the North Open Cut (TP-3) (three preservation options presented).**
- **Cover two tailings piles (TP-1 and TP-2) with a cover system that will limit infiltration.**

See page 12 for more detail.

What do you think?

Find out about the proposed cleanup plan at public meetings scheduled for March 13, 2002 in South Strafford and March 14, 2002 in Thetford. At these meetings, EPA will summarize the cleanup proposal and will be available to respond to your questions and concerns about how the cleanup. For more information about these meetings, call EPA Community Involvement Coordinator Sarah White toll free at (888) 372-7341 ext. 81026. Should you have specific needs or questions about the facility, its accessibility or transportation, please contact Ed Hathaway at 888-372-7341 ext. 81372.

EPA is accepting public comment on this cleanup proposal from March 15, 2002 through April 15, 2002. If you have comments regarding EPA's proposed cleanup plan for the Elizabeth Mine Site, EPA wants to hear them before making a final decision

Public Information Meetings

March 13, 2002
7:00 p.m.
Barrett Hall
Route 132
South Strafford, VT

March 14, 2002
7:00 p.m.
Parish Players Hall
Academy Road
Thetford Hill

Comment Meeting

Opportunity to enter official comments for public record about this Proposed Plan

April 10, 2002
7:00 p.m.
Barrett Hall
Route 132
South Strafford, VT

To provide formal comments, you may:

Offer oral comments during the public hearing on April 10, 2002 (see page 16 for details)

Send written comments postmarked no later than April 15, 2002 to:
Edward Hathaway, RPM
U.S. EPA Region I
Suite 1100 (HBT)
1 Congress St
Boston, MA 02114-2023

E-mail comments by April 15, 2002 to: **hathaway.ed@epa.gov**

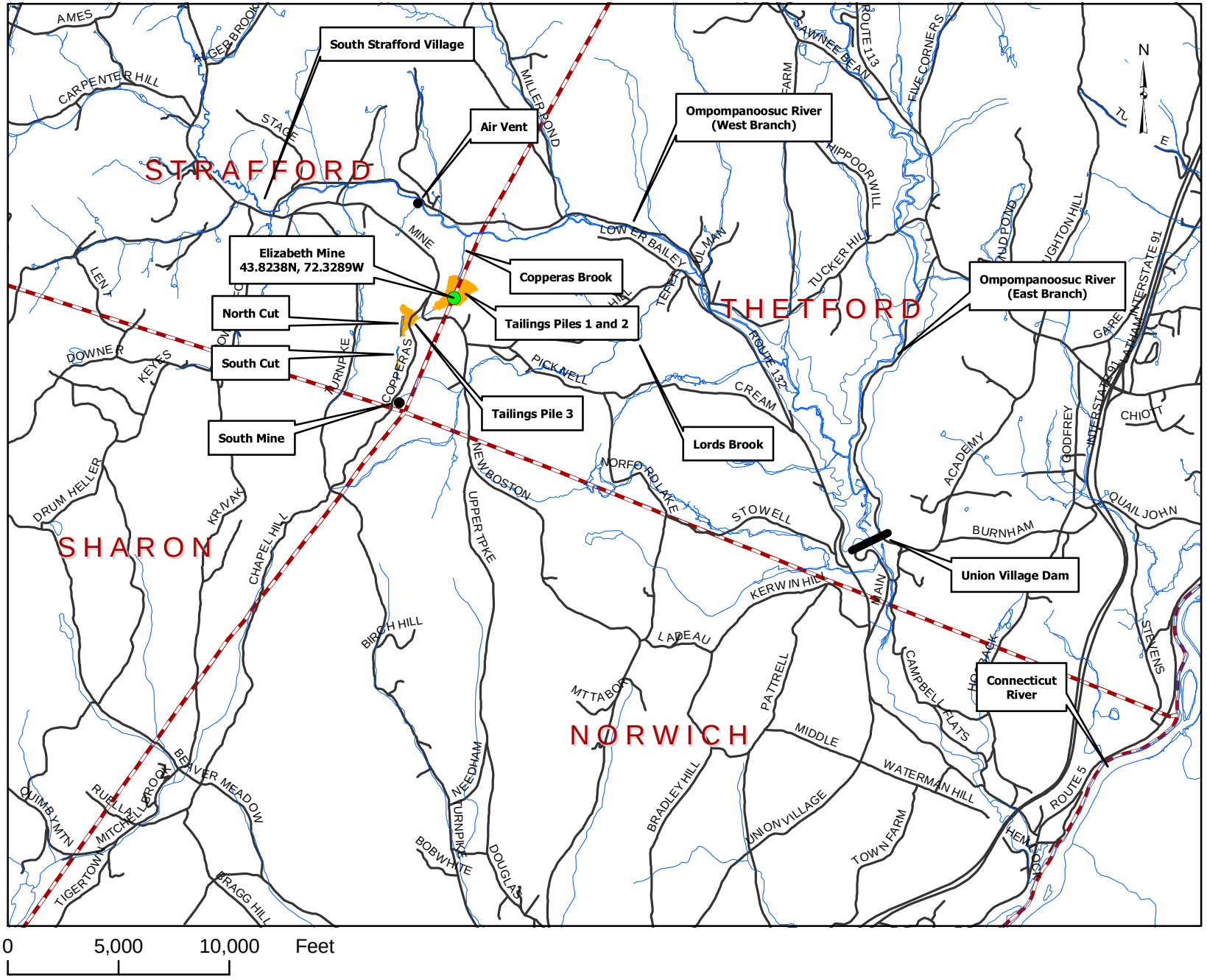

Figure 1 - Site Location Map

BACKGROUND INFORMATION

Site Description

The Elizabeth Mine is located in the towns of Strafford and Thetford in east-central Vermont, approximately 1.9 miles southeast of the village of South Strafford, on the eastern flank of Copperas Hill. It is approximately 15 miles north of White River Junction and 9 miles west of the Connecticut River. See Figure 1 for Site location.

Four areas have been identified as potential sources of contamination (See Figure 2):

1. Three areas of waste rock, tailings, and heap leach piles:
   TP-1 a 30 acre tailing pile;
   TP-2 a 5 acre tailing pile; and
   TP-3 a 12 acre area of heap leaching piles and waste rock.

2. Two areas of excavated bedrock (referred to as the North Open Cut and the South Open Cut).

3. The underground workings (shafts and adits) that extend for almost one mile northward under the WBOR.

4. A small area of tailings and associated shafts and cuts near the South Open Cut(referred to as the South Mine).

The three areas of waste rock, tailings, and heap leach piles (TP-1, TP-2, and TP-3) as well as the North Open Cut are located within the Copperas Brook drainage. (See Figure 3) The Copperas Brook watershed drains into the WBOR, approximately six miles upstream from its confluence with the Ompompanoosuc River, near the Union Village Dam. The Ompompanoosuc River empties into the Connecticut River a approximately three miles downstream of the Union Village Dam.

The South Open Cut and the South Mine are located within the Lord Brook watershed. These two source areas discharge to a small seasonal stream that flows into Lord Brook. Lord Brook runs along the eastern side of Gove Hill until joining with the WBOR just west of the Route 132 bridge in Thetford.

The water collected within the one mile of underground mine workings discharges at a location known as the “air shaft”. The water from the air shaft flows down a short drainage into the WBOR about 0.5 miles upstream of the Copperas Brook - WBOR confluence.

Site History

Studies by the Vermont Agency of Natural Resources (VT ANR) during the 1970's and the U.S. Army Corps of Engineers (USACE) in the 1980's identified the Elizabeth Mine as a source of pollution to the WBOR.

In 1999, the VT ANR requested EPA to conduct an assessment of the Elizabeth Mine to determine if a removal action would be an appropriate early cleanup. EPA performed an initial evaluation and concurred with the VT ANR assessment that there was an obvious source of contamination at the Site that could be addressed as an early action using the EPA Non-Time-Critical Removal Authority (NTCRA). EPA signed an Approval Memorandum in February 2000 authorizing the preparation of a Engineering Evaluation and Cost Analysis (EE/CA) in support of the early cleanup (NTCRA). To assure the complete

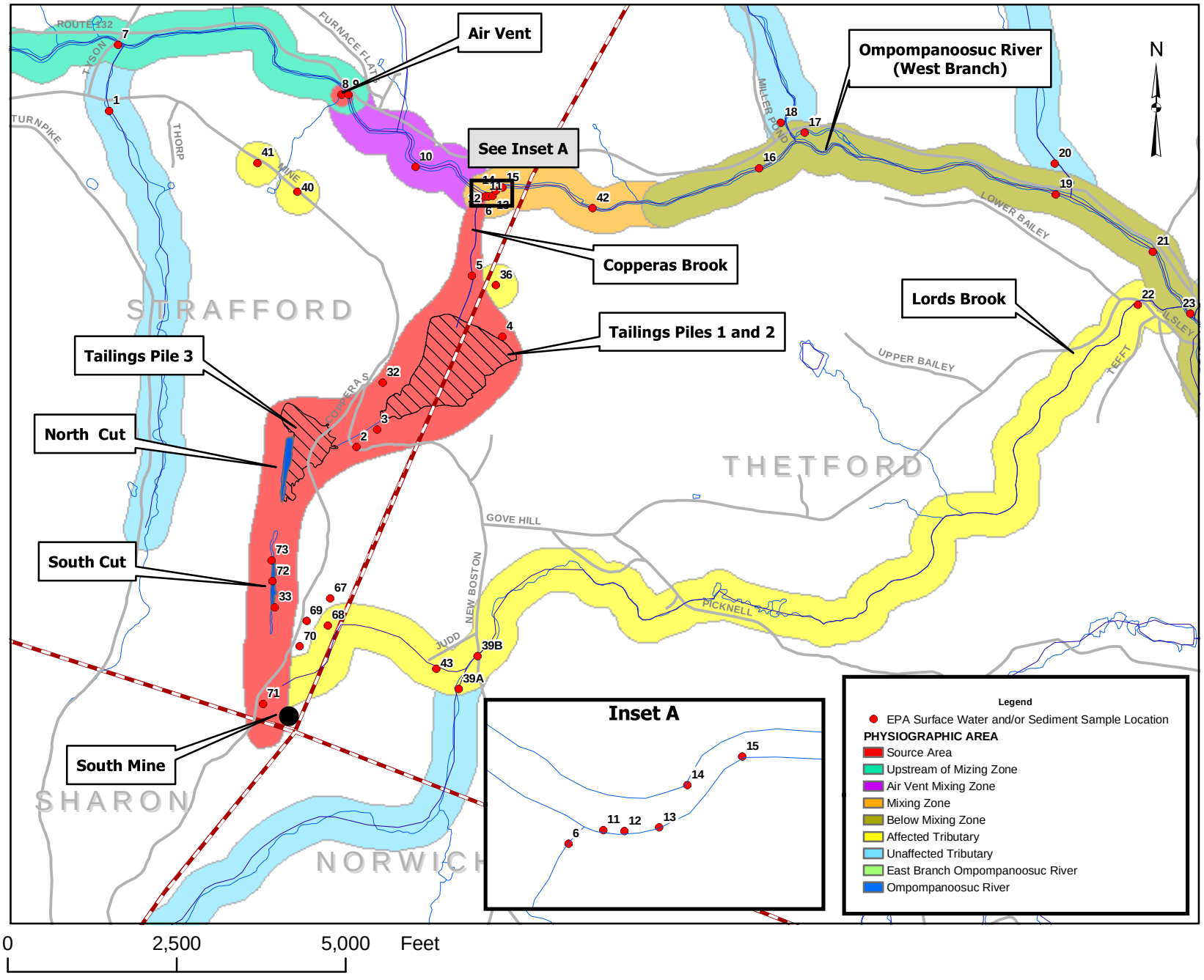

Figure 2 - Potential Areas of Contamination

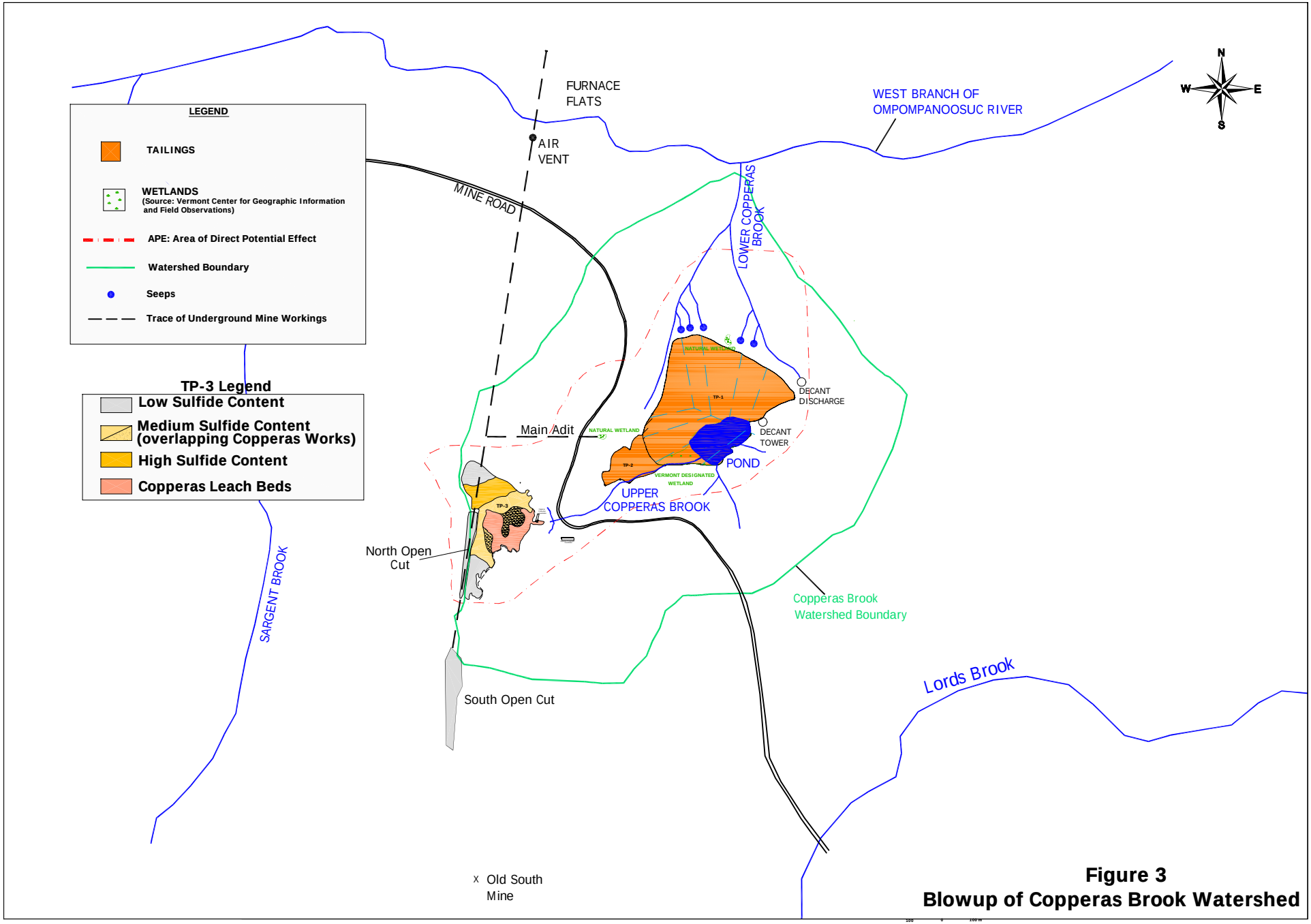

Figure 3
Blowup of Copperas Brook Watershed

characterization of the Site and all potential sources of contamination, the State of Vermont requested that EPA propose the Site for listing on the National Priorities List (NPL) in December 2000. The Elizabeth Mine was placed on the NPL in June 2001.

The industrial history of the Elizabeth Mine began with the discovery of a massive sulfide ore body along a ridge located southeast of South Strafford village in 1793. The mine was initially worked for the sulfide mineral pyrrhotite to manufacture copperas. Copperas is a crystalline green hydrous iron sulfate that has been used for a variety of purposes including: production of sulfuric acid; a disinfectant and sheep dip; astringent medicine; to blacken and color leather; and as a drier in ground pigment manufacturing. Major production of Copperas began in 1810 and ended in the 1880's. In 1830, Strafford Copper Works was formed to extract copper from the mine. During the early mining operations, copper was smelted on-site.

Underground mining began in the early to mid-1800s. The mine was worked intermittently for copper from 1830 until 1930. In 1942, the mine reopened in response to World War II. Most of the underground copper mining occurred between 1942 and the mine's final closure in 1958.

The copperas production area includes 12 acres at the top of the Copperas Brook watershed adjacent to the North Open Cut. This area contains colorful piles of variably pyrolyzed sulfide ore that are part of the "heap leach" piles from the copperas production. Some of the heap leach piles are overlain by waste rock from some of the earliest copper mining at the Site. This area is known as TP-3.

The tailings in areas designated as TP-1 and TP-2 were generated through the milling of sulfide ores between 1942 and 1958. A sulfide flotation mill was constructed during this period, where the ore was refined and the resulting concentrate was shipped to off-site smelters. The remaining material was pumped to settling ponds, resulting in the formation of the tailings piles. Today, an orange iron-oxide rich "rind" covers the surface of TP-1 and TP-2 to a depth of one to two feet below the tailings surface. Below this oxidized cap, a uniform layer of black sulfide-rich anoxic tailings extends to the base of each pile.

Historic Significance of the Elizabeth Mine

The Elizabeth Mine is a historic resource that embodies the distinctive landscape, engineering, and architectural resources that are characteristic of an early nineteenth- to mid-twentieth-century American metal mining and processing site. It constitutes one of the largest and most intact historic mining sites in New England and includes the only intact cluster of hard-rock mining buildings in the region.

The Elizabeth Mine was the site of a major nineteenth century U.S. copperas manufacturing plant and is associated with successful patents for copperas production. It is also associated with a number of significant commercial, scientific, and political figures, including Isaac Tyson, Jr., a Baltimore, Maryland-based chemical and mining figure who was recently inducted into the American Institute of Mining, Metallurgical and Petroleum Engineers' (AIME) Mining Hall of Fame. EPA has determined the Elizabeth Mine Site to be eligible for listing on the National Register of Historic Places.

Scope and Role of this Action

EPA has proposed to implement a phased approach to the cleanup of the Elizabeth Mine Site. The first phase would be an early cleanup action that targets the more obvious sources of contamination at the Site. The second phase would be the cleanup of any remaining areas of contamination that are identified through the remedial investigation and feasibility study

(RI/FS). An RI/FS is a comprehensive investigation that would determine the need and scope of any additional cleanup actions beyond the action proposed in this document.

The proposed cleanup plan described in this document and further described in the EE/CA is focused on the control of AMD and metals being released from the exposed tailings, waste rock, and heap leaching piles at the Site. The cleanup will be implemented as NTCRA.

The goal of the early cleanup action (NTCRA) is to control a major source of the AMD and metals that adversely affect Copperas Brook and a section of the WBOR. The expected result of the cleanup action is a dramatic improvement in the water quality within the WBOR from the confluence with Copperas Brook to the Union Village Dam.

Community Involvement to Date

EPA has committed substantial resources toward responding to community concerns and involving the community in the cleanup process. EPA has provided the community with technical resources through the Technical Assistance Grant (TAG) and the Technical Outreach Services to Communities (TOSC) programs. These programs provided the community with independent expertise from university and private professional experts to evaluate the EPA Reports. EPA also provided the Towns of Strafford and Thetford with a Redevelopment Initiative Grant to hire experts to assist in evaluating future use options for the Site after the cleanup is complete.

This cleanup proposal represents the culmination of two years of dialogue between EPA, the State ANR, the State Historic Preservation Officer (SHPO), and the local communities. To address the community concerns and to serve as a focal point for discussion with EPA, the Elizabeth Mine Community Advisory Group (EMCAG) was formed in April 2000. It consists of ten member organizations representing a cross section of the community.

The EMCAG member organizations are:

- Town Strafford Selectboard
- Town of Thetford Selectboard
- Elizabeth Mine Study Group (EMSG)
- Citizens for a Sensible Solution (CASS)
- Elizabeth Mine Survivors
- Adjacent Landowners and Residents
- Non-residential Landowners
- Thetford Conservation Commission
- Strafford Planning Commission
- Strafford Historical Society

EPA has met with the EMCAG almost monthly since April 2000. In September 2000, the EMCAG unanimously agreed to support the placement of the Elizabeth Mine on the NPL.

EPA has developed a process for extensive community involvement in shaping the cleanup at the Site. This process included the development of a series of reports for review by the EMCAG. The first report was a preliminary report of cleanup options, the Alternatives Analysis Report (AAR) (April 2001). EMCAG, VT ANR, and SHPO comments on the AAR were used to develop the first draft Engineering Evaluation and Cost Analysis (EE/CA), released in September 2001. The first draft EE/CA was also reviewed by the EMCAG, its technical consultants, and the VT ANR. In November 2001, the EMCAG submitted comments to EPA relating to the draft EE/CA. The final EE/CA (March 2002) reflects the culmination of those comments and the ongoing dialogue between EPA and the community.

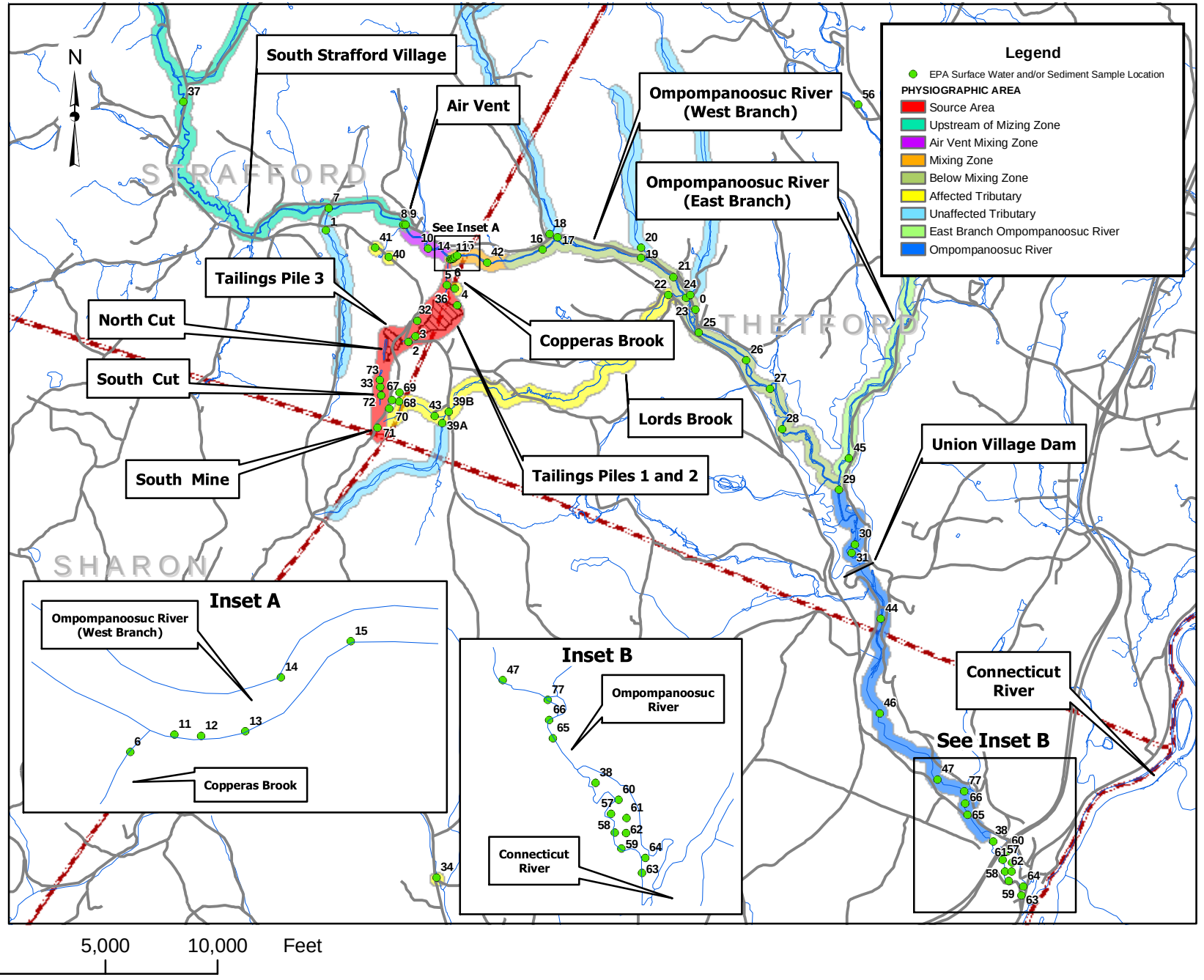

Figure 4 - Sample Locations and Physiographic Areas

EPA INVESTIGATIONS AND IMPACT ASSESSMENT

Investigation Program (2000 - 2001)

During 2000 and 2001, EPA implemented a data gathering program to better define the contamination at the Site. While substantial information had been collected prior to EPA involvement, it was important to obtain up to date and independent information to assess the impact of the Elizabeth Mine on human health and the environment. This early cleanup proposal was based on the information gathered in 2000 and early 2001. Data collection and assessment activities will continue into 2002 and beyond as part of the RI/FS.

A summary of the data collected through 2001 and preliminary conclusions from that data are contained in the following reports:

- Site Summary Report (October 2000);
- Site Conditions Report (February 2001);
- Preliminary Ecological and Human Health Risk Assessment (July 2001); and
- Engineering Evaluation and Cost Analysis (March 2002).

During 2000 and 2001 samples were taken for chemical analysis from:

- Residential wells adjacent to the Site;
- Tailing Piles TP-1, TP-2, and TP-3;
- Discharge from air shaft;
- Soils from adjacent residences;
- Indoor dust from adjacent residences;
- Surface water and sediments from Copperas Brook, Lord Brook, WBOR, and other brooks in the area;
- Fish from the WBOR; and
- Seeps discharging from TP-1.

In addition to the chemical analysis, various other studies were performed to assess the environmental impacts of the Site, including:

- Toxicity testing of the surface water and sediments;
- Benthic surveys;
- Fish population surveys;
- Algae (periphyton) surveys;
- Flow measurements in Copperas Brook and WBOR;
- Water levels measurements within the tailings;
- Mapping of the Site area; and
- Historic resource mapping and research.

Figure 4 shows the surface water and sediment sampling locations and how the data was grouped into areas of similar characteristics (physiographic areas) to assess impacts to surface water and sediment.

Results of the Investigation

The investigations completed by EPA confirm the findings of the previous investigations by the State of Vermont, USACE, and the EMSG. The Elizabeth Mine is a source of AMD drainage that results in low pH and elevated metal concentrations along the entire length of Copperas Brook as well as elevated metal concentrations along a six mile stretch of the WBOR. The alkalinity of the WBOR neutralizes the impact of the acid such that the pH of the WBOR is not acidic. However, the metal concentrations in the surface water are above levels considered toxic to fish. The benthic and fish population surveys confirm that all of Copperas Brook, a portion of Lord Brook, and a five mile stretch of WBOR fail to meet the VT ANR biological criteria for a Class B surface water.

The EPA investigations have also confirmed that the three tailing and waste rock piles (TP-1, TP-2, and TP-3) within the Copperas Brook watershed are the primary source of contamination to the WBOR. The very high

concentrations of contaminants detected in the surface water of Copperas Brook along with the documented impacts in the WBOR just below Copperas Brook clearly identifies this area as the primary source of contamination.

The "air vent" located along the banks of the WBOR which discharges ground water from the underground workings is another source of contamination. The air vent is located approximately one-half mile upstream of the confluence of Copperas Brook and the WBOR.. The studies completed to date suggest that the air vent is a less significant source of contamination than the tailings.

The South Open Cut and the South Mine waste rock piles are other small source areas at the Site. EPA investigations indicate that while these areas may be having a significant impact on a section of upper Lord Brook, these areas may not be having a significant impact on the WBOR.

What is causing the contamination?

The contamination at the Elizabeth Mine Site is primarily a result of acid mine drainage or "AMD". AMD is generated by the interaction of waste sulfide minerals (pyrrhotite, pyrite, and chalcopyrite) with water and oxygen. The bedrock that was mined for copperas and copper is naturally rich in sulfide. The mining process breaks the rock into small pieces that exposed more of the sulfide in the rock to oxygen and water. The oxidation of sulfides exposed to natural weathering conditions produces acid, which in turn dissolves metals such as aluminum, cadmium, cobalt, copper, iron, manganese, and zinc. These metals can be toxic to fish and other aquatic biota when present in surface water at concentrations above the water quality standards. In addition to the release of metals through AMD, erosion of the exposed tailings is also a mechanism for contaminants to enter the WBOR .

What are the primary contaminants of concern?

Fifteen contaminants were detected in surface water at concentrations above Vermont Water Quality Standards (VT WQS) or EPA criteria: aluminum, barium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, selenium, silver, thallium, vanadium, and zinc. Of these, six contaminants (aluminum, cobalt, copper, iron, manganese, and zinc) were detected at a frequency and concentration in the WBOR to be considered the primary Contaminants of Concern (COCs). While many of the COC's are found as naturally occurring constituents in the surface water of the region, the concentrations of the COC's in the WBOR were much higher downstream of the mine than upstream.

Tables 1 and 2 summarize the hazard index (ratio of contaminant to the safe level) for six COCs. A hazard index above one indicates a potential for a problem (for example a hazard index of 10 indicates that the contaminant is present at a concentration 10 times the level considered acceptable for a given receptor such as fish). These tables compare the hazard index of Copperas Brook and the section of the WBOR just below the confluence with Copperas Brook to the hazard index of areas upstream of Copperas Brook that are not impacted by the Site. For example, the upstream levels of copper did not exceed VT WQS while the levels found in Copperas Brook were 2210 times the VT WQS and the levels in the WBOR below Copperas Brook were 63 times the VT WQS. While aluminum was detected above standards upstream of the mine, the levels within Copperas Brook and the WBOR below Copperas Brook show a substantial increase in aluminum as a result of the mine drainage.

Table 1
Hazard Indices for Maximum Concentrations

Contaminant	Source Area (Copperas Brook)		Mixing Zone of WBOR below Copperas Brook		Upstream reference in WBOR	
	Chronic AAC	Acute MAC	Chronic AAC	Acute MAC	Chronic AAC	Acute MAC
Aluminum	1540	179	201	23	42	5
Cobalt	770	2	9	0.02	0.8	0.002
Copper	2210	1250	63	41	1	0.6
Iron	492		50		5	
Manganese	64	2	17	0.6	6	0.2
Zinc	30	30	1	1	0.1	0.1

Acute Criteria or Maximum Allowable Concentration (MAC): the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) **once every three years** without deleterious effects.
Chronic Criteria or Average Allowable Concentration (AAC): the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) **once every three years** without deleterious effects.
Hazard Indices: The hazard indices is the plural of hazard index. A hazard index is a number that represents the ratio of a safe or acceptable level to the level detected at the Site. For example: The above table indicates that copper is detected in the surface water of Copperas Brook at 2210 times the acceptable level using the AAC and 1250 times the acceptable level using the MAC. The levels in the Mixing Zone of the WBOR were 63 times the AAC and 42 times the MAC.

Table 2
Hazard Indices for Average Concentration

Contaminant	Source Area (Copperas Brook)		Mixing Zone of WBOR below Copperas Brook		Upstream reference in WBOR	
	Chronic AAC	Acute MAC	Chronic AAC	Acute MAC	Chronic AAC	Acute MAC
Aluminum	216	25	25	3	5	0.6
Cobalt	108	0.2	2	0.004	0.4	0.0008
Copper	221	125	8	5	0.2	0.1
Iron	108		12		0.6	
Manganese	30	1	4	0.1	0.8	0.03
Zinc	5	5	0.3	0.3	0.03	0.03

Acute Criteria or Maximum Allowable Concentration (MAC): the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) **once every three years** without deleterious effects.
Chronic Criteria or Average Allowable Concentration (AAC): the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) **once every three years** without deleterious effects.

Figure 5 - West Branch Ompompanoosuc River Ecological Data

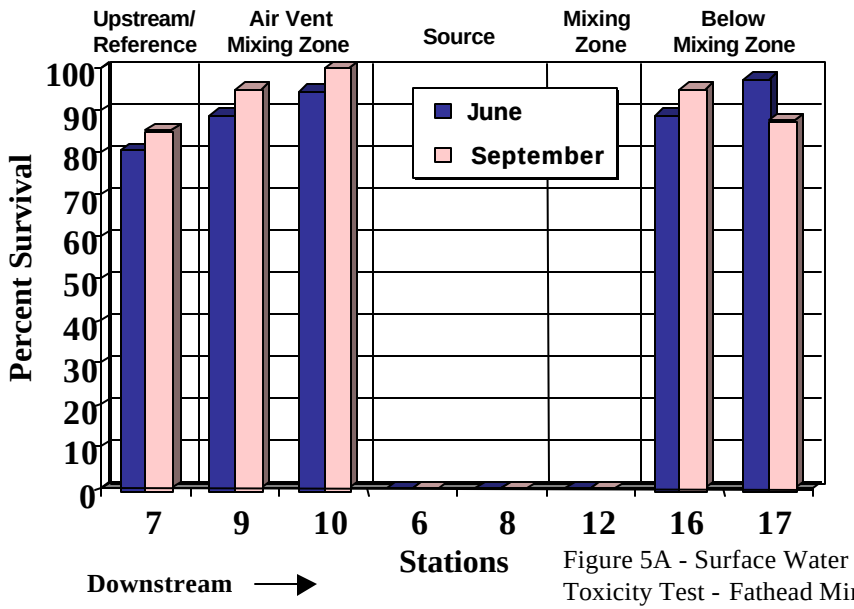

Figure 5A - Surface Water Toxicity Test - Fathead Minnow

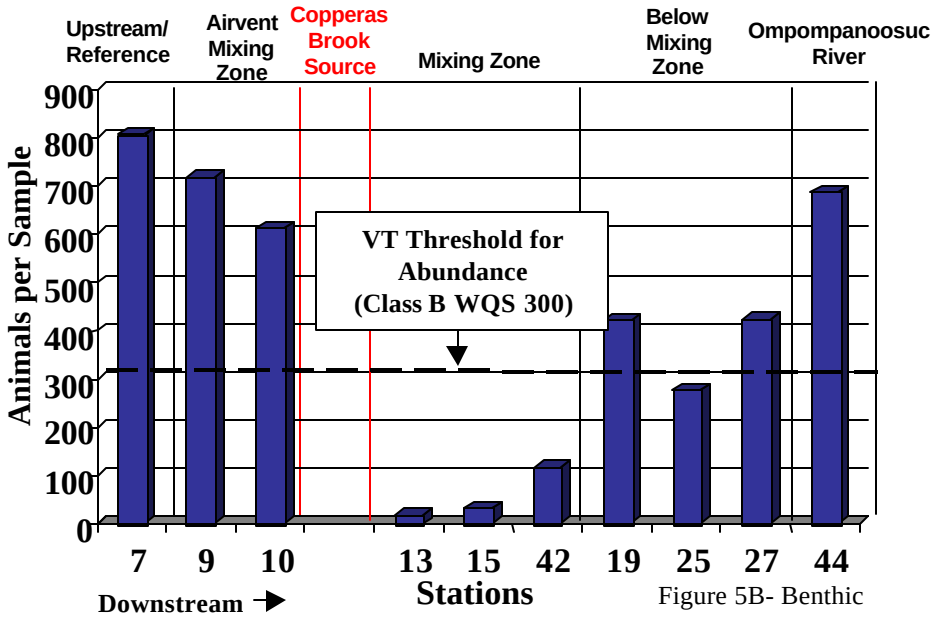

Figure 5B- Benthic Epifauna Density

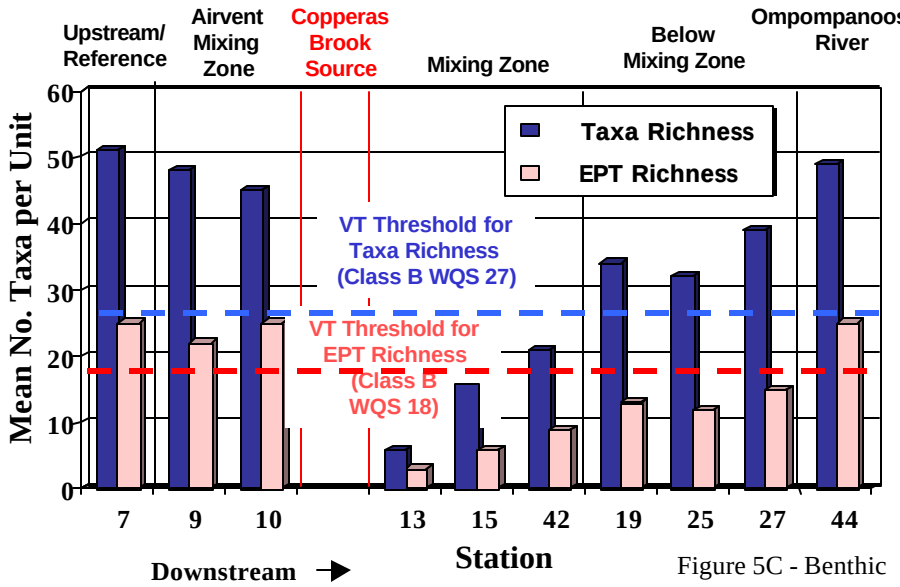

Figure 5C - Benthic Epifauna Diversity

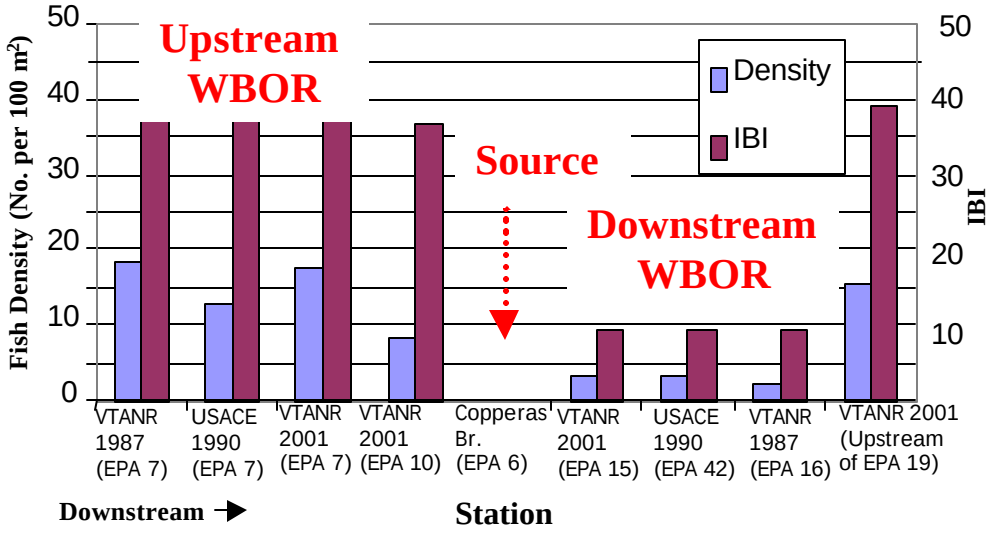

Figure 5D - West Branch Ompompanoosuc River Fish Studies

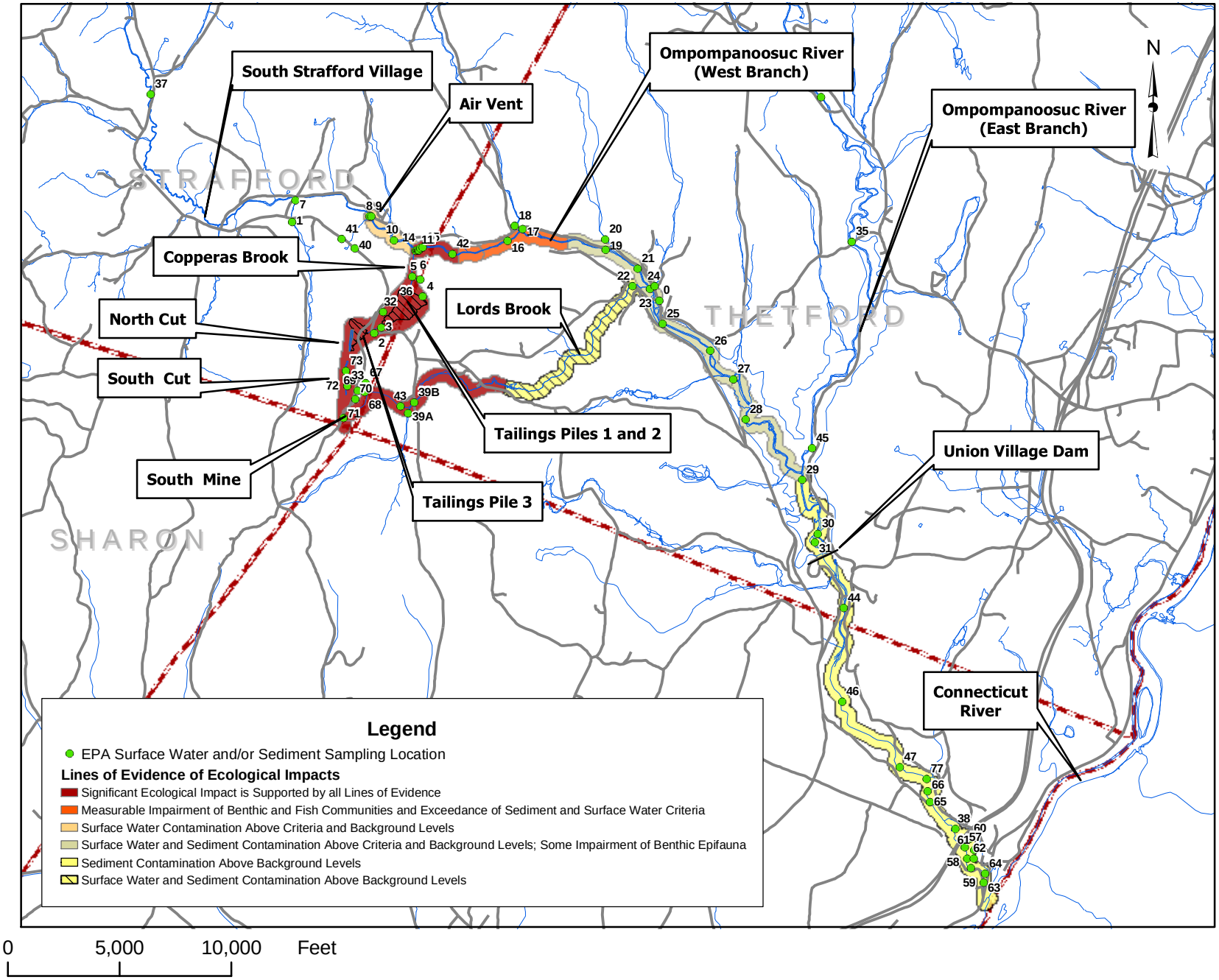

Figure 6 - Lines of Evidence of Ecological Impacts

Why is this cleanup needed?

This cleanup is necessary to begin the process of recovery for the WBOR after decades of AMD. The aquatic biological community (fish and invertebrates) in Copperas Brook and in the half-mile section of the WBOR below the confluence with Copperas Brook (this area is referred to as the "Mixing Zone" in the Tables and Figures) is severely affected by mine-related contamination. A recent survey by the VT ANR confirmed that approximately one mile of the WBOR below the confluence with Copperas Brook fails VT Class B Water Quality Standards relating to fish populations. A survey of the benthic (bottom dwelling) community performed by EPA and VT ANR at the same time as the fish survey revealed that about five miles of the WBOR below the confluence with Copperas Brook fail to meet VT Class B Water Quality Standards. The benthic survey confirmed severe impairment in the first mile with less severe, yet significant, impacts for the next four miles. The numerical VT WQS are exceeded for certain metals extending as far downstream as Union Village Dam.

In addition to the fish and benthic surveys, EPA performed toxicity tests to evaluate the quality of the surface water and sediments of Copperas Brook and WBOR. The toxicity tests indicate that the surface water and sediment in Copperas Brook and the first few hundred yards of the Mixing Zone of the WBOR are highly toxic to aquatic organisms. There was almost complete mortality of the test organisms in these areas. These highly toxic effects decrease rapidly with distance downstream and upstream from Copperas Brook where the nature of the impact shifts from almost complete elimination of the biota to a significant decline in the abundance and diversity of the biota. Figure 5 graphically depicts the significant impacts to fish and benthic organisms (bottom dwelling invertebrates) in the Source Area (Locations 6 and 8) and the Mixing Zone Area (Locations 12, 13, and 42). The graphs also show the high quality of the WBOR upstream of the Mixing Zone and that full recovery (to levels equal to upstream of the mine) of fish and benthic organisms does not occur until after EPA sampling location 27, which is just prior to the confluence with the Ompompanoosuc River above Union Village Dam.

Since all lines of evidence show that Copperas Brook and the Mixing Zone are the most severely impacted areas, it can be inferred that TP-1, TP-2, and TP-3, which are the contaminant sources located within the Copperas Brook drainage, are the cause of the most significant impacts to the WBOR. These impacts firmly support the need for an early cleanup action (NTCRA) to address these principal sources of contamination. See Figure 6 for a graphic presentation of the extent of impact.

An assessment of potential impacts to human health was performed. Contamination from the site has adversely impacted one residential water supply. This well is no longer in use and the residents have re-located. The water of the remaining residential wells in the area were sampled and found to meet federal and state primary drinking water standards. No other threats to human health have been identified to date.

Removal Action Objectives

Based upon the results of the investigations to date and the preliminary evaluation of human health and ecological risks, EPA identified the following objectives to serve as the basis for cleanup option development. The NTCRA focuses on the following objectives:

- Achieve VT WQS (chemical and biological) as well as other applicable standards for the WBOR by preventing or minimizing the discharge of water with mine-related metals contamination to Copperas Brook and the WBOR;

- Minimize erosion and transport of tailings or contaminated soil into the surface waters of Copperas Brook and the WBOR;
- Evaluate the stability of the waste piles (tailings, waste rock, and leach piles) and modify slope configurations (re-grading, covering, or buttressing) as necessary to provide for an acceptable level of long-term stability;
- Consider measures to minimize and, if possible, avoid an adverse effect on historic resources at the Site, as required by the National Historic Preservation Act (NHPA); and
- Comply with all applicable, relevant, and appropriate federal and state regulations (ARARs) while achieving these objectives.

Alternatives Evaluated for the Early Cleanup of the Elizabeth Mine Site

The Elizabeth Mine Site EE/CA contains a short list of cleanup alternatives based upon input from the community and the State. EPA has worked closely with the EMCAG to develop the list of alternatives developed in the EE/CA. An initial screening of alternatives was presented to the EMCAG in an Alternatives Analysis Report (AAR) released in April 2001. Based on the comments regarding the AAR, EPA developed the draft EE/CA which was released for review by the EMCAG and its technical consultants in September 2001. The alternatives evaluated in the final EE/CA result from the comments from VT ANR and the EMCAG regarding the AAR, the draft EE/CA.

The major themes in the comments from the community were to: reduce the volume of trucks that would travel through the local community; minimize the impact on the historic resources at the Site; ensure that the cleanup would meet its environmental objectives over the long-term; and minimize costs. EPA has carefully weighed these factors along with the Superfund guidelines for cleanup, and the input from the VT ANR in developing the EE/CA.

Based upon the discussions between EPA, VT ANR, and the EMCAG, all of the cleanup Alternatives described in the EE/CA include the following baseline items:

- Preservation of a portion of TP-3 to protect historic resources(up to 100%, exact amount to be determined during design);
- Diversion of surface water away from TP-1, TP-2 and TP-3;
- Collection and treatment of storm water runoff and drainage from TP-3 with passive treatment systems;
- Collection and treatment of drainage from the seeps at the toe of TP-1 with passive treatment systems;
- Stabilization of the steep slope areas of TP-1 and TP-2 only as necessary to achieve acceptable long-term stability while maintaining the current tailing profile to the extent possible; and
- Backfilling/stabilization of the decant piping system beneath TP-1.

The items above represent common components of each of the cleanup alternatives. The remaining component of each cleanup alternatives is the type of cover system that would be installed over TP-1 and TP-2. Four different cover systems were developed for consideration in the EE/CA. Cleanup alternatives 2B and 2C have the same multilayer cover system but differ because alternative 2B proposes to consolidate TP-2 onto TP-1 to reduce the size of the cover. Figure 7 shows a plan view of the baseline items described above and the cover system for each Alternative. Table 3 summarizes the cost of each Alternative.

The five cleanup alternatives evaluated in the EE/CA are described below.

Alternative 2B (Geosynthetic Infiltration Barrier Cover System with TP-2 Removal)

Alternative 2B is designed to minimize the footprint of the cover system to reduce capital and maintenance costs. The cover system for Alternative 2B is an infiltration barrier that minimizes the amount of water and oxygen that would enter TP-1 and TP-2. This type of cover system should result in a significant decline in the flow at the seeps over time thereby minimizing the long-term treatment costs for the seeps of TP-1. In addition to the baseline items previously discussed, Alternative 2B includes:

- Consolidation of TP-2 onto TP-1;
- Consolidation of the portion of TP-3 (if any) designated for removal onto TP-1; and
- Placement of a multilayer infiltration barrier cover system over consolidated TP-1.

Capital costs for Alternative 2B range from: $13.8 to $16.7 million depending upon the percentage of TP-3 removed. The maintenance costs for the cleanup will be the responsibility of the State of VT. The estimated annual costs to inspect, maintain, and sample range from $82,000 - $482,000 per year depending upon the percentage of TP-3 that is retained for treatment.

Alternative 2C (Geosynthetic Infiltration Barrier Cover System)

Alternative 2C, like Alternative 2B, was designed to minimize the infiltration of water and oxygen into the tailings. Alternative 2C is EPA's preferred alternative and is described in more detail on pages 12 - 14 of this Proposed Plan. In addition to the baseline items previously discussed, Alternative 2C includes:

- Consolidation of the portion of TP-3 (if any) designated for removal onto TP-1; and
- Placement of a multilayer infiltration barrier cover system over TP-1 and TP-2.

Capital costs for Alternative 2C range from: $13.1 to $16 million depending upon the percentage of TP-3 removed. The maintenance costs for the cleanup will be the responsibility of the State of VT. The estimated annual costs to inspect, maintain, and sample range from $90,000 - $490,000 per year depending upon the percentage of TP-3 that is retained for treatment.

Alternative 3B (Evapotranspiration Soil Cover)

Alternative 3B is a soil cover of sufficient thickness to for allow the water retention, evaporation, and transpiration properties of a vegetated soil to minimize infiltration into the tailings. In addition to the baseline items previously discussed, Alternative 3B includes:

- Consolidation of the portion of TP-3 (if any) designated for removal onto TP-1; and
- Placement of a 42 inch thick soil cover over TP-1 and TP-2 to reduce infiltration by means of evaporation and plant use.

Capital cost for Alternative 3B range from: $12.4 to $15.6 million depending upon the percentage of TP-3 removed. The maintenance costs for the cleanup will be the responsibility of the State of VT. The estimated annual costs to inspect, maintain, and sample range from $110,000 - $510,000 per year depending upon the percentage of TP-3 that is retained for treatment.

Alternative 3C (Minimal Soil Cover)

Alternative 3C is designed to be the minimal soil cover. Alternative 3C would only slightly reduce infiltration of water and oxygen into the tailings beyond what is currently occurring.

In addition to the baseline items previously discussed, Alternative 3C includes:

- Consolidation of the portion of TP-3 (if any) designated for removal onto TP-1; and
- Placement of the six inches of soil over the surface of TP-1 and TP-2.

Capital costs for Alternative 3C range from: $9.5 to $12.3 million depending upon the percentage of TP-3 removed. The maintenance costs for the cleanup will be the responsibility of the State of VT. The estimated annual costs to inspect, maintain, and sample range from $132,000 - $532,000 per year depending upon the percentage of TP-3 that is retained for treatment.

Alternative 3D (Hardpan Barrier Layer)

Alternative 3D includes a chemical cap formed by the reaction of the sulfides and carbonate to form a gypsum layer that will substantially reduce infiltration. In addition to the baseline items previously discussed, Alternative 3D includes:

- Consolidation of the portion of TP-3 (if any) designated for removal onto TP-1;
- Placing lime and/or crushed limestone on top of the tailings to form a chemical cap on TP-1 and TP-2;
- Placement of a drainage net beneath the soil to prevent ponding of water above the hardpan layer; and
- Placement of 18 inches of soil on top of the limestone to promote a long-term vegetative cover.

Capital costs for Alternative 3D range from: $12.2 to $15 million depending upon the percentage of TP-3 removed. The maintenance costs for the cleanup will be the responsibility of the State of VT. The estimated annual costs to inspect, maintain, and sample range from $90,000 - $490,000 per year depending upon the percentage of TP-3 that is retained for treatment.

The Criteria for Choosing a Cleanup

As specified in EPA guidance, three basic criteria are evaluated to balance the pros and cons of cleanup alternatives. These criteria are:

(1) Effectiveness:

Overall protection of human health and the environment: Will it protect you and the plant and animal life on and near the site? EPA will not choose a plan that does not meet this basic criterion.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): Does the alternative meet all federal and state environmental statutes, regulations and requirements on-site?

Long-term effectiveness and permanence: Will the effects of the cleanup plan last or could contamination cause future risk?

Reduction of toxicity, mobility or volume through treatment: Does the alternative reduce the harmful effects of the contaminants, the spread of contaminants, and the amount of contaminated material through the use of a treatment technology?

Short-term effectiveness: How soon will site risks be adequately reduced? Could the cleanup cause short-term hazards to workers, residents or the environment?

(2)Implementability: Is the alternative technically and administratively feasible? Are the right goods and services (i.e. treatment machinery; space at an approved disposal facility) available for the plan?

(3) Cost: What is the total cost of an alternative over time? EPA must find a plan that gives necessary protection for a reasonable cost.

EPA selected the Proposed Cleanup Alternative (Alternative 2C) based upon an evaluation of the above criteria. EPA strongly considers State and community input when developing the cleanup decision.

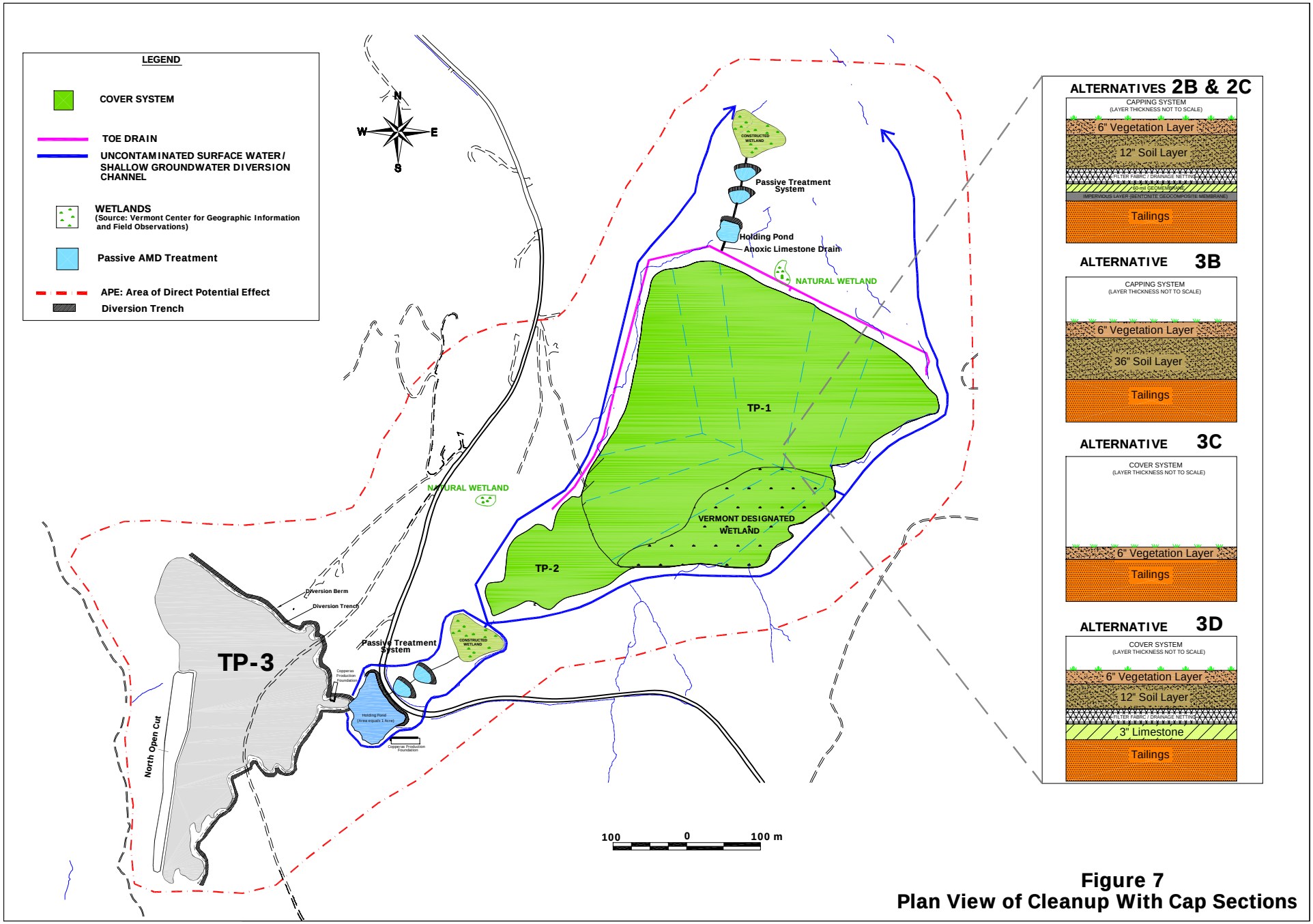

Figure 7
Plan View of Cleanup With Cap Sections

Table 3
Elizabeth Mine Cleanup
Long Term O&M (PRSC) Cost Table
Option 1 (100% Preservation of TP-3); Option 2 (50% Preservation of TP-3); Option 3 (20% Preservation of TP-3)

Cleanup Alternatives		2B Infiltration Barrier Cap (Geomembrane) on TP-1 and Remove TP-2	2C* Infiltration Barrier Cap (Geomembrane) on TP-1 and TP-2	3B Soil Evapo-Transpiration Cover on TP-1 and TP-2	3C Six Inch Soil Cover on TP-1 and TP-2	3D Chemical Cap (Hardpan) with Soil Cover on TP-1 and TP-2
Capital Costs	Option 1	$13,855,000	$13,129,000	$12,437,000	$9,538,000	$12,164,000
	Option 2	$15,655,000	$14,915,000	$14,030,000	$11,254,000	$13,930,000
	Option 3	$16,721,000	$15,982,000	$15,568,000	$12,321,000	$14,996,000
PRSC Activity	TP-1 Maintenance	$82,000	$90,000	$110,000	$132,000	$90,000
	TP-3 Maintenance (Option 1 – Complete Preservation of TP-3)	$254,000 - $400,000	$254,000 - $400,000	$254,000 - $400,000	$254,000 - $400,000	$254,000 - $400,000
	TP-3 Maintenance (Option 2/3 – Preservation of 20%-50% of TP-3)	$153,000 - $200,000	$153,000 - $200,000	$153,000 $200,000	$153,000 $200,000	$153,000 $200,000
Total Annual State Costs	Based on TP-1 and TP-3 Option 1	$336,000 - $482,000	$344,000 - $490,000	$364,000 - $510,000	$386,000 - $532,000	$344,000 - $490,000
	Based on TP-1 and TP-3 Option 2/3	$236,000 - $282,000	$244,000 - $290,000	$164,000 $310,000	$286,000 $332,000	$243,000 $290,000

Notes:

(1) All alternatives include: a surface water/groundwater diversion to divert clean water around TP-1 and TP-2; filling the decant tower, and passive treatment of the seeps of TP-1 and the run-off from TP-3.

(2) All alternatives include measures to stabilize the slopes of TP-1 and TP-2 as determined during geotechnical design studies and as required by VT Solid Waste Management Rules (unless these are waived by ANR).

(3) The range in TP-3 costs for each option are based upon the assumptions for the disposal of the sludge generated by the passive treatment systems. The low end cost assumes off-site disposal as a non-hazardous solid and the high end cost assumes off-site disposal as a hazardous waste liquid.

(4) All costs are presented as an annual amount the State of VT would need to appropriate into a fund to handle annual and periodic replacement costs. The present value is not presented.

* Alternative 2C is EPA's preferred cleanup option presented in the Proposed Plan.

A Closer Look at EPA's Preferred Alternative...

The objective of the preferred alternative (Alternative 2C) is to minimize the generation of AMD and to capture and treat the remaining AMD that flows from the three tailings piles (TP-1, TP-2, and TP-3). The goal of this action will be to improve the water quality of the WBOR and to minimize the effect of the cleanup on the historic resources located at the Site.

Alternative 2C includes the following:

1. Surface water and groundwater diversion ditch: Diversion ditches will be installed around the perimeter of the tailings to intercept clean water and carry this water around the tailings. This will prevent clean water from coming into contact with the sulfide-bearing materials that cause the AMD. These trenches will be installed to a depth that will intercept shallow groundwater that may also be flowing into the tailings.

2. Slope Stabilization: Stabilization of the steep slopes of TP-1 and TP-2. Design studies will determined the extent to which the slopes of TP-1 and TP-2 require stabilization. Factors that EPA will consider during the design include: stability of the tailings and cover system, minimization of erosion, reduction in AMD, historic preservation, and future use of the Site.

3. Infiltration barrier cover system: Installation of an infiltration barrier cover over TP-1 and TP-2. The cover is expected to have the following layers (top to bottom):

- Soil layer: This layer provides support for the vegetative cover, protects the barrier layers, and allows for the retention and use of water by vegetation. It will include approximately 6 inches of topsoil and 12 inches of additional soil material. EPA will try to minimize the thickness of this layer in a manner which will preserve the protectiveness of the remedy, while reducing the amount of fill material that will have to be trucked to the Site via local roads. Alternative cover materials, such as stone, will also be evaluated during design;
- Drainage layer: This layer allows for the drainage of water that flows through the soil layer and cannot flow past the barrier layer. A geosynthetic (engineered) drainage layer provides a conduit to carry water off the barrier layer without allowing the water to pond on top of the barrier layer.
- Barrier layer: This layer prevents water from flowing into the tailings. The top barrier will be a geomembrane. During design, the need for a second barrier layer will be evaluated. If determined necessary, the second barrier layer would be a geosynthetic clay liner. The design will also evaluate the need for a barrier layer on the steep slopes. If design studies indicate that an acceptable degree of erosion stabilization and infiltration reduction can be achieved, an alternative cover configuration will be considered for the slopes of TP-1 and TP-2.
- The cover system will have a final grade to promote drainage off the cover and prevent ponding on the primary barrier layer.

4. Collection and treatment of the seeps along the toe of TP-1: A collection system will be designed to capture the seeps that discharge along the toe of TP-1. This water will be treated using a combination of aerobic and anaerobic passive systems.

The passive treatment system concept for TP-1 includes:

- Holding ponds to stabilize flow;
- Anoxic limestone channels to neutralize acidity;

- Anaerobic bioreactors (either Successive Alkalinity Producing Systems (SAPs), Sulfate Reducing Bacteria (SRBs) or both) to further neutralize acidity and reduce metal concentrations using organic material and limestone; and
- Aerobic wetlands to remove additional metals in a open water wetland.

5. Collection and treatment of run-off from TP-3: The flow from the area of TP-3 that is left in place due to historic preservation concerns will be collected in an interceptor trench installed along the edge of the waste rock and heap leach piles. This water will be treated using a combination of aerobic and anaerobic passive systems. The passive treatment system concept at this time includes:

- Holding ponds to stabilize flow;
- A lime application system (Semi-Active Alkalinity Dosing System) and settling basin for initial treatment prior to the anaerobic bioreactors;
- Anaerobic bioreactors (either Successive Alkalinity Producing Systems (SAPs), Sulfate Reducing Bacteria (SRBs) or both) to neutralize acidity and reduce metal concentrations using organic material and limestone; and
- Aerobic wetlands to remove additional metals in a open water wetland.

6. Preservation of a portion of TP-3. The SHPO and VT ANR have advocated the preservation of TP-3 to the extent practical. As a result, no cover or substantial regrading will occur within the area of TP-3 that is designated for preservation. Some limited work may be performed to minimize the erosion in the area. Since the maintenance costs associated with the preservation of TP-3 will be paid for by the State of VT, EPA has deferred to the State for a determination regarding the amount of TP-3 to be preserved. Three preservation options are presented in the EE/CA. Upon completion of the design, including the pilot studies of the passive treatment systems, EPA will present the VT ANR with a refined estimate of the costs to maintain a passive treatment system for TP-3. At that time, EPA will request a final determination regarding the TP-3 preservation option from the VT ANR. The VT ANR may choose one of the three preservation options presented in the EE/CA or decide that none of the preservation options are acceptable from a cost and performance perspective and request complete removal of TP-3. See Figure 8 for a plan view of the three options for TP-3.

Capital Cost of Preferred Alternative: The approximate capital cost for Alternative 2C ranges from $13.8 million if all of TP-3 is left in place to $16 million for complete excavation of TP-3.

Post-Removal Site Control (PRSC): Long-term maintenance of the multilayer cap and passive treatment systems will be necessary to maintain the effectiveness of the cleanup. The State of Vermont will be responsible for all PRSC activities including: mowing and erosion repairs for the cover systems, cleaning the diversion ditches, sampling and maintaining the passive treatment systems, and periodic replacement of portions of the passive treatment systems.

The expected cost to the State of Vermont varies considerably, depending upon the percentage of TP-3 preserved. The annual cost to maintain the cover and treatment system for TP-1 and TP-2 alone would be approximately $90,000. The estimated range of costs to treat TP-3 assuming that 20- 50% of TP-3 is preserved ranges from $153,000 to $200,000 per year. The estimated range of cost for 100% preservation of TP-3

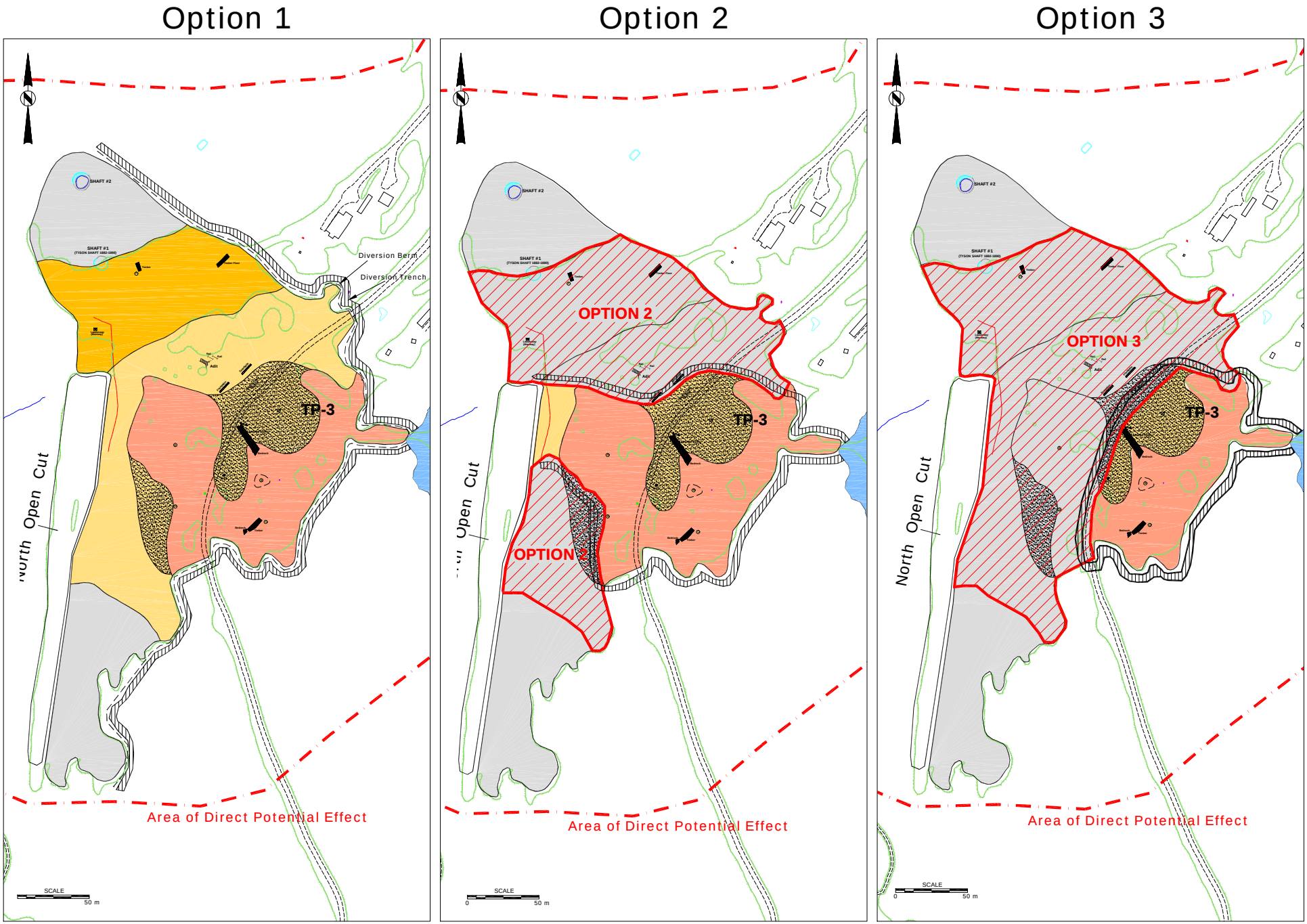

Figure 8
TP-3 Removal Options

ranges from $254,000 per year to $400,000 per year.

In addition to comment regarding the cleanup presented in the EE/CA and this Proposed Plan, EPA is also seeking public comment on the following three items:

(1) Unavoidable impacts to Wetlands and Floodplain:

The Wetlands below TP-1, on the surface of TP-1, adjacent to the adit, and within the stream channel of Copperas Brook from TP-3 to the outlet of TP-1 as well as floodplain areas within Copperas Brook from TP-3 to the outlet of TP-1 will be impacted by the cleanup action. See Figure 7. These impacts are unavoidable as there are no practicable alternatives to the cleanup activities. The wetlands in these areas will be completely destroyed. As a result, wetland mitigation will be included in the design. Any floodplain impacts will be mitigated by designing a final surface water flow system that will result in equal or better flood storage capacity than what currently exists. The cleanup action also involves the dredging and filling of wetlands and waters of the U.S. Portions of Copperas Brook will be altered and re-located to separate it from the tailings. The re-location is unavoidable as the natural channel is beneath the tailings and removal of the two million cubic yards of tailings is considered impracticable.

(2) Adverse Effect to a Historic Resource

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (16 USC 470f), requires EPA to take into account the effects of all actions on historic properties that have been determined to be eligible for the National Register of Historic Places. EPA has determined the Elizabeth Mine Site to be eligible for the National Register of Historic Places. EPA has also determined that the construction activities required to implement the cleanup will have direct and indirect impacts on features of the historic property at the Elizabeth Mine Site. EPA has determined that these impacts are unavoidable and necessary to protect human health and the environment. The preliminary Area of Potential Effect (APE) for direct effects is shown in Figure 7. The APE will be further defined to address indirect effects, cumulative effects and other effects as part of the design. EPA will work with the SHPO and other consulting parties to develop a Memorandum of Agreement (MOA) between the EPA, the SHPO, and other appropriate consulting parties to address any adverse effects to historic properties.

(3) Findings with respect to the VT Solid Waste Management Rules:

EPA has determined that certain requirements of the VT Solid Waste Management Rules (VT SWMR) cannot be met in order to implement the cleanup action consistent with historic preservation and community concerns regarding truck traffic and cost. EPA is making the finding that alternative measures can be taken in implementing the remedy given that:

- **the proposed alternative measures to the requirements of the VT SWMR will not endanger or tend to endanger human health or safety;**
- **compliance with certain VT SWMR would produce serious hardship by causing the destruction of certain areas targeted for historic preservation without equal or greater benefit to the public**;
- **the material at the Site is not considered to be a hazardous waste subject to regulation under the Resource Conservation and Recovery Act (RCRA) Subtitle C; and**
- **there is no practicable means known or available to meet both the historic preservation requirements and certain requirements of the VT SWMR, however, the substitute or alternative measures proposed in this cleanup plan would**

achieve an equivalent level of protection of public health and the environment.

The specific alternative measures proposed to the particular requirements of the VT SWMR are detailed below:

- The design of the cleanup will determine the appropriate surface and slope grades at the Site as opposed to the minimum grade of 5% and the maximum grade of 33% specified in the VT SWMR. Performance objectives for the grading will be to: minimize ponding on the barrier layer and promote run-off; minimize erosion; minimize AMD generation; and optimize slope steepness in the interest of historic preservation.

- Final closure of exposed waste rock and heap leach piles would not be required for TP-3. EPA would design and construct a collection and treatment system to address the run-off from TP-3. The change is dependent upon VT ANR accepting the responsibility for the maintenance of the treatment system.

- Cleanup alternatives will not be required to include an infiltration barrier on the slopes of TP-1 or TP-2 if the design determines the infiltration barrier to be unnecessary to stabilize the slopes, minimize erosion, and minimize AMD generation.

Potential Local Impacts from Cleanup

The cleanup would result in short-term impacts to the local community as a result of the significant construction activity and associated truck traffic. Approximately 8,000 truck loads of material will be necessary to complete the cleanup. Most of the traffic will be over the six to eight months required for cover system construction. In addition, there will be heavy equipment operating at the site for approximately two construction seasons which is typically April through October. EPA will implement measures during construction to minimize the off-site transportation of dust and to prevent excessive erosion and sediment transport into the WBOR.

EPA will work with the local residents and town officials to develop a traffic strategy that minimizes the impact on the local community to the extent practical. It is possible that a source of material can be located within close proximity to the Site. This would greatly reduce truck impacts. While impacts to some of the historic resources and wetlands at the site are unavoidable, EPA will implement measures to mitigate these impacts.

Why Does EPA Recommend the Cleanup Action?

All of the cleanup alternatives presented in the EE/CA and this Proposed Plan were compared against each other. The only significant difference between the alternatives is the cover system proposed for TP-1 and TP-2. Alternatives 2B, 2C, and 3B are the only cleanup alternatives with a cover system that would comply with the VT SWMR. As a result, only 2B, 2C, and 3B were eligible for selection as the recommended cleanup alternative. After comparing these alternatives and weighing the strengths and weaknesses, EPA recommends Alternative 2C as presented in this cleanup plan as the best balance of public health and environmental protection considering cost, effectiveness, and implementability of each of the cleanup alternatives.

The cleanup plan described in this Proposed Plan would significantly reduce the impacts from the Site to the WBOR. It is possible that almost five miles of the WBOR will be restored to biological VT WQS as a result of this action. EPA also believes that the cleanup proposal fully considers the historic value of the site and includes all reasonable measures to minimize the adverse effect to the historic resources. The Proposed Alternative will also have a high degree of long-term effectiveness and minimizes the long-term costs to the State of VT.

The proposed cleanup is consistent with EPA's program management goal of reducing the risk to ecological receptors to levels that will result in the recovery and maintenance of healthy local populations and communities of biota. The proposed cleanup is also consistent with the November 20, 2001 letter from the EMCAG indicating that nine of the ten groups represented in the EMCAG support cleanup Alternative 2C.

How You Can Comment On This Proposal

This Proposed Plan is part of the formal public comment process for the Elizabeth Mine Site. The EE/CA and the supporting information for the Proposed Plan and cleanup decision can be found in the Administrative Record. The Administrative Record is available at the EPA Record Center and Norwich Public Library.

There are three different ways in which individuals can express their comments on this Proposed Plan.

1. Comments can be submitted in writing to the address on the cover page of the Proposed Plan. These comments must be post-marked prior to the end of the last day of the comment period (April 15, 2002).

2. Comments can be sent to the EPA RPM by email at: hathaway.ed@epa.gov.

3. Comments can be spoken into the official public record during the public hearing (April 10, 2002) that will occur during the comment period.

EPA encourages anyone with a concern or who favors the cleanup to express their opinion during the comment period. All comments are welcome. Any of the three mechanisms above are acceptable for providing comments and all of the comments are given equal weight.

Two types of public meetings will occur with respect to the Proposed Plan. The first will be informational meetings (on March 13 and 14) to explain the proposed cleanup and answer any questions that may arise. Comments that are made during these meetings will not be part of the "official record". These meeting will focus on a discussion of the Proposed Plan and EE/CA and are considered informational only.

The second type of meeting, a public hearing, will occur during the official comment period. At this meeting (on April 10), EPA will provide a brief summary of the cleanup proposal and then the floor will be open for spoken comments. A stenographer will be present to record all of the comments offered during this comment session. Comments made must be limited in duration in order to allow all individuals present to have an opportunity to speak their comments into the record. EPA does not respond to any of the comments made at the meeting other than to indicate the time limits or request clarification. At the close of the comments session, if time permits, EPA will be available to answer questions.

The comment period will last for thirty days unless an extension is requested. EPA will typically allow a 30 day extension if an extension is requested. Once the comment period is complete, EPA will assemble and evaluate all of the comments submitted. Appropriate revisions to the Proposed Plan will be made based on these comments. EPA will then sign the Action Memorandum describing the chosen cleanup plan. The Action Memorandum and a summary of responses to public comments will be made available to the public at the Norwich Public Library and through EPA Records Center in Boston.

For More Information about the Cleanup

All of the technical and public information publications prepared to date for the site are available for public review at the following locations:

EPA Records Center
1 Congress Street,
Suite 1100
Boston, MA 02114-2023
(617) 918-1453
Hours: 10:00 a.m.-noon, 2:00 p.m.-5:00 p.m.

Norwich Public Library
368 Main Street
Norwich, VT 05055
(802) 649-1184

You can view a PDF version of the Proposed Plan or EE/CA on the epa.gov website. The web address is http://www.epa.gov/region1/superfund/index2.htm. Click on the "Find New England Sites" box and type "Elizabeth Mine" and then click on "Go".

In addition, EPA has provided each of the groups comprising the EMCAG with a copy of the final EE/CA.

What Happens after the Cleanup Decision?

Following the Action Memorandum, EPA will seek funding for the cleanup. If funding is available, EPA will initiate the design of the cleanup in 2002. The design, including pre-design data gathering and pilot studies, would be performed during 2002, 2003 or 2004. Actual implementation of the cleanup would not occur until late 2003 or 2004, at the earliest.

If only partial funding for the NTCRA is provided, then EPA will phase the implementation of the project. The diversion of groundwater and surface water diversion and passive treatment system for TP-3 would be the highest priority items.

Use This Space to Write Your Comments

or to be added to the mailing list

EPA encourages you to provide your written comments and ideas about the cleanup alternatives under consideration to address the contamination at the Elizabeth Mine Superfund Site. You can use the form below to send written comments. If you have questions about how to comment, please call ***EPA Community Involvement Coordinator Sarah White at 617.918.1026 or 888.372.7341, ext.81026 (toll free).*** Please mail this form or additional sheets of written comments, postmarked no later than **April 15, 2002** to:

Edward Hathaway
Remedial Project Manager
U.S. Environmental Protection Agency
Region I, (HBT)
1 Congress Street, Suite 1100
Boston, MA 02114 - 2023
or E-Mail to : hathaway.ed@epa.gov
Fax: (617) 918-1291

(Attach sheets as needed)

Comment Submitted by:

Elizabeth Mine Superfund Site
Public Comment Sheet (cont....)

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Fold, staple, stamp, and mail----------

Place
Stamp
Here

Edward Hathaway
Remedial Project Manager
U.S. Environmental Protection Agency
Region I (HBT)
1 Congress Street, Suite 1100
Boston, MA 02114 -2023