

**TECHNICAL REPORT ADDENDUM
ELIZABETH MINE SITE (VT-OR-28)
South Strafford and Thetford, Vermont**

**U.S. Army Corps of Engineers Contract #W912WJ-11-D-0006
Nobis Contract #12-NH-83602-001**

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Appendix F: *Summary Report, World War II Buildings Demolition and Waste Rock Removal Monitoring, Elizabeth Mine Site, Strafford and Thetford, Vermont.* (Kierstead, Matthew A., 2012) Prepared for U.S. Army Corps of Engineers, Concord, MA. Prepared by: PAL, Inc., Pawtucket, RI.

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Introduction

Nobis Engineering, Inc. (Nobis) is assisting the U.S. Environmental Protection Agency (EPA) with final Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund) environmental remediation (cleanup) work at the historic Elizabeth Copper Mine site (Site) in Strafford and Thetford, Vermont. The EPA consulted with the Vermont Division for Historic Preservation (VT DHP, the State Historic Preservation Office (VT SHPO)) in 2001 and determined that the Site is eligible for listing in the National Register of Historic Places. Section 106 of the National Historic Preservation Act (NHPA) requires Federal agencies to identify potential adverse effects of their actions on historic properties including archaeological sites (cultural resources) and seek ways to avoid, minimize or mitigate any such effects. Milestone Heritage Consulting (Milestone) is assisting EPA with their compliance obligations under the NHPA, outlined in a Memorandum of Agreement (MOA) between consulting parties finalized in March 2010. MOA Stipulation VI (Reports and Educational Products).A (Technical Reports).3 calls for production of an addendum following the cleanup actions that includes a brief synopsis of all work conducted by EPA to identify, record and interpret the history of the Elizabeth Mine; and review of additional data collected during cleanup actions including construction monitoring. Nobis has retained Milestone to provide this Technical Report Addendum to satisfy MOA Stipulation VI.A.3.

Cultural Resource Management Reports Synopsis

Between 2000 and 2014, multiple cultural resource reports were generated for the Elizabeth Mine Superfund cleanup project's lead federal agency, the U.S. Environmental Protection Agency. These reports were produced by several cultural resource management sub-contractors under contract to a variety of engineering and environmental firms under contract to the U.S. Army Corps of Engineers, New England District. Several of the later reports were generated as stipulations under the Elizabeth Mine MOA. The reports are listed below in chronological order of production. Where applicable, executive summaries or management abstracts are included in Appendix A.

Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Orange County, Vermont.

Date: October 2000

Author: Tom Jamison

Prepared by: Hartgen Archaeological Associates, Inc., P.O. Box 81, Putney, Vermont 05346

Hartgen Report Number: HAA #V095

Produced by: Arthur D. Little, Inc., Acorn Park, Cambridge, MA 02140-2390

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: N/A

This report was prepared by Hartgen Archaeological Associates (Hartgen) and their mining history subconsultants to define historical aspects of the Elizabeth Mine to determine if EPA had potential obligations regarding impacts to cultural resources under NHPA. The report presented identification of the physical extent of then current understanding of mining-related activity, and presented discussion of site mining history, landscape, technology and structures. It identified the then-known and visible historic resources within a possible project Area of Potential Effect (APE), and made a preliminary determination that the Site was eligible for Listing in the National Register of Historic Places. Based on this report, EPA determined that the Elizabeth Mine Site was eligible for inclusion in the National Register of Historic Places, and the VT SHPO concurred, concluding that the site was eligible as a National Register Historic District.

Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine, South Strafford, Orange County, Vermont (Supplement to: Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Orange County, Vermont, Hartgen Archaeological Associates, Inc., October 2000).

Date: October 2001

Author: Matthew A. Kierstead

Prepared by: PAL, Inc., 210 Lonsdale Avenue, Pawtucket, Rhode Island 02860

Produced by: Arthur D. Little, Inc., Acorn Park, Cambridge, Massachusetts 02140-2390

Arthur D. Little Report Number: 70939

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: DACW33-00-D-0002

This report was prepared by PAL, Inc. to supplement the Hartgen report at the request of EPA. This report provides additional historic and technological context information at the national, regional, state and local levels for the Elizabeth, Ely, and Pike Hill mine sites in Orange County, Vermont. It identifies all of the known discrete areas of historic mining-related activity at the Elizabeth Mine, and discusses their historic, landscape and archaeological values. The known and potential historic and archaeological resources at each of the sites are discussed in terms of their chronological history, including their periods of significance, landscape evolution, and function and technology. This report also includes preliminary evaluation of the physical integrity, archaeological research value and interpretive potential of areas of the Elizabeth Mine. The contextual and descriptive information and statements regarding overall site significance and interpretive potential assisted EPA and VT SHPO in determining the effects of proposed cleanup activities on known resources and archaeologically sensitive areas at the Elizabeth Mine Site. For additional information, see the Executive Summary in Appendix A.

Historic/Archaeological Mapping and Testing, Elizabeth Mine Site, Strafford and Thetford, Vermont (Two Volumes).

Date: January 2003

Authors: Principal Investigator/Contributing Author: Suzanne G. Cherau; Project Supervisor/Primary Author: Ben Ford; Industrial Historian/Secondary Author: Matthew Kierstead

Prepared by: PAL, Inc., 210 Lonsdale Avenue, Pawtucket, Rhode Island 02860

PAL Report Number: 1237.03

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road
Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: DACW33-02-M-0187

This report presents the results of field investigations that resulted in identification of numerous historic industrial and domestic resources related to the mine operations during the nineteenth and early-to-mid twentieth century. The report presents results of background research focused on collecting information needed to develop historic contexts for the project Area of Potential Effect (APE) and its environs, including interviews with local mine experts and a review of local manuscript collections. The report presents results of field investigations including a walkover survey and site mapping using global positioning system (GPS) coordinates linked to the site's geographic information system (GIS), detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the Site, and limited subsurface testing to locate and identify prehistoric and historic period resources within the APE. Identified resources consist of visible structural remains and features along with representative artifacts recovered from the ground surface and in 50-x-50 centimeter test pits at select resource areas. No prehistoric period resources were identified in the project APE. Recommendations included documentation of the mine landscape. For additional information, see the Executive Summary in Appendix A.

Historic American Engineering Record (HAER) Documentation/Historic Industrial Landscape Documentation, Elizabeth Mine, Strafford and Thetford, Vermont.

Date: November 2003

Authors: Principal Investigator: Suzanne Cherau (PAL); Historical Narrative Author: Matthew A. Kierstead (PAL); HAER Drawings: Dennis O'Brien (Dennis O'Brien Maps & Wayfinding); HAER Large-Format Black-and-White Photography: Robert Brewster (Warren Jagger Photography); Aerial Landscape Color Photography: Charles Feil (Views from Above), Matthew A. Kierstead (PAL); Terrestrial Color Photography: Matthew A. Kierstead (PAL).

Prepared by: PAL, Inc., 210 Lonsdale Avenue, Pawtucket, Rhode Island 02860

PAL Report Number: 1237.04

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road,
Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: DACW33-03-M-0033

This report documents in words, photographs and drawings, the history, operations, buildings and landscape of the 1942-1958 period of industrial activity at the Elizabeth Mine. Because of the presence of standing buildings and structures and the overall scale and complexity of the Site, Historic American Engineering Record (HAER) documentation methodology was chosen. The documentation includes a written historical and technological narrative; 66, 4"X5" large-format

architectural view camera photographs of the landscape and buildings, and four ink-on-mylar drawings showing the Site, buildings, underground workings, and ore beneficiation process. Archival copies of these products were submitted to the Library of Congress (LoC) under the supervision of HAER. The documentation also included a set of 84 aerial and terrestrial 35mm color film slides documenting the colorful mine landscape prior to cleanup (not submitted to LoC). Copies of the HAER documentation and color landscape documentation slides were sent to the VT SHPO, U.S. Army Corps, University of Vermont Bailey-Howe Library Special Collections, Vermont Historical Society Library, and Strafford Historical Society.

Archaeological Data Recovery, Upper and Lower Copperas Factories and Intercopperas Areas and Monitoring Mitigation for a Non-Time-Critical Removal Action (NTCRA), Elizabeth Mine Site (VT-OR-28), South Strafford and Thetford, Vermont (3 Vols.).

Date: November 2013

Authors: Matthew A. Kierstead, Senior Industrial Historian; Erin Timms, Industrial Archaeologist; Suzanne Cherau, Principal Investigator

Prepared by: PAL, Inc., 210 Lonsdale Avenue, Pawtucket, Rhode Island 02860

PAL Report Number: 2358

Produced by: Woods Hole Group, Inc., 81 Technology Park Dr, East Falmouth, Massachusetts 02536

Woods Hole Group Contract Number: PAL0004

and Weston Solutions, Inc., 43 Constitution Drive, Suite 2 West Bedford, New Hampshire 03110

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: #W912WJ-09-D-0001

This report satisfies MOA Stipulation III (Copperas Factories and National Register Nomination). A, which stipulated implementation of a previously approved archaeological data recovery plan for the former Copperas Factories area as part of the Remedial Action. It also satisfies MOA Stipulation V (NTCRA and other Cleanup Action Activities). B (Construction Monitoring).1, which stipulated that since significant data relating to historic industrial mining process could be recovered through direct observation of waste rock removal activities, EPA had to monitor that activity within the Tailings Pile 3 (TP-3) TP-3 and Copperas Factories areas. MOA Stipulation VI (Reports and Educational Products). A (Technical Reports). 2 stipulated that the Copperas Factories data recovery investigations result in an appropriate technical report and documentation. Archaeological excavations were conducted in 2009 and 2010 within the large, complex Copperas Factories site. Waste rock removal monitoring was conducted in areas associated with copperas factories operation between the North Open Cut to the west and Mine Road to the east, encompassing all of the TP-3 area.

The archaeological data recovery revealed clear evidence of all successive steps of copperas boiling, cooling, and crystallizing within the copperas factories, evidence that correlated elegantly with the various nineteenth-century descriptions of operations. Data recovery and monitoring uncovered massive timber underpinnings for the Upper Factory, and evidence of several other, possibly earlier factories in the immediate surrounding area. Monitoring of waste

rock removal on TP-3 revealed evidence of the mining, roasting and heap-leaching operations. Monitoring observations supplemented and informed interpretation of the data recovery information from the Copperas Factories. For additional information, see the Executive Summary in Appendix A.

Phase IB Archaeological Survey, Elizabeth Mine East Village, Haul Road and Slope Stabilization Project Area, Strafford and Thetford, Vermont.

Date: September 2009

Authors: Nichole A. Gillis, Suzanne G. Cherau

Prepared by: PAL, Inc., 210 Lonsdale Avenue, Pawtucket, Rhode Island 02860

Report Number: PAL Report No. 2370

Produced by: Woods Hole Group, Inc., 81 Technology Park Dr, East Falmouth, Massachusetts 02536

Woods Hole Group Contract Number: PAL0004

and Weston Solutions, Inc., 43 Constitution Drive, Suite 2 West Bedford, New Hampshire 03110

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: #W912WJ-09-D-0001

This report presents the results of a Phase IB archaeological survey of the 6-acre Elizabeth Mine East Village – Haul Road and Slope Stabilization Work project area. This work was conducted to satisfy MOA Stipulation V (NTCRA and other Cleanup Action Activities). C (Borrow material).1, which stipulated that proposed on-site borrow areas be assessed by qualified professionals to identify and evaluate any historic properties in the proposed borrow area APE. The project area was located within an area that was previously identified as being archaeologically sensitive for resources associated with a house and barn (farm) component of the East Village Site at Elizabeth Mine. The archaeological survey included archival research, a walkover survey, and subsurface testing to locate and identify any potentially significant archaeological resources that might have been affected by project construction. No potentially significant archaeological sites were identified and no further archaeological investigation of the project area were recommended. For additional information, see the Management Abstract in Appendix A.

Summary Report, World War II Buildings Demolition and Waste Rock Removal Monitoring, Elizabeth Mine Site, Strafford and Thetford, Vermont.

Date: February 2012

Author: Matthew Kierstead

Prepared by: PAL, Inc., 210 Lonsdale Avenue, Pawtucket, Rhode Island 02860

PAL Report Number: 2673

Produced by: Nobis Engineering, Inc., 18 Chenell Drive, Concord, New Hampshire 03301

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: #W912WJ-09-D-0001

This report presents the results of monitoring demolition of the World War II-era buildings, deemed a safety hazard, during mine waste rock removal during November and December 2011. The purpose of the monitoring was to provide photographic documentation of the work, assist with retrieval of mining-related artifacts for salvage, and help make decisions about demolition or retention of features and post-demolition cover design. The report scope did not include a written inventory of artifacts.

From Copperas to Cleanup: The History of Vermont's Elizabeth Copper Mine

Date: May 2014

Author: Matthew Kierstead

Prepared by: Milestone Heritage Consulting

Milestone Heritage Consulting Report Number: 0003

Produced by: Nobis Engineering, Inc., 18 Chenell Drive, Concord, New Hampshire 03301

Nobis Engineering, Inc Contract Number: 12-NH-83602-001

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: W912WJ-11-D-0006

This 62-page "popular report" was produced to satisfy MOA Stipulation VI (Reports and Educational Products).1 (Popular Report) for a historical report for the general public. It presents, in words and pictures, the story of 150 years of industrial activity at the Elizabeth Mine and how EPA and its project partners documented and reclaimed its legacy on the landscape. The report places the mine in the contexts of regional geology and national and Vermont copper mining history. It covers the history and technology of copperas and copper making 1809-1958. It includes discussion of the environmental impacts associated with mining and EPA's cleanup activities. EPA printed 110 copies for distribution to relevant federal and Vermont state agencies, universities, historical societies, contributors and reviewers, and other relevant parties.

Technical Report Addendum, Elizabeth Mine Site (VT-OR-28), Strafford and Thetford, Vermont.

Date: June 2014

Author: Matthew Kierstead

Preparer: Milestone Heritage Consulting

Milestone Heritage Consulting Report Number: 0003

Produced by: Nobis Engineering, Inc., 18 Chenell Drive, Concord, New Hampshire 03301

Nobis Engineering, Inc Contract Number: 12-NH-83602-001

Produced for: U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751

U.S. Army Corps Contract Number: W912WJ-11-D-0006

This report was produced to satisfy MOA Stipulation VI (Reports and Educational Products). A (Technical Reports). 3 (Technical Report Addendum) to produce an addendum following the

completion of all cleanup actions. The addendum includes this brief synopsis of all the work conducted by EPA to identify, record and interpret the history of the Elizabeth Mine. It also includes discussion of additional data collected during the cleanup actions including the construction monitoring.

Additional Data Discoveries

Several historical items and sources of new information associated with the Elizabeth Mine surfaced during the cleanup process after the Copperas Factories data recovery archaeology campaign. These new materials were discovered too late to be included in the reports listed above, and are summarized below.

Strafford Historical Society

Judd Collection

The Strafford Historical Society (SHS) received a donation of Elizabeth Mine-related materials, now catalogued as "The Carrie and Charles Judd Historical Articles on Strafford and the Elizabeth Mine," in September, 2011. The collection was originally the property of Charles Judd, the longest-serving employee of the Elizabeth Mine in its last period of operation, 1942 to 1958. After first working as a carpenter on the mine buildings, Judd worked underground as a rigger and timber boss, in charge of shoring up excavated areas as needed. By the time the mine closed, he was assistant mine supervisor and in charge of all underground operations. The Judd collection has the potential to add depth to the understanding of the World War II and 1950s eras of Elizabeth Mine operations.

Newspaper Clippings

The collection contains approximately 100 local and regional newspaper article clippings, many from the *Valley News*, from the early 1940s to the early 1970s. Topics include: general retrospective mine history, early 1940s mine reopening, explanations of general operations, appeals for labor and the "farmer-miner" labor program, accidents, sale of pyrrhotite to Brown Paper Co., changes in management and reports of their addresses to local civic organizations, Appalachian Sulphides, Inc.'s move to Ore Knob, NC, the 1958 mine closing, and subsequent land sales into the 1960s. The newspaper clippings also cover an area of historical activity largely unreported in previous cultural resource reports: early 1970s metallic ore prospecting and community responses. In the early 1970s, there was renewed exploration for Appalachian metal deposits driven by high copper prices and new understanding of ore geology based on plate tectonics. Many investigations were conducted by petroleum companies, then diversifying into metals, and sometimes in joint ventures with Canadian companies. Humble Oil, partnered with Prospecting Geophysics, Ltd., of Montreal, Quebec, conducted extensive ground and aerial surveys for new copper ore deposits in Orange County in the early 1970s. The threat of new

mining activity prompted formation of the "Orange-Windsor Coalition Against Copper Mining" in South Strafford.

Photographs

The Judd Collection also includes previously unseen black-and-white and color photographs and slides of 1940s-1950s operations as well as post-mining landscape conditions. Landscape photograph subjects include mine plant surface buildings, North and South open cuts, and tailings piles. The Collection includes numerous photographs showing miners and equipment representing almost every phase of underground mining activity, which have already proven useful for inclusion in the Popular Report, *From Copperas to Cleanup*. Several photographs show the appearance and locations of machinery within the ore processing buildings. The Collection also includes a number of portraits of miners identified by name.

The Elizabeth Miner

The Judd Collection also includes copies of the Vermont Copper Company employee magazine, *The Elizabeth Miner*, for May to December 1945, April to August 1946; all of 1947, and some months from 1948 and 1949, its last year of publication. The Vermont Copper Company encouraged the employees to publish *The Elizabeth Miner*, a reflection of their recognition of the value of positive employee relations and morale. Most content was lighthearted, including cartoons, jokes, humorous anecdotes from on and off the mine property, miners' family news, and announcements and reports of company events such as picnics and baseball games. The magazine included information about operational or management changes affecting workers and was also a venue for frequent safety reminders. Occasional technical articles provided insights into the different jobs at the mine, which were sometimes mysterious to workers in other departments. During World War II *The Elizabeth Miner* was also a patriotic booster, providing news about former miners serving overseas.

The Judd Collection also includes additional miscellaneous Elizabeth Mine-related materials as well as non-mine, Strafford-related ones. The SHS Finding Aid for "The Carrie and Charles Judd Historical Articles on Strafford and the Elizabeth Mine" is included in this report as Appendix B.

Mine Maps

In 2011, the late Gwenda Smith of the Strafford Historical Society acquired three original oversize ink-on-linen drawings of the Elizabeth Mine in an online EBay auction. The three maps, described briefly below, are shown in this report in Appendix C. As the original drawings are oversize and detailed, large, high-resolution versions are also included in the report CD (Appendix G).

"Plan of Land of Vermont Copper Co., South Strafford, VT. Drawing No. 104. Scale 1"=400', File No. 101."

This map shows the property boundaries of the Strafford Mining Co., Vermont Copper Co., Elizabeth Copper Co., and surrounding landowners from Norwich in the south to north of the West Branch of the Ompompanoosuc River and west to Sargent Brook. It also shows roads and watercourses; and numerous building footprints. The buildings are numbered; unfortunately there is no key or list giving the building names or functions. The map appears to date from 1908 or slightly later, as it includes the ca. 1908 Heckscher Vermont Copper Corporation smelter and associated mine car trestle. Careful comparison of map features with current conditions reveals changes in features such as road patterns, for instance the original routing of Mine Road immediately west of the Copperas Works store, boarding house and post office, foundations of which are now located immediately west of the current Mine Road alignment. The road appears to have extended south to the Lower Copperas Factory, where it took a right-angle turn to the east. The current alignment of Mine Road lies on a broader curve inside and east of the original L-shaped alignment.

"Plan of Mine Adits Nos. 1 & 3 of Vermont Copper Co., So. Strafford, VT. Scale 1 in=40 ft. Surveyed by Walker & Gallison, Civil Engineers, Montpelier & Barre, VT, Oct. 1907."

This drawing shows reflected plan and profile underground sections through the "Deep Adit" (No. 1) and 1898 Tyson Adit (No. 3). Both adits incline gently to the east to facilitate drainage. The drawings show that the outer approaches to the adits were in timbered trenches in soil and loose rock. The Deep Adit did not connect to upper workings at that time, but ended in short north-south drifts, presumably in, or to locate, the orebody. The map shows the original alignment of Mine Road, crossing the over the Deep Adit approach trench on a short bridge.

"Plan of Mine of Vermont Copper Co., So. Strafford, VT. Scale 1 in.=40 ft. Surveyed by Walker & Gallison, Civil Engineers, Montpelier, VT, Oct. 1907."

This drawing shows reflected plan and sections through the mine workings from the south end of the North Open Cut to the extent of subsurface mining in 1907. The maps is extremely helpful for understanding the spatial relationships between surface openings and underground workings and how development of internal mine passages progressed within the orebody north and down as it was mined. Details include numerous crosscuts, underground shafts, stopes and inclines. The wide, funnel-like upper section of the Tyson No. 2 shaft is unusual and may explain the recent "sinkhole" surface feature at that location. The map shows the partial footprint of the "Cob Shop" building outside the mouth of the No. 2 (1831) Adit, as also indicted on the 1874 Vermont Copperas Company map. Curiously, like the *Adits No. 1 & 3* drawing above, the shaft shown on the 1874 map and uncovered east of Copperas Road during waste rock removal is not shown on this drawing.

Finding Aids

In addition to the Finding Aid for the SHS Judd Collection, this report includes the SHS Finding Aid for all SHS "Materials Relating to the History of Copperas and Copper Industries, Primarily in Strafford," as compiled by Gwenda Smith (Appendix D).

Construction Monitoring

Additional data collected during the Elizabeth Mine cleanup included construction (waste rock removal) monitoring in several different areas across the Site. Elizabeth Mine MOA Stipulation V (NTCRA and other Cleanup Action Activities). B (Construction Monitoring).1 stipulated that since previous archaeological testing indicated that significant data relating to historic industrial mining process could be recovered through direct observation of waste rock removal activities, EPA had to monitor that activity within the Tailings Pile 3 (TP-3) and Copperas Factories areas. Monitoring was conducted in areas associated with copperas factories operation between the North Open Cut to the west and Mine Road to the east, encompassing all of the TP-3 area in 2009 and 2010. Monitoring of demolition of the World War II-era buildings was conducted in 2011. Monitoring of the South Mine Shaft excavation took place in 2012. The work is summarized below, and the results sections of the relevant reports are included as appendices as indicated below.

TP-3 Area Waste Rock Removal Monitoring

Results of the TP-3 area construction monitoring were presented in Volume 1, Chapter 5 of the PAL, Inc. report, *Archaeological Data Recovery, Upper and Lower Copperas Factories and Intercopperas Areas and Monitoring Mitigation for a Non-Time-Critical Removal Action (NTCRA), Elizabeth Mine Site (VT-OR-28), South Strafford and Thetford, Vermont* (Cherau, Kierstead and Timms, 2013).

The 2009 data recovery test trench program and other cleanup activities at TP 3 had indicated that significant data relating to the copperas factories could be recovered as a result of direct observation (monitoring) during the 2009 and 2010 waste rock removal activities. PAL provided archaeological monitoring of these activities, at times conducted concurrently with the data recovery excavations, within and surrounding the Copperas Factories Subsite portion of TP 3. Removal of waste rock included historic masonry and/or timber structural remains associated with mining activity. Monitoring resulted in observations that supplemented and in some cases significantly informed interpretation of the data recorded in the adjacent and overlapping data recovery areas.

Chapter 5 of the PAL report presented the results and interpretations of the monitoring for the North Berm, Sedimentation Basin area, Copperas Brook Corridor area, and a portion of the Ore Roasting and Leaching area, which contained resources associated with the final stages of

processing raw copperas liquor into finished copperas crystals. The Ore Roasting and Leaching area predominantly contained remains of structures associated with the preceding stages of generating, conveying and storing the raw copperas liquor. The field reports for the remainder of the monitoring in the Ore Roasting and Leaching Area and the Pine Grove Drainage Trench, as well as the Upper Adit/Cob shop, Cob Shop/Blacksmith Shop site and the Tyson No. 1 Shaft site, were included in the PAL report's Appendix F.

It should be noted that the copperas factories area at the foot of TP-3 still contains archaeological information below the stone aprons over the Upper and Lower factory foundations, and also in the South Berm area, which was intentionally preserved in exchange for monitoring removal of the North Berm in consultation with the Vermont State Archaeologist.

Chapter 5 from the PAL report as well as that report's Appendix F are included in this report as Appendix E.

World War II-Era Buildings Demolition Monitoring

Nobis Engineering, Inc. (Nobis), in partnership with Weston Solutions, Inc. (Weston), conducted building demolition and mine waste rock removal under contract with EPA in the Elizabeth Mine World War II buildings area during November and December 2011. The ca. 1942 buildings, some already collapsed, and some requiring asbestos abatement, were in deteriorated condition and deemed a safety hazard. PAL, under contract to Nobis, conducted demolition monitoring during critical phases of the work in the WWII buildings area. The purpose of the monitoring was to provide photographic documentation of the work and discoveries, assist with retrieval of mining-related artifacts for onsite storage by the property owner, and in making decisions about demolition or retention of features and post-demolition cover design.

At the time of demolition, the remaining standing buildings in the upper tier of mine support buildings included, from north to south: the Assay Laboratory (an occupied rental property not included in the work), the Office/Warehouse, Machine Shop/Workshop, Air Compressor Building, and Change House and Core Storage Shed. The remaining standing buildings in the lower tier of ore processing buildings included, from north to south: the Thickener (and Filter/Dryer) building, the Concentration (Flotation) Mill, and the Garage. The lower tier area also included exposed and buried ore crusher plant foundations, mine railroad and conveyor trestle support trestle piers, dry-laid stone walls, storage tank saddles, etc.

Demolition monitoring consisted of observing heavy equipment operators demolish the buildings and remove the debris to an adjacent stockpile area. Digital photographs were taken of the landscape, buildings, demolition activity, artifacts, etc. Results of the demolition monitoring including disposition of artifacts, field notes and recommendations were presented in the PAL, Inc. report, *Summary Report, World War II Buildings Demolition and Waste Rock Removal Monitoring, Elizabeth Mine Site, Strafford and Thetford, Vermont* (Kierstead 2012). The demolition monitoring report (minus photos) is included in this report as Appendix F.

South Mine Open Cut and Shaft Monitoring

The linear South Mine open cut and shaft are located on Copperas Road at the extreme south end of the Elizabeth Mine Site, approximately 1 mile south of TP-1 and TP-2 (Figures 1, 2 and 3). EPA began cleanup work in this area in 2010-2011 (see Historic Landscape Impacts Documentation section below). In 2012, EPA dewatered the South Mine open cut, and requested that Milestone inspect and document the conditions and newly exposed, previously submerged features, as well as monitor attempts to locate the bottom of a vertical bedrock mine shaft in a wetland depression just north of the cut at the east edge of Copperas Road. The results of that monitoring are formally presented here for the first time.

South Mine Open Cut

After the water in the South Mine Open Cut was pumped down, the shape, method and extent of mining were revealed. The orebody consists of a shallow, north-south trending lens or pod of massive sulfide oriented on strike with the other known mined orebodies to the north. The eastward dip of the lens appears to be at a more shallow angle than the other orebodies, suggesting its emplacement higher up the flank and near the top of a bedrock fold. The thick overhead hanging wall was supported by a row of inclined thick rock pillars dividing the mined out area into a series of "rooms" and a longitudinal gallery (Figure 4). Although the water was not entirely pumped out, the bottom or back wall of the cut was visible at and below the water line, although it is unclear if the wall ends in barren rock or if the sulfide ore continues to plunge on dip. Historical features observed included rock drill holes in the hanging wall (Figure 5), timber supports (Figure 6), and a grille or screen made of thick saplings (Figure 7), possibly a fence installed after mining ended to keep people and/or livestock from falling into the cut.

South Mine Shaft

The South Mine Shaft is located in a watered depression approximately 100 feet north of the South Mine Open Cut, on strike with the cut and the other known mined orebodies to the north (Figure 8). The shaft site was marked by the rotted stubs of what appeared to be vertical planks, possibly from a plank-lined shaft collar, protruding from the mud. This feature was thought to be an abortive, exploratory working dating from the Civil War period mentioned in Vermont Copperas Company records transcribed by the late Vermont mining historian Collamer Abbot from the so-called "Nash Papers" (repository unknown). That document indicated the company decided to cease work on the shaft, presumably as it failed to reach massive sulfide mineralization. The Milestone monitor, in cooperation with staff from AMEC, Inc., observed a backhoe carefully excavate in and around the planks, removing muck, water and loose planks and timbers until the water table was reached. Removal of the debris revealed a 6 ft X 6 ft plank-lined, timber-framed mine shaft collar, these dimension being common for historic mine shafts (Figure 9). Milestone set aside several small structural timbers (Figure 10) as well as one large notched timber, possibly originally a support for a heavy plank cap (Figure 11). The bottom of the shaft could not be felt with the backhoe bucket. Subsequent investigations by AMEC reached refusal at a depth of 41 feet. The presence of shaft timbering and fairly shallow

refusal depth strongly suggest this shaft is the uncompleted one noted in the Nash Papers. The shaft opening is currently capped with a temporary timber cover; final capping design is forthcoming.

WWII-Era Artifacts

The property encompassing the WW II buildings, owned by the local Cook family, contained numerous large outdoor mining-related artifacts, and the buildings contained artifacts ranging from massive fixed air compressors to paper records. Prior to demolition, PAL conducted a preliminary inventory of the more important outdoor artifacts that were of particular value for interpreting mining activity and operations. During demolition, PAL recorded the salvage of artifacts in notes and photographs. The PAL monitor coordinated with property owner Stanley Parker regarding location and transfer of artifacts on site. The artifacts are now stored on site in the Change House, in the open air on the concrete slabs of the Air Compressor Building, Machine Shop/Workshop, Office/Warehouse, and in three donated steel explosive storage containers near the site of the former 1948 Adit. No artifact inventory was made by PAL as that task was not included in the monitoring scope of work. To date the property owner has not compiled an artifact inventory. The artifact discussion below is organized by original location, lists or characterizes the artifacts found, and notes their location or disposition at the end of the monitoring campaign. For additional information on artifacts recovered and relocated, see the demolition monitoring report in Appendix F.

Large Outdoor Artifacts

The area east and northeast of the Change House contained several large artifacts including an electric mine locomotive, two sets of geared mine locomotive drive wheels, an ore skip hoist, an ore bucket. These artifacts were moved to the Air Compressor Building foundation. A tall structural steel mine equipment service hoist gantry that originally straddled the mine surface plant railroad tracks was dismantled and moved to the Office/Warehouse foundation. The whereabouts of two spoked steel mine hoist cable sheave wheel pulleys once stored at this location remains unknown. Three ore mill flotation tanks formerly located outside the Concentration (Flotation) Mill were moved to a location south of the dynamite storage sheds.

Indoor Artifacts

Drill Cores

Elizabeth Mine artifacts include sets of boxed exploratory rock drill cores from 1942-1958 operations as well as from 1980s explorations. These were stored in several attached and free-standing sheds around the Change House, as well as on racks inside the building. Hand drawn and colored underground mine geology diagrams corresponding to the WW II cores exist in the possession of John Slack of the U.S. Geological Survey. Together, these cores and drawings are a unique and valuable scientific document of metallic sulfide ore geology. To date no single

repository for the cores has been found. Select samples of the cores have been taken for storage and use by the USGS, Vermont Geological Survey and Norwich University. The boxed 1980s cores are stored together on the Office/Warehouse foundation, and associated paperwork remains in the Change House.

South Core Storage Shed

This temporary structure, located immediately south of the Change House, contained several large plastic froth flotation tubs, metal tanks, and other ore processing plant vessels. These artifacts were relocated to the Machine Shop/Workshop foundation slab.

Change House

Mining-related artifacts useful for historical interpretation were flagged, photographed and inventoried by PAL as part of earlier work previous to the demolition monitoring campaign. No artifacts were removed or relocated from the building during demolition, except for the 1980s drill cores. Change House artifacts include a variety of types of compressed air drills and jacks, Vermont Copper Company and Appalachian Sulfides, Inc. daily flotation mill sheet ledgers, miners' lockers and clothing baskets, desks, storage cabinets, a bulletin board, and a sign indicating time lost to accidents. The owner has removed a large quantity of non-mine related machinery and debris stored in the building after the mine closed.

Air Compressor Building

This building contained an air compressor, tanks, pipes and electrical equipment clustered at its south end. The electrical equipment was removed and disposed of on site. The large Ingersoll-Rand Imperial Type 10 compressor with an approximately 10 ft diameter flywheel and associated plumbing, and including its large drive belt, was left in place. Additional artifacts found in the building and left on the concrete foundation slab include two, four-wheeled shop carts, large pulleys, a hanging beam scale, and a large dial indicator for a mine hoist or truck scale, a 4,000 cfm Roots-type air pump (apparently used to provide fresh air underground), a safe, and an 1890s patented Mead-Morrison compressed air hoist.

Machine Shop/Workshop

This building contained an internal combustion driven mine locomotive that was relocated to the Air Compressor Building foundation slab. A small cluster of overhead machine line shafting and pulleys on the roof trusses was removed and placed with the mine locomotive. Fixed features including the base for a gas-fired blacksmith forge, wood anvil base, and rectangular area of floor containing end-grain wood blocks, possibly for a drop forge, were left in place.

Office/Warehouse

The Warehouse contained thousands of artifacts arranged on partially collapsed shelves on a partially collapsed floor under a partially collapsed roof. The property owner and his representatives were allowed to enter the building with proper safety supervision for one day to retrieve artifacts. Retrieved items included a wide variety of mechanical and electrical replacement parts, tools, and other equipment for operation and maintenance of mine equipment and machinery. The Office contained a variety of paperwork, mostly associated with personnel, payroll, and bookkeeping. The artifacts were moved by the owner to dry storage in the three donated explosive storage sheds.

Thickener (and Filter/Dryer) Building

Demolition revealed an *in situ* Oliver pump, a smaller pump, and a Fairbanks scale for weighing ore transport trucks. This mechanical equipment was left in place. Several representative heavy structural timbers were salvaged at the request of the property owner. Loose artifacts were relocated to the storage containers by the property owner.

Concentration (Flotation) Mill

Several representative heavy roof timbers were salvaged at the request of the property owner. Loose artifacts were relocated to the storage containers by the property owner.

Garage

Loose artifacts were relocated to the storage containers by the property owner.

Historic Landscape Cleanup Impacts

In 2001 the Environmental Protection Agency designated the Elizabeth Mine a Superfund site. Mine tailings and waste rock piles were a source of acid rock drainage (ARD), heavy metals, and sediments to Copperas and Lord brooks, tributaries to the West Branch of the Ompompanoosuc River, a tributary of the Connecticut River. EPA selected a Non-Time-Critical Removal Action (NTCRA) in 2002. EPA's cleanup approach was to consolidate all mine waste in one place and isolate it from water and oxygen by capping it and diverting water around it. EPA chose the existing, large 1942-1958 ore mill flotation tailings, renamed Tailings Piles (TP) 1 and 2, as the location for all mine site waste.

The NTCRA was separated into two phases by EPA. Phase I NTCRA activities were performed from 2006 through 2010 and included installation of surface and shallow ground water diversion channels around TP-1 and TP-2, re-grading and stabilization of the west slope of TP-1, removal of waste rock under Mine Road and construction of a temporary sedimentation basin below TP-3, excavation and consolidation of waste rock from TP-3 to TP-1 and TP-2, excavation and consolidation of scattered tailings north of TP-1, installation of an interceptor trench to divert

shallow groundwater along the west side of TP-1, and establishment of a water treatment plant to reduce discharge of iron from TP-1.

Phase II NTCRA activities were performed in 2011 and 2012 and included consolidation of waste rock and tailing to TP-1 and TP-2, final grading on TP-1 and TP-2, construction of an infiltration barrier cover system over TP-1 and TP-2, borrow development, topsoil manufacturing, channel construction, and site-wide restoration of disturbed areas and streams. The tailings pile cover was designed to allow for future potential site uses such as a solar energy array, recreation, or historic interpretive trails.

The cleanup actions implemented through 2013 have been successful. The volume of water flow from the tailings pile and concentrations of acid and metals have all been significantly reduce or almost entirely eliminated. Biological monitoring of the Ompompanoosuc River from 2010 to 2013 shows dramatic recovery of the aquatic ecology. Final cleanup steps will address the long-term solution for the leachate flowing from TP-1 and metal-contaminated water flowing from the South Mine and South Open Cut into Lord Brook. The State of Vermont will be responsible for the long-term maintenance and monitoring of the Site.

The cleanup activity profoundly altered the appearance of the Elizabeth Mine's industrial landscape features, which were massive, but ultimately temporary, expressions of site history. The individual sections below briefly describe, from south to north, the cleanup activities, landscape changes and current appearance of the various major historic activity areas, which are, in some cases, still as dramatic, but in different ways.

South Mine Open Cut and Shaft

The linear South Mine open cut and shaft are located approximately 1 mile south of TP-1 and TP-2. Work in 2011 and 2012 included clearing and grubbing a 4.2 acre wooded area, construction of surface water diversion trenches, removal and relocation to the TP-1/TP-2 waste repository of approximately 32,000 CY of waste rock. The site was seeded and mulched. The shaft was partially excavated to determine its depth (see Construction Monitoring section above). Remediation in the South Mine and Shaft area is incomplete at the time of this report (see Future Site Work below). The current appearance of the overall cleared site and exposed Open Cut are shown in Figures 1, 2 and 3 above.

South Open Cut and Tailings Pile 4

The South Open Cut and adjacent former site of Tailings Pile 4 (TP-4) are located within the Lord Brook watershed approximately 3/4 mi south of TP-1 and TP-2. Development of cleanup engineering solutions for the South Open Cut opening, its pit lake and associated water drainage are ongoing (See Future Site Work below). TP-4 is a feature historically associated with the construction of the South Open Cut. The reclaimed area consists of a former early 1950s truck haulageway trench extending from a point near the middle of the South Open Cut east to

Copperas Road, and the site of a former deep fan of barren and sulfidic waste rock associated with trench development across Copperas Road to the east. In 2012 approximately 6,210 CY of waste rock was removed from an approximately 1.3 acre area on the west side of Copperas Road and consolidated on TP-1. The bedrock was left exposed as water flows from the South Open Cut across this area (Figures 12 and 13). At TP-4 east of Copperas Road, approximately 37,000 CY of waste rock was removed from an approximately 1.5-acre area, which was consolidated on TP-1. The area was covered with soil and seeded, and a crushed stone-lined drainage trench installed to carry the water exiting the South Open Cut (Figure 14).

Tailings Pile 3 Hillside

Some of the most dramatic changes to the Elizabeth Mine historic industrial landscape occurred at Tailings Pile 3 on Copperas Hill, on the steep open hillside between the North Open Cut to the west and Copperas factories to the east, bisected by north-south Copperas Road, where the colorful remains of the ca. 1809-1882 copperas ore roasting, heap leaching and liquor collection, as well as waste rock from 1880s-1890s Tyson-led copper mining, were located. Approximately 240,000 CY of waste material on the 12.4-acre hillside was excavated down to bare bedrock and hauled to the TP-1/TP-2 waste repository for burial (Figures 15 through 24). Once TP-3 was scraped clean, Copperas Road was reconstructed on a slightly different alignment, and culverts and rock-lined drainage channels were installed along the road. Vandal-proof stainless steel bat access safety grates were installed in the vertical shaft Manway north of the North Open Cut (Figure 25) and 1831 Adit on the side of the hill below (Figure 26). A protective screen was installed over the shaft discovered below Copperas Road (Figure 27). Most of the hillside bedrock was left bare, resulting in a remarkable and unusually large expanse of rock visible and available for geological study. Exposure of the bedrock also revealed evidence of physical manipulation of the hillside for gravity-fed copperas liquor diversion and collection. This is visible in the large diagonal rock trench below Copperas Road (Figures 16, 22, 23, 28), as well as numerous small notches cut into the crowns of the bedrock corrugations across the hillside (Figure 29), which still clearly funnel runoff diagonally down across the hill to toward the former Copperas Factories. A northerly portion of the hillside was covered in crushed rock to provide slope stabilization. The "pine grove" area, which contains stone walls, possibly associated with copperas manufacturing, was left intact (Figure 30).

Copperas Works Area and Mine Road

Between 2009 and 2010, EPA removed the majority of the lead-contaminated soil at the copperas factories and placed this material on TP-1/TP-2 repository. The lead-contaminated soil left within the footprint of the copperas factories was covered with two feet of rounded stone to prevent human contact and to highlight the remnant foundations (Figures 31, 32 and 33).

Approximately 50,000 CY of mine waste rock fill and accumulated sediment from TP-3 copperas waste piles in the 2.5-acre area flanking the sharp bend in Mine Road near the copperas factories were relocated to the repository in 2009 and 2010. Mine Road was removed,

reconstructed, and a temporary Sedimentation Basin was installed to capture sediment from TP-3 while it was being scraped clean. Copperas Brook was routed in a new bedrock channel (Figure 34) and under Mine Road in a new culvert. In 2012 the Sedimentation Basin was removed and the area flanking Mine Road was restored to natural vegetative habitat. The restored appearance of this area is shown in Figures 35 and 36.

Tailings Piles 1 and 2 Waste Repository

The greatest physical changes to the historic mining landscape took place at the 1943–1958 ore mill tailings piles (TP-1 and TP-2). The tailings piles became a 45-acre repository platform for over 356 million CY of consolidated mine waste, excavated from the South Mine, South Open Cut, copperas works roast beds and heap leach piles at TP-3, Mine Road, Copperas Factories area, TP-1 and TP-2 perimeter, and the WW II buildings complex. In 2008, an interim treatment plant was installed to remove the iron in the water leaching from TP-1 (Figure 37). To prepare the TP-1/TP-2 area for the waste repository, its steep, eroded sides were re-graded to a shallower angle for slope stability. Once mine waste was consolidated on the tailings pile, EPA graded it to shed water, installed a cover system including 2 million sq ft of impermeable plastic infiltration barrier to block water from infiltrating into the waste, and covered that with two feet (153,000 CY) of soil to protect the membrane and grow grass. EPA constructed 6,550 feet of linear stone-lined diversion trenches to reroute Copperas Brook and surface water around TP-1 and TP-2. Permanent access roads were installed. The tailings pile cover was completed in 2012. It was designed to allow for future potential site uses such as a solar energy array, recreation, or historic interpretive trails. The completed waste repository now has the outward appearance of a capped municipal landfill (Figures 38 through 43).

World War II Buildings

As discussed above, most of the World War II buildings were cleared of asbestos and demolished. Approximately 4,140 CY of associated building debris and approximately 28,000 CY of surrounding waste rock were cleared from the 3.2-acre area and placed in an adjacent portion of the waste repository. Demolition was monitored, and salvage and relocation and staging of historical artifacts was overseen by PAL. The low concrete walls and slab foundations of the buildings were left in place to interpret building locations, relationships and functions, and in some cases as locations for staging large mechanical or structural artifacts.

Upper Tier Support Buildings

Change House

The Change House was determined to be structurally stable was left standing per negotiations with the property owner, who has subsequently made repairs including a new roof (Figure 44).

Air Compressor Building

The concrete slab foundation is used for open-air artifact storage (Figure 45). The large Ingersoll-Rand air compressor was left in place (Figure 46). The air intake tower pits at the south end of the building were filled for safety.

Machine Shop/Workshop

The concrete slab foundation is used for open-air artifact storage. The blacksmith forge and anvil base were left in place. The steps to the partial basement at the north end of the building were filled for safety (Figure 47).

Office/Warehouse

The concrete slab foundation is used for open-air artifact storage. The two-story concrete walk-in safe tower with wood frame gable roof was left standing in the northwest corner of the foundation (Figure 48).

Assay Laboratory

The Assay Laboratory is an intact, habitable building and was left standing (Figure 49).

Lower Tier Ore Processing Buildings

Primary Crusher

Ore Storage Silo

Concentration (Flotation) Mill

Thickener (and Filter/Dryer) Building

Demolition of the lower tier of ore processing buildings exposed massive concrete foundation walls, stepped levels of concrete slab floors, concrete machinery mounting piers and pads, and a timber ore storage bin support structure, all previously hidden by the buildings and their collapsed debris. The PAL cultural resources monitor determined that long-term visibility of this landscape was of potential interpretive value, as the forms and relationships of these structural features clearly express the relative locations of the ore storage, transportation and processing machinery between and within the buildings. The foundations were left in place and the surrounding ground graded, and covered with stone riprap to provide an enhanced view of the foundations to interpret the gravity-fed ore milling process, and inhibit growth of vegetation, especially trees that could damage the foundations and obscure them from view in future (Figure 50).

The heavy timber copper ore storage bin supports at the east edge of the Thickener (and Filter/Dryer) Building were left in place to better interpret the building's function and heavy timber construction elements (see Figure 50).

1898 Tyson Adit Preservation Easement

Although not constructed for World War II-era operations, the 1898 Adit is located within the WW II complex and was used 1942-1958 for underground mining operations. A Preservation Easement has been placed on this masonry portal and wingwall structure to protect it by agreement between EPA, VT SHPO and the property owner (Figure 51).

Additional Site Conditions Assessment

Milestone Heritage Consulting conducted additional conditions assessments of several Elizabeth Mine copper mining and smelting areas that were not near, included in or impacted by cleanup activities, but that had the potential to have been impacted by natural or man-made activity during the cleanup period.

Furnace Flat North

The Furnace Flat area, north of the main mine site, east of South Strafford village, between the West Branch, Ompompanoosuc River and Route 132 at Furnace Flats Road, is a historic 1850s-1880s copper smelting and associated manufacturing archaeological site that includes river bottomland. At the request of EPA, MHC inspected the site for erosion damage or burial under fluvial deposits associated with Hurricane Irene, which caused flooding of the river in August 2011. Other than some riverbank erosion opposite the site, the only damage appeared to be the washout and destruction of the historic south stone abutment for the former road bridge at this location (Figure 52). The north abutment remains in place.

Furnace Flat South

The Furnace Flat South area, site of innovative copper smelting activity under Isaac Tyson, Jr. in the 1830s, is located diagonally opposite and downstream from Furnace Flat North. Inspection of this area indicated that floodwater energy had been largely directed at the opposite, north bank in this area, and no sand or gravel had been deposited on the smelter site.

Sargent Brook

The Sargent Brook site, west of the main mine site on the Josler property on Turnpike Road, was the site of copper smelting under James Tyson in the 1880s and 1890s. The extensive slag heaps

had been previously partially excavated by the property owner for use as aggregate and fill. That activity had encroached on historic masonry structures interpreted as the smelting furnace base or nearby smelter shop floor, recorded during the PAL 2003 Historic/Archaeological Mapping and Testing (Cherau, Ford and Kierstead 2003). Milestone inspected the site and saw no evidence of any recent slag excavation. Hurricane Irene damage was limited to erosion to the banks of Sargent Brook and did not affect the smelter site.

Future Site Work

At the time of this report production, cleanup work remains incomplete at two historic mining areas at the Elizabeth Mine, the South Mine (discussed above) and the South Open Cut.

South Mine and Shaft

At the south mine, remaining work includes pumping out the water in the open cut, removing loose rock from the overhanging rock wall, filling the cut, filling the 41 ft deep vertical shaft, rerouting surface drainage, minor additional waste rock removal, and planting/site restoration.

South Open Cut

Development of cleanup engineering solutions for the South Open Cut opening, pit lake and water drainage remain ongoing.

It is anticipated that one or both of these areas will require additional landscape documentation and/or construction monitoring, and that activity and change will be documented in a supplement to this addendum.

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U.S. Environmental Protection Agency, et al.

2010 Memorandum of Agreement Among the U.S. Environmental Protection Agency, the Vermont Department of Environmental Conservation, and The Vermont State Historic Preservation Office for Cleanup of the Elizabeth Mine, in Strafford and Thetford, Vermont. March 2010.



Figure 1. South Mine, overview looking south across Copperas Road.



Figure 2. South Mine open cut looking south prior to dewatering, Copperas Road at right.



Figure 3. South Mine open cut dewatering, showing roof support pillars, looking southeast.



Figure 4. South Mine open cut, detail of pillars, looking northeast.



Figure 5. South Mine open cut, detail of hand drill holes in hanging wall, looking east.



Figure 6. South Mine open cut, rock wall support timber, looking southeast.



Figure 7. South Mine open cut, detail of sapling screen, looking northeast.



Figure 8. South Mine shaft collar after excavation, looking south to South Mine open cut.



Figure 9. South Mine shaft, detail of vertical planks in timber collar remains.



Figure 10. South Mine shaft, recovered joists from former shaft cap.



Figure 11. South Mine shaft, recovered timber from former shaft cap.



Figure 12. South Open Cut, former 1950s truck haulageway area after cleanup, looking east.



Figure 13. South Open Cut, former 1950s truck haulageway area after cleanup, looking west.



Figure 14. Tailings Pile 4 area after cleanup, looking northeast.



Figure 15. TP-3 aerial view looking north, L to R: North Open Cut, former roast bed/heap leach area bisected by Copperas Road, Upper Copperas Factory Site and Mine Road.



Figure 16. TP-3 aerial view looking west, T to B: North Open Cut, roast bed/heap leach area bisected by Copperas Road showing culverts, and copperas liquor bedrock trench.



Figure 17. TP-3 aerial view looking south, L to R: relocated copperas road, upper portion of road bed/heap leach area, and North Open Cut.



Figure 18. TP-3 looking north, L to R: North Open Cut, road bed/heap leach area, Copperas Road, with area of slope stabilization rock on till in right background.



Figure 19. TP-3 looking north, L to R: Copperas Road, lower roast bed/heap leach area, Lower Copperas Factory Site.



Figure 20. TP-3 looking northeast across upper roast bed/heap leach area across Copperas Road to Upper Copperas Factory Site, with TP-1/TP-2 waste repository in the distance.



Figure 21. TP-3 looking southeast across upper roast bed/heap leach area across Copperas Road.



Figure 22. TP-3 looking southeast from Copperas Road, L to R: capped Upper Copperas Factory, and lower roast bed/heap leach area.



Figure 23. TP-3 looking southeast from Copperas Road across lower roast bed/heap leach area, showing diagonal bedrock copperas liquor trench, with North Open Cut at upper right.



Figure 24. TP-3 looking southwest from Copperas Road showing culverts, upper roast bed/heap leach area and North Open Cut at upper right.



Figure 25. TP-3, Security/bat grate over manway shaft north of North Open Cut, looking southeast.



Figure 26. TP-3, Security/bat grate over 1831 Adit, looking northwest.



Figure 27. TP-3, safety grille over new cap over shaft east of Copperas Road, looking north.



Figure 28. TP-3, L to R: capped Lower Copperas Factory site, lower and upper roast bed/heap leach areas bisected by Copperas Road, and North Open Cut, looking southwest.



Figure 29. TP-3, detail of historic notch cut into bed rock to divert copperas liquor flow.



Figure 30. TP-3, preserved "Pine Grove" possible copperas factory archaeological site, looking west.



Figure 31. Capped Upper and Lower copperas factories, looking southeast from Copperas Road on TP-3.



Figure 32. Capped Lower Copperas factory at left and capped Upper Copperas Factory in middle distance behind pine trees, with Mine Road at right, looking northwest.



Figure 33. Capped Lower Copperas Factory, looking south from Mine Road.



Figure 34. TP-3, detail of new rock trench channel for Copperas Brook, with Upper Copperas Factory cap at right, looking northwest.



Figure 35. Mine Road, L to R: Lower Copperas Factory, Upper Copperas Factory and TP-3 in the distance, and restored former cleanup Sedimentation Basin area at right, looking west.



Figure 36. Mine Road, restored curve with capped Lower Copperas Factory beyond, looking south.



Figure 37. TP-1/TP-2 waste repository, view of water treatment plant (L) and settling pond (R), looking northwest.



Figure 38. Aerial view of completed waste repository with TP-3 area in background, looking southwest.



Figure 39. Aerial view of completed waste repository, looking west.



Figure 40. Completed waste repository, looking west from east edge, showing Copperas Brook diversion trench in foreground and TP-3 area at upper left.



Figure 41. Completed waste repository, looking northwest from east edge, showing Copperas Brook diversion trench in foreground.



Figure 42. Completed waste repository, looking north from Mine Road, showing Copperas Brook diversion trench in foreground.



Figure 43. Completed waste repository, looking northeast from Mine Road, showing Copperas Brook diversion trench in foreground.



Figure 44. World War II buildings area, showing saved miners' Change House, with 1898 Adit at right, looking southwest.



Figure 45. World War II buildings area, Air Compressor Building foundation with salvaged machinery, looking southwest.



Figure 46. World War II buildings area, Air Compressor Building, detail of Ingersoll-Rand Imperial Type 10" air compressor for underground mine drills, looking southwest.



Figure 47. World War II buildings area, Machine Shop/Workshop foundation and stockpiled salvaged artifacts, looking south.



Figure 48. World War II buildings area, Office/Warehouse foundation, with two-story safe tower at right, looking south.



Figure 49. World War II ore crusher foundation (L) and Assay Laboratory (R), looking west from TP-1.



Figure 50. World War II ore plant foundations, L to R: ore crusher, Thickener/Dryer, Flotation Mill and Ore Silo, looking northeast to TP-1/TP-2 waste repository.



Figure 51. 1898 Tyson Adit portal and wingwalls, looking west.



Figure 52. Furnace Flat North smelter site, site of washed out historic mine road bridge abutment on south bank, West Branch, Ompompanoosuc River, looking south.

APPENDIX A

Cultural Resource Report Executive Summaries and Management Abstracts

EXECUTIVE SUMMARY

The Public Archaeology Laboratory, Inc. (PAL) was contracted by Arthur D. Little, Inc., on behalf of the Environmental Protection Agency (EPA), to conduct archival research and to assemble supplemental information in support of the *Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Vermont*, prepared by Hartgen Archaeological Associates, Inc. (October 2000). The supplemental information presented in this document was generated to respond to report comments made by the Vermont State Historic Preservation Office (VTSHPO), the community and other official commentors.

Elizabeth Mine is a designated National Priorities List (Superfund) site, and as such, the EPA is coordinating the hazardous material cleanup of the site to protect human health and the environment. The EPA determined that the Elizabeth Mine Site is eligible for inclusion in the National Register of Historic Places, based on the documentation provided in the Hartgen report (letter from E. Hathaway to E. Wadhams, dated January 10, 2001). The VTSHPO concurred with the EPA's finding of National Register eligibility and concluded that the site is eligible as the Elizabeth Mine Historic District, although the district's formal boundaries have not yet been determined (letter from E. Wadhams to E. Hathaway, dated March 9, 2001). While the site or district boundaries have not been determined, the EPA recognizes that any proposed cleanup action at the site has the potential to adversely affect some portion of the historic property.

This supplemental report provides historic context information at the national, regional, state and local levels for the Elizabeth, Ely, and Pike Hill mine sites in Orange County, Vermont. This report identifies all of the known discrete areas of historic mining-related activity at the Elizabeth Mine, and discusses their historic, landscape and archaeological values. The known and potential historic and archaeological resources at each of the sites are discussed in terms of their chronological history, including their periods of significance, landscape evolution, and function and technology. This report also includes preliminary evaluation of the physical integrity, archaeological research value and interpretive potential of areas of the Elizabeth Mine. The contextual and descriptive information and statements regarding overall site significance and interpretive potential will assist the EPA and VT SHPO in determining the effects of proposed cleanup activities on known resources and archaeologically sensitive areas at the Elizabeth Mine site.

This report partially fulfills EPA's compliance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800. It identifies and evaluates the historic properties that may be affected by EPA's actions. Additional areas of research are identified and recommendations are made for future consideration of the historic properties. When the final alternatives for EPA action are selected and all interested parties have been consulted, a Memorandum of Agreement will be executed.

EXECUTIVE SUMMARY

Introduction

Elizabeth Mine is a designated National Priorities List (Superfund) site, and as such, the Environmental Protection Agency (EPA) is coordinating the hazardous material cleanup of the site to protect human health and the environment. This report presents the results of an historic/archaeological mapping and testing survey of the Elizabeth Mine Site (Vermont Archaeological Inventory VT-OR-28) in Strafford and Thetford, Orange County, Vermont (see Figure 1-1 of the technical report). The currently defined site encompasses approximately 800 acres of land within the Ompompanoosuc River drainage, a major tributary of the Connecticut River. The majority of the mine site is located in South Strafford in the southern part of the town of Strafford, with an eastern portion in Thetford and small portions at its southern extremity in Sharon and Norwich, which are located in Windsor County. The site is focused on the core area of historic mining activity, although the total land area historically associated with the mine reached 8,000 acres where the mining company(s) had mining rights only. PAL conducted the archaeological investigations for the Department of the Army, New England District, Corps of Engineers (NAE).

Prior to the current investigations, the site had been studied as part of the EPA's compliance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800. The initial cultural resources study, titled Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Vermont, was prepared by Hartgen Archaeological Associates, Inc. (Hartgen 2000). The supplemental report, titled Historical Context and Preliminary Resource Evaluation, Elizabeth Mine Site, South Strafford, Orange County, Vermont (PAL 2001), and an addendum report, titled Addendum to Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine, South Strafford, Orange County, Vermont (PAL 2001), were both prepared by PAL under contract with Arthur D. Little, Inc. on behalf of the EPA. The goal of the current investigations was to locate, identify, photograph, map, and in some cases draw visible structural, artifactual, and landscape features associated with the Elizabeth Mine Site. Limited subsurface testing was also conducted to locate and identify prehistoric and historic period resources within the preliminary Area of Direct Potential Effect (APE). The current APE covers an estimated 170 acres characterized by Tailing and Mine Waste Piles 1, 2, and 3 (TPs), and surrounding lands. The total current study area for the site encompasses approximately 460 acres.

The fieldwork, report, and database will assist the EPA in complying with Section 106 of the National Historic Preservation Act of 1966, as amended, for the proposed undertaking at the Elizabeth Mine Site. The report is a scholarly document that not only fulfills the mandated legal requirements, but also serves as a scientific reference for future professional studies and as a framework for possible future interpretive programs. All archaeological survey work was undertaken in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, 1983), the Advisory Council on Historic Preservation's handbook "Treatment of Archaeological Properties" (1980), and the Vermont State Historic Preservation Office's (VTSHPO) Guidelines for Conducting Archeology in Vermont (2002).

The Elizabeth Mine was established in the early nineteenth century and operated until the mid-twentieth century. It lies approximately one-half mile south of the West Branch of the Ompompanoosuc River, in the rugged uplands of east-central Vermont (Figure 1-2). This section of Orange County hosted mining activity in the approximately 20-mile long Copper Belt, and by

the late nineteenth century was the location of several other mining operations, including the Ely Mine in Vershire (VT-OR-14) and Pike Hill Mines (Eureka and Union) (VT-OR-27) in the town of Corinth. Today, Elizabeth Mine contains major mining landscape features, numerous standing structures, and the aboveground and buried remains of structures and features related to several periods of mining operations at the site. There are also a number of non-mining historic period farmstead sites within the approximately 800-acre mine site.

Survey Methodology

The current investigations of the Elizabeth Mine Site included additional background research and field investigations. The background research focused on collecting information needed to develop prehistoric and pre-/non-mining historic period contexts for the APE and its environs. Additional research into the mining period was limited to interviews with local mine experts and a review of local manuscript collections. The fieldwork was comprised of three primary tasks: 1) site mapping using the global positioning system (GPS) coordinates linked to the site's geographic information system (GIS) completed as part of another contract effort (included as Appendix H of the technical report); 2) detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the site; and 3) limited subsurface testing to locate and identify prehistoric and historic period resources within the preliminary APE that may be directly impacted by the proposed site remediation project. The subsurface testing included several locations selected by the Abenaki Tribe as areas that could potentially contain Native American resources. These investigations resulted in the identification of historic period resources for which there is physical evidence and the preparation of archaeological sensitivity maps for prehistoric and historic archaeological resources within the entire site.

The goal of the archaeological survey was to locate, identify, photograph, map, and in some cases draw visible structural and landscape features and artifacts associated with the Elizabeth Mine Site. These activities were conducted in the APE where cleanup activities will take place and outside the APE within documented activity areas. To accomplish this objective, three research strategies were used:

- additional archival research and local informant interviews;
- field investigations, consisting of a comprehensive site walkover/GPS survey, limited subsurface testing in the APE, and detailed drawings of select cultural features; and
- laboratory processing and analyses of recovered cultural materials.

Background research was conducted to assist in the development of prehistoric and pre-/non-mining historic period contexts. Historical contexts are needed to interpret and evaluate the significance of any Native American and Euro-American (non-mining) resources that may be identified during the field investigations. The background research for prehistoric sites primarily consisted of a review of archaeological site files and cultural resource management reports and studies maintained at the Vermont Division for Historic Preservation (VDHP) for up-to-date information about known prehistoric sites within and/or near the site. Interviews with the Native American Abenaki representatives also provided information relating to culturally sensitive locations within the site.

Additional historic research focused on examining primary and secondary documentary sources (town histories, maps, etc.), including those previously collected by PAL and others, to identify potential Euro- American (non-mining) archaeological sites within or adjacent to the project area. Interviews with local persons knowledgeable about the non-mining history of the area, including

Gwenda Smith, historian/curator of the Strafford Historical Society, were conducted to assist in the development of the pre-mining historic context. An interview with mining historian Collamer Abbott regarding the industrial use of the site was also conducted, along with a review of his archival collection at the University of Vermont for preliminary information relating to its contents and potential contribution to the site's mining period history.

The first field survey task was to produce a comprehensive site plan that depicts the spatial configuration of visible features and landscape elements. This site plan is linked to the GIS cultural resources database for the site (see Appendix H of the technical report). For the purposes of this survey, the Elizabeth Mine Site includes known and documented habitation and mining activity areas at TPs 1, 2, and 3, Old South Mine, South Open Cut, Sargent Brook Smelter Site, Furnace Flat South Smelter Site, and Furnace Flat North Smelter Site.

Initially, a walkover survey with close ground inspection was conducted to locate and identify visible features and landscape elements across the site. The survey encompassed 460 acres that extended from the cemetery in the south to Furnace Flat North and from the Sargent Brook Smelter Site in the west to east of TP 1 (see Appendix B of the technical report). The types of resources that were recorded as part of the site mapping include structural features, area features, linear features, and isolates (see Table 2-1 of the technical report). The walkover survey was designed to maximize coverage of open and wooded areas, using pedestrian transects at 30-meter (m) intervals. The transects were oriented along predetermined compass headings across roughly 460 acres of the historic mining landscape.

Visible features and landscape elements identified during the walkover survey were recorded using a GPS unit. A Trimble GeoExplorer 3, containing PAL's custom historic resource GPS database, with an external antenna, set to collect from a minimum of four satellites achieving a maximum PDOP (percent dilution of precision) of seven was used to collect geographic and attribute data for all identified features. With these settings a minimum accuracy of 5 m was achieved. Linear features such as roads, trenches, and stone walls were recorded as lines, while finite objects like building corners, exploratory drill casings, and discrete artifact scatters were recorded as points, and larger more amorphous features such as large artifact scatters and mine openings were recorded as polygons. Representative photographs were taken of all recorded visible features and landscape elements.

Areas not subjected to GPS survey, because of a lack of landowner permission at the time of the field investigations, include: 1) the majority of the area along the strike of the ore north of the North Open Cut and the West Branch on the Ompompanoosuc River; 2) Lower Bailey Road east of TP 1 (the haul road near Gove Hill); and 3) two house foundations near the intersection of Furnace Flat Road and Route 132. The documented historic period resources in these areas provide information as to their archaeological sensitivity in relation to the overall Elizabeth Mine Site (see Chapter 7 of the technical report).

The information collected during the walkover of accessible site areas was transferred from the GPS unit to the project map utilizing both ESRI ArcView 3.2 and 8.1 GIS. This data was instrumental in determining where subsurface testing would occur within the project APE. Additionally, the GIS data permitted a more sophisticated analysis of the landscape and visualization of the historic spatial arrangement of the project area.

Information collected during background research and the walkover survey was used to develop a predictive model to assess the potential for the presence of Native American and Euro-American resources, the types of sites that might be found, and their cultural and temporal affiliation. The

development of predictive models for locating cultural resources has become an increasingly important aspect of CRM and planning.

The predictive sensitivity model used criteria to rank the potential for the project area to contain Native American or Euro-American sites. The general criteria used to assess the Elizabeth Mine project area were proximity of known and documented cultural resources, local land use patterns, environmental characteristics, and the area's physical condition. The prehistoric period Native American archaeological sensitivity of the Elizabeth Mine Site was based on the VDHP's environmental predictive model for pre-contact settlement sites and information collected during the walkover survey on current project area conditions. The predictive model alone was not sufficient because it provides only a rough approximation of an area's sensitivity while the walkover survey took into account the relative importance of resources and natural barriers to their procurement. Because of the size of the APE and the diversity of environments contained within it, it was necessary to divide the Native American archaeological sensitivity assessments into eight regions based on an environmentally derived parsing of the landscape.

The likelihood of Euro-American archaeological resources was a foregone conclusion based on the intensive mining use of the site during the historic period and the previous historic and archaeological studies conducted by PAL and others. However, based on historic maps and the comprehensive walkover survey it was possible to identify areas of intensive Euro-American utilization, areas of sporadic Euro-American use, and areas where there were little or no Euro-American resources. Furthermore, by georeferencing, or "rubbersheeting," historic maps of the mine on top of the modern project map it was possible to ascertain which historic resources had been buried or destroyed by subsequent mining campaigns. Based on the GPS survey and archival research a number of Euro-American industrial and domestic occupation areas were identified within/adjacent to and outside of the project APE at the Elizabeth Mine Site. The large majority of these areas were grouped collectively within designated subsites, or vicinities of intensive occupation.

Limited subsurface testing was conducted in moderate and high archaeologically sensitive portions of the project APE to locate and identify any potentially important archaeological resources. A total of 73 test pits were excavated for historic period resources within the project APE. These test pits, 50-x-50 centimeters (cm) in size, were excavated at 8-m intervals along 14 judgmental linear transects and as 28 judgmentally placed test pits. Specific subareas subjected to subsurface testing include: the World War I Era Smelter Site, the Tyson Mill Site (specifically the blacksmith shop), the Preston Farm, the Blaisdell Farm, the Farm, North Village, South Village, and TP3 (cob shop, Upper Copperas Factory). Subsurface testing was conducted at a representative sample of visible historic period resources within the project APE. This testing was designed to collect archaeological data on the temporal affiliation, possible function(s), and subsurface soil matrices for individual resource areas (or subsites) where this information was not readily discernable based on visual characteristics alone.

In addition to the above testing, 44 test pits were placed in areas of the project APE determined to be archaeologically sensitive for prehistoric period resources based on the results of the predictive model, walkover survey, and consultation with representatives of the Abenaki Tribe. An additional four test pits were placed in the area northeast of TP1 in proximity to a culverted branch of Copperas Brook. All of these test pits, 50-x-50 cm in size, were excavated at 8-m intervals along nine judgmental transects and as six judgmentally placed test pits.

Furnace Flat North, Furnace Flat South, Tyson Mill Site, Sargent Brook Smelter Site, Blaisdell Farm, the Farm, North Village, TP3, South Village, the Twin Foundations, East Village, and the

Lower Copperas Factory contain visible structures and landscape features that were subjected to detailed plan and cross-section line drawings. Plan maps, which show the spatial relationship of the various features of a resource, were created at either a scale of 1 inch equals 2 m or 1 inch equals 5 m, depending on the size of the resource. Similarly, cross sections were employed to depict the topographic relationships between the various features as well as aspects of wall construction.

Cross sections were completed at a scale of 1 inch equals 2 m. In general the transit was used to establish a baseline and measurements were taken relative to the transit along a tape measure to create the cross sections. However, a number of the shorter wall profiles were drafted using a tape measure across the top of the wall with measurements taken down from the top of the wall. In general the plan maps were created using a hand compass and tape measure to establish the angles and distances between points within a resource. However, in the case of TP3 where the exceedingly steep slope of the area prohibited the effective use of a tape measure, the transit was used to measure both angle and distance. The field maps were digitized using AutoCAD 2000i and were then exported into the GIS database. Besides adding more detail to the GIS map the field drawings permitted the data collected during the GPS survey to be corrected for greater accuracy.

All cultural materials recovered from the project APE during subsurface testing and representative industrial related artifacts collected from the entire site during the field mapping were organized by subsite and provenience, and recorded and logged in on a daily basis. Cultural materials were sorted by type and either dry brushed or cleaned with tap water depending on the material or artifact type and condition. Following the laboratory processing and cataloging activities, all recovered cultural materials were stored in acid-free Hollinger boxes with box content lists and labels printed on acid-free paper. These boxes are being temporarily stored at the PAL facilities in Pawtucket, Rhode Island according to curation guidelines established by the U.S. Army Corps of Engineers.

Results

No prehistoric period cultural resources were encountered during the archaeological mapping and testing at the Elizabeth Mine Site. While upland cultural adaptations have been recorded in northern New England, especially during the Late Archaic and Late Woodland periods, the focus of Native American activity in the region appears to have been concentrated in the major river valleys. With the Connecticut River only a few miles to the east, there may have been only sporadic prehistoric period settlement and land use in the vicinity of the West Branch of the Ompompanoosuc River and Copperas Brook. The rugged, upland topography would not have been particularly attractive for the types of long-term habitation activities (e.g., structures, food processing/storage/disposal pits, hearths, lithic workshops) that would have left readily discernable cultural deposits in the archaeological record at the site. There are only limited settings within the site study area that are relatively flat and contain sources of raw materials and perennial water sources where potentially important prehistoric period resources could be present. These settings include the terrace overlooking the West Branch of the Ompompanoosuc River in the northeast portion of the study area, north of TP1; and quartz outcrops in the west-central portion of the study area, west of the North Open Cut.

A total of 545 distinct historic period features was recorded during the GPS component of the fieldwork. Identified artifact, feature, and structure concentrations were collectively organized into 18 spatially distinct historic period industrial and domestic subsites related to the nineteenth and twentieth-century operations of the Elizabeth Mine. The historic and archaeological mapping

and testing program identified 11 industrial archaeological subsites, seven domestic archaeological subsites; and 43 architectural resources including 31 buildings, nine structures, one individual object, and a multiple object artifact scatter. Thirteen of the industrial and domestic archaeological subsites are located in the project APE. Twenty-eight of the architectural resources are located within the APE. All of the identified archaeological and architectural resources were interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address salient research questions. The following three tables summarize the identified cultural resources by type, time period, major visible physical remains, integrity, and historical research value (documentary data, archaeological sensitivity).

The identified historic period architectural and archaeological resources at the Elizabeth Mine Site are all components of a larger, complex, integrated cultural landscape. The Elizabeth Mine can be considered a single megasite composed of numerous temporally, functionally, historically and physically related industrial, agricultural, domestic and administrative subsites. The natural and man-made environments provide the most dramatic visual images of the mine, and are as important as the buildings, structures, features, and artifacts arranged within them. The cultural landscape at Elizabeth Mine provides insights into the technological advances of copper production, copper mining and metallurgy, and informs about how the arrangement of features defines socioeconomic relations of the inhabitants.

Recommendations

No prehistoric period Native American resources were identified within the project APE. The results of subsurface testing conducted within the APE combined with unfavorable environmental factors and the extent of historic period industrial soil disturbances indicates an overall low potential for important prehistoric period resources to be present. No additional archaeological investigations for prehistoric period sites within the project APE are recommended.

The 13 APE historic mine period subsites and associated landscape features interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address priority research topics related to themes of industry and abandoned communities important to Vermont history (see VDHP 2002:22). The industrially-related research themes for the identified Elizabeth Mine resources within the project APE focus on the various mine technologies, spatial organization of industrial complexes, and the living conditions of the mine workers. These research themes have been identified as important to Vermont history, and as such should be important to a broad public, including the communities of Strafford and Thetford.

Prior to any earthmoving activities related to the site environmental characterization work, documentation of the mine landscape will be undertaken in the spring 2003 as part of the mitigation efforts for the project. These activities are likely to cause irrevocable changes to the landscape and important cultural features related to industrial and domestic subsites. The landscape documentation will encompass the project APE and other major landscape features including the South Open Cut. The landscape documentation will consist of aerial photographs of the TP1/2/3/North Open Cut/South Open Cut landscape, done in the most archivally stable color transparency film available with some additional black-and-white; and terrestrial large format (4" x 5" negative) color transparency and black-and-white photographs of the TP1/2/3/North Open Cut/South Open Cut landscape.

The current survey identified industrial and domestic archaeological resource areas within the project APE that have the potential to address important priority research topics in the state of Vermont (refer to Executive Summary Tables 1 and 2/Tables 7-1 and 7-2 in the technical report).

The proposed trenching associated with the site environmental characterization work should take place with consideration for further investigating industrial archaeological resources as shown on Figure 8-1 and in Appendix B of the technical report. A collaborative effort between cultural resource specialists and the geotechnical team would be expected to provide some of the information identified as data gaps in the research priority topics discussed above. Pending the evaluation of archaeological data collected during the site characterization work, additional systematic archaeological investigations of targeted resources may be warranted as part of mitigation efforts for the project. However, the Corps and EPA have no plans to pursue additional archaeological investigations at this time either to further address the research questions or as possible mitigation. Domestic archaeological resource areas having high research potential should be avoided during site environmental characterization work and cleanup activities.

It is possible that additional areas of potential effect including borrow pits and access roads may be identified in archaeologically sensitive areas outside of the current APE, in which case archaeological survey may be warranted. The survey work would be designed to identify and evaluate any potentially important belowground historic period resources. The need for and scope of additional archaeological investigations within project impact areas will be included in the project's Memorandum of Agreement (MOA).

There are no current plans to alter the WWII buildings in the project APE. However, given their relatively unstable condition and importance to the overall mine site, Historic American Engineering Record (HAER) documentation will be undertaken in the spring of 2003 as part of the mitigation efforts for the project. These buildings and structures include: the upper tier of administrative, maintenance, and operational buildings; the adit and mine car rail line and bridge; the lower tier of ore bin, crusher, grinding/flotation mill, thickener/drier building, tailings pump house and launder remains; the 1948 Shaft Site, TP1 and 2, the Ompompanoosuc River Pump House and Air Shaft, and any other miscellaneous associated resources. Standard HAER documentation will consist of recording the buildings with a set of measured drawings showing site plans, materials handling routes and process flow charts. Although the PAL Historic Context Report (PAL 2000) contains a general history of the Elizabeth Mine that could serve as a basis for the HAER narrative report component, that document will be updated to reflect new information discovered during the course of subsequent research and fieldwork, and edited to shift the focus primarily to the Elizabeth Mine. Since the HAER documentation concentrates strongly on process, the narrative and drawings will be created in consultation with an industrial historian knowledgeable about the Elizabeth Mine and the ore beneficiation processes used there. A set of photographs separate from the above-mentioned landscape documentation will be done in large format (4" x 5" negative) for the building exteriors (interiors if available) using mostly black-and-white with some color, and also including limited representative views of the TP1/2/3 and North/South Open Cuts landscapes as they were sources of ore during the World War II period.

EXECUTIVE SUMMARY

An archaeological data recovery program and archaeological monitoring efforts were conducted at the Elizabeth Mine Site (VT-OR-28) in South Strafford, Orange County, Vermont. These investigations were conducted in support of the Non-Time-Critical Removal Action (NTCRA) at Tailings Pile 3 (TP 3) at the Elizabeth Mine being performed by the United States Army Corps of Engineers-New England District (USACE) for Region 1 of the Environmental Protection Agency (EPA) through Interagency Agreement. The archaeological data recovery and monitoring investigations were conducted in the Cleanup Action's Area of Potential Effect (APE) in accordance with Stipulations III and V of the Memorandum of Agreement (MOA) for the cleanup of the Elizabeth Mine, signed and dated March 2010.

The EPA NTCRA Cleanup Action activities were determined to result in irreversible impacts to the Copperas Factories Subsite (Upper and Lower Copperas Factories, Inter-Copperas Factory area) within TP 3 within the Elizabeth Mine Site. The archaeological data recovery and construction monitoring were conducted for these portions of TP 3 to mitigate the adverse effects of the cleanup impacts to these site elements. The data recovery plan was developed in conjunction with the cleanup design to minimize the adverse effects of the remediation on the significant Copperas Factories Subsite. Cleanup activities necessitated additional data recovery investigations in 2009 and 2010 in the area of the North Berm and Copperas Brook within the Copperas Factories Subsite, and the Pine Grove area situated both within and in proximity to the Subsite. The research design/questions for the original data recovery program and additional work areas expanded on the themes presented in the 2003 PAL technical report, *Historic/Archaeological Mapping and Testing, Elizabeth Mine Site, Stratford and Thetford, Vermont*. The research questions included the general process of copperas manufacture, particularly within the factories where the boiling, cooling, crystallizing and packing took place. The data recovery methodology was designed to address the research questions. The methodology consisted of field investigations, additional documentary research, and laboratory processing and analysis of recovered data.

The 2009 and 2010 data recovery and construction (mine waste removal) monitoring at the Elizabeth Mine copperas factories uncovered extensive, and in some cases, unanticipated industrial archaeological features associated with copperas manufacturing. The 2009 field season work at the visible foundation at the Upper Factory uncovered tiered remains of copperas boiling, cooling and crystallizing process structures and vessels. The 2009 field season work at the visible foundation at the Lower Factory uncovered an unusually intact assemblage of workspace features and artifacts, as well as the remains of copperas processing equipment both comparable to and different from that found at the Upper Factory. Work in 2009 in the North Berm and South Berm areas and the 2010 work in the Copperas Brook Corridor revealed additional copperas processing features and factory structural remains, and revealed that the Upper Factory site as originally understood was more complex and much larger than anticipated and may have contained the remains of more than one of the reported factories at that location. Subsequent mine waste removal monitoring in several of these areas revealed additional information that contributed to the understanding of the site.

The 2009 and 2010 archaeological data recovery campaigns provided sufficient data to address the research questions for the Copperas Factories Subsite posed in the 2003 PAL survey report and data recovery research design. The data recovery investigations contributed to the understanding of the copperas manufacturing process and plant construction and layout at the Elizabeth Mine site. The excavations confirmed and documented locations, relationships and construction of vessel structures associated with the successive steps of copperas production. In the case of the Upper Factory the data recovered corresponded elegantly with the tiered boiler-cooler-crystallizer sequence on the landscape as described in the historical record. The different layout of the Lower Factory indicated an alternate

arrangement of the manufacturing process, and the artifacts indicated an additional multi-use workshop function. The presence of additional boiler features in the North Berm and South Berm suggested the remains of another factory or factories, or steps in copperas manufacturing undocumented in the written historical record.

The data recovery investigations were also successful in documenting deep and/or expansive heavy masonry and timber substructures and brick and stone construction of copperas boilers, coolers and crystallizers that add to the understanding of nineteenth-century rural industrial site construction methods. The excavations demonstrated the site's three-dimensional, spatial and structural complexity and four-dimensional (temporal) complexity in remains that appear to reflect different factories operating in successive phases or in ways not described in historical record. The site analysis demonstrated the importance of the use of archival research materials and careful examination and creative use of the written historical record, which is not always accurate, for site interpretation. The site analysis also underscored the importance of consulting knowledgeable experts in the areas of applicable disciplines including mining engineering, chemistry, economic and structural geology, and even maple sugar pan construction and operation to inform an accurate understanding of industrial and natural processes and constraints affecting the manufacturing and post-manufacturing behavior of and impacts to the site and associated materials.

The 2009 and 2010 data recovery investigations also suggested that interpretation of archaeological data at similar types of industrial sites may be complicated by the action of mining and post-mining period natural and human-aggravated phenomena including steep topography, wet soils, waste material disturbance/movement/re-deposition, erosion, unusual rock and soil chemistry, rock alteration, and timber preservation and decay. The appearance and behavior of these phenomena can challenge the traditional understanding of soil stratigraphy, artifact and structure preservation, etc. The universal physics of natural processes obviously apply everywhere, but topographic or chemical anomalies can accelerate those processes, and mining activity disturbance can violate the basic principle of stratigraphic superposition. What applies in an undisturbed, or residential, or agricultural, etc. setting may not always apply in an industrial or mining setting.

Despite the extensive data recovery efforts in 2009 and 2010, the surviving unexcavated portions of the copperas factories still have the potential to provide information about copperas manufacturing at the Elizabeth Mine. EPA cleanup design elements for the copperas factories and small parts of TP 3 were changed during archaeological data recovery to balance the removal of mine waste with protection of significant archaeological resources. The South Berm, where a copperas liquor boiler was discovered, was set aside for preservation in exchange for the data recovery and monitoring of removal of the boiler feature at the adjacent North Berm in consultation and agreement with the VT State Archaeologist. At the Upper Factory and Lower Factory, instead of removing the mine waste after the data recovery, the archaeological sites were retained, including all structural remains, and covered with a geotextile fabric marker layer and capped with distinctive round tan granite river cobbles, the boundary of which corresponds with the larger, lead-contaminated soil area and contrasts with the gray, irregular crushed rock of the sedimentation basin lining. The capped sites also include the reburied objects (in situ and out of place) discussed in the report narrative and illustrated in Appendix B.2 of this report. The capping and marking method delineates the extent of cleanup archaeological investigations, protects the factory archaeological sites from looting, and preserves them for potential additional future archaeological investigations.

All project information (i.e., excavation records, maps, photographs, artifacts removed from the site) is currently on file at PAL, 26 Main Street, Pawtucket, Rhode Island, until such time as the USACE and/or EPA designates a permanent repository in accordance with the State of Vermont laws and the private

landowners. Appendix A contains the comprehensive inventory of all artifacts removed from the site during the 2009 and 2010 data recovery excavations, including the objects illustrated in Appendix B.1.

Should ongoing mine water or other environmental testing lead to a decision that the copperas factories or the South Berm are continuing to contribute to water quality issues, additional data recovery would add to the information collected during the 2009 and 2010 seasons. Data recovery within the unexcavated portions of the Upper Factory has the potential to reveal additional copperas manufacturing vessels, and most significantly, to expose the remaining underlying timbers and bedrock, potentially confirming interpretation of the sloping timber structure explored and documented in 2009 and 2010. Data recovery at the South Berm would confirm the function of the boiler feature located there; the apparent integrity of that feature suggests that careful bisection would add significantly to the understanding of its construction and operation. PAL does not recommend any additional data recovery at the Lower Factory; the 2009 data recovery uncovered the majority of the factory working floor and subsequent removal of mine waste at the north foot of the factory wall precludes work in that area. PAL's conclusion that the Inter-Copperas Area was associated with temporary copperas storage suggests that additional work in that area would not make a major contribution to the understanding of the manufacturing process and would not benefit from additional data recovery.

MANAGEMENT ABSTRACT

PAL completed a Phase IB archaeological survey of the Elizabeth Mine East Village – Haul Road and Slope Stabilization Work project area in South Strafford and Thetford, Vermont. The proposed project involves construction of a new haul road and slope stabilization work on approximately 6 acres. The archaeological survey included archival research, a walkover survey, and subsurface testing to locate and identify any potentially significant archaeological resources that may be affected by project construction. The project area is located within an area that was previously identified as being archaeologically sensitive for resources associated with the house and barn (farm) component of the East Village Site (ca. 1809–1942) at Elizabeth Mine.

Thirty-five 50-x-50-centimeter test pits were excavated within the project area. The test pits were excavated along four judgmental transects, one 30-x-30-meter block, and as one judgmental test pit. The archaeological testing effort excluded a 50-foot buffer area around the previously identified barn and dwelling foundations, which will not be impacted by the proposed project.

A low density of post-contact period cultural material was recovered from plow zone and mixed plow zone and slope wash contexts from 17 test pits. The majority of the recovered cultural materials are ceramics of mid-to late-nineteenth-century manufacture, and include primarily whiteware ceramic sherd fragments. Other cultural materials recovered in lesser quantities include brick fragments, unidentified metal, nails, and curved and flat glass. The recovered materials likely represent low-density field scatter associated with documented occupation of the farm house and barn. Additionally, two remnant walls of a previously unidentified foundation were identified adjacent to Mine Road. Historical photographs suggest that the foundation ruins may have been associated with a free-standing shed. However, the foundation appears to have been almost entirely demolished by the construction of Mine Road and a pull-out on Mine Road. It no longer possesses any structural integrity. No pre-contact cultural material or features were identified within the project area.

In summary, no potentially significant archaeological sites were identified and no further archaeological investigation of the project area is recommended. These recommendations are contingent on a 50-foot construction buffer around the barn and house foundations north of Mine Road. If project plans change to impact areas within the 50-foot buffer zone, additional archaeological investigations may be necessary.

APPENDIX B

**Strafford Historical Society, Finding Aid for: "The Carrie and Charles Judd Historical
Articles on Strafford and the Elizabeth Mine"**

CARRIE AND CHARLES JUDD
HISTORICAL ARTICLES
ON STRAFFORD
AND ON THE ELIZABETH MINE
(Donated by Richard Josler, Sept. 2011)
INVENTORY

I. ELIZABETH MINE MATERIALS

SHOE BOX - Mine Related Materials:

3 Daily Time Report pads: Vermont Copper Co. Inc. - unused sheets remaining
Time Log account book with miners' names and daily hours worked
Inventory of lumber, steel etc., handwritten
Eimco Hard Rock tunneling: record-breaking method
Personnel Sheets: written recommendations for Charles Judd and Wendell Pixley
9 Booklets: Mine Hazards, Prevention of Accidents, etc. from the U. S. Bureau of Mines 7
Pictures of Elizabeth Mine, package of singles and plastic display sheet of 6 more
2 "Super Paks" of snapshots of Elizabeth mine and miners - identified
2 boxes of slides: #1 - Copper Mine; #2 - not of copper mine
1 (moldy, in plastic bag) small account book with names in it
Blasters' Handbook (Charles L. Judd, Strafford)
Strafford Town Report 1952, Cover: Elizabeth Mine. Hand-written notes on mine info
Over The River And Through The Years - Book 4 - Mills and Mines - Katharine Blaisdell

YELLOW LEGAL-SIZE FOLDER:

3 Copies of MOMENTUM, Valley News Supplement on "Vermont Mines" Nov. 1980 (Mining Vital to Vt. Economy; Working the Mines Then and Now; Photo Chas. Judd) 2 Posters Aug. 5 1943 ; "100 Men Wanted At Once" with clip-and-mail coupon to apply.

Folder: A Working Heritage : two booklets: "VT Workers VT Resources; (Clay Wood, Metal, Stone)" and "A Useful Trade (1 8th Century Itinerant Portrait Artists)."

GREEN FOLDER: REPRINTS

Feature Parade reprint: Only Copper Mine in New England, by Joseph Napolitan - 1957

Mining in the Vermont Hills, by Cliff Somerville, 3 pages

Pomfret Post, Dec. 1972 "Unauthorized Copper Prospecting Angers Landowners" 8 pgs.

Charles Judd talk on "The Elizabeth Mine, South Strafford, Vt."

"Elizabeth Copper Mine," handwritten Report and edits - 6 pages

DARK RED SCRAPBOOK of Newspaper Clippings from Valley News

Orange Co. Sites Probed For Copper Mine Prospects

Copper Mining in the Upper Valley? Two Companies Interested (10/5/1 972)

Mines Not All Bad (Forum)

Citizens Unite Against Mining; Surveyors Annoying Residents - Pomfret (10/9/1972)

Citizens Plan Probe of Copper Mining Prospects - Pomfret

Meeting on Mining Tonight - Pomfret (11/2/1972)

Inter-Town Meeting on Copper (Times Argus) re bill to ban surface mining in Vermont.

Meeting Called on Mining Issue: Propose Stiffer Laws - Pomfret (10/27/1972)

Salmon Vows to Fight Strip Mining in Orange Co.

Candidates would oppose Strip Mining

Copper Mining History - Times Argus (10/26/1973)

Eastern Vt. Prospecting Activities - Strafford

Urges Controls on Strip Mining - Times Argus

Pomfret Board Adopts Resolve Vs Miners (10/17/1972)

Copper Prospectors May Face Charges (11/17/1972)

Coalition Vs Copper Mining Formed At South Strafford Meeting

Organize Vs Mining - Times Argus (11/21/1972)

Interest Stirs in Area Copper (photo by Rosa Tyson)

BLACK LEGAL-SIZE FOLDER: Newspaper Clippings

2 Plastic sleeves of articles from Valley News in 1972:

Copper Mining Legacy -2 Show Interest: Humble Oil & Canadian firm (9/28/72)

Mine Opponents File Legislation with John Alden

Humble Oil Officials tell its Vt. Mining Plans

Agency Decides Humble Oil Drilling Permit Not Needed

Board Rules Firm Needed No Permit For Mine Tests

Humble Explains Copper Mining

Humble May Need Act 250 Clearance

Orange County Meeting on Mining (11/7/1972) 1956 Valley News Clippings:

4 Articles by Collamer Abbott on Copperfield:

-Once-Busy Copperfield Is Now Only A Memory

-In 1870s Copperfield Was Nation's Biggest

-Copper field's '83 Riot Was Mortal Blow to Mine

-Hope Still Flickers For Copperfield Mine

(Photos of Copperfield)

Jan. 1990 Environmental Awakening: Elizabeth Copper Mine Site of Anti-Nuclear Film

MAGAZINES & BOOKLETS ON MINING: In Box

Engineering & Mining Journal - Oct. 1952 "New Life For Vt.'s 160-yr-old Copper Mine"

Topics - Feb. 1957 - page 27, "Copper Mine in Vermont"

Green Mountain Copper by Collamer Abbott - 1973

MANILLA LEGAL-SIZE FOLDER: The Elizabeth Miner: Monthly Mine Newsletters May 1945 - Dec. 1945; April 1946 - August 1946; 1947, some 1948, some 1949

MANILLA FOLDER: NEWSPAPER CLIPPINGS ON ELIZABETH MINE

March 1943 - Copper Mines Coming To Life - 6 million lbs/year expected from Strafford

Aug. 5 1943 - Full Pg. Ad "100 Men Wanted At Once" Experience Unnecessary, Good \$

1943 - Vermont Copper Mine May Reopen: Copperfield Ghost Town expected to Revive

Sept. '44 Fred Snow tells Rotarians What is Going On There "Strafford Copper Mining"

Dec. 14, 1944 Plan of Mining & Concentrating Properties, Elizabeth Mine, So. Strafford

Dec. 1944 Two Newfoundland Men Were Killed by Falling Rock Underground At Mine

Brown Co. Treats Copper Waste To Get Gas For Pulp Production

So. Strafford Copper Mine Has Had Amazing Recovery

Gen'l Manager for Copper Co. is from Utah - speeds erection of buildings

Strafford Copper Mine Written Up in Boston Paper (Sept. 1945)

Strafford-Pompa Road To Be Finished Sept. 1

Feb 1946 Vt. Farmers Work As Part-time Copper Miners

Appalachian Mine Outfit Pushing Research Project

Copper Mining in Vt. Traced in Historical Exhibit

Ashe Co. N.C. (Ore Knob) People Cooperate with Appalachian Sulphides Co., Canada

"Ashe Gas" from Ore Knob N.C. Visit to a mine there

Feb, 1945 Gov. Wills Adds Plea For More Copper Miners

Copper Mine in Full Operation - Strafford Mine turns out 500 Tons Daily

Weapons of War From The Hills Of Vermont - Photos

Search Is On For Hidden Metals In This State

Maine Explores Extent of Copper Deposits on the Easterly Shore of Penobscot Bay

Four Photos Taken At Elizabeth Mine

How Crude Copper Ore Is Reduced - Elizabeth Miner gives description

Copper Mine President Forecasts Its Success - Frederick "Pop" Snow

New Plant To Use 5, Strafford Sulphur; Iron Output To Rise

Feb. 18, 1952 Mine Elevator Fails: List Seven Casualties (The Dartmouth)

Feb. 21, 1952 Eight Injured In Mine Accident. Men thrown 30-40 Feet As Hoist Reverses

Feb. 1952 Operations Resume At Vermont Copper Mine (Strafford Social News Column)

Feb. 13, 1953 Many New Jobs Opened - Mine Waste Used In Making Paper

1953 Photo: Eliz. Mine Supt. Clinton Miller from Montana & Stanley Tullar 800' below

1957 Vermont Leads All In Asbestos - Eliz. Mine only vital Copper Mine Still Operating

April 1957 Only Copper Mine in New England - Yields 800 tons of Copper Ore Daily

Feb. 1958 Strafford Mine Running Out Of Ore Inspires Vt. Copper Exhibit

Strafford Gives Needy Families U. S. Surplus Food -Photo Mr. & Mrs. George K. Brown

So. Strafford Copper Mine To Close Down For Good - Area Loses Largest Payroll

1958 S. Strafford Mine Featured in Vermont Life Magazine

March 1958 The Sound of a Lone Hammer Breaks The Air's Stillness in S. Strafford j

Oct 31, 1968 Strafford Copper Mine Finis

Sept 22 1969 Strafford Mine Properties Go At Auction Sale For \$57,075

1/24/73 Ely Copper Mine History Told At Bradford Meeting

MAMLLA FOLDER: REPRINTS OF MINE ARTICLES

Report of Vermont State Geologist Reopening the Vermont Copper Mines

Map of Strafford

Appalachian Suiphides Inter-office Memo re men telling "Deer Stories" during work time

Strafford Copper Mines Reopened - typed from Chelsea Herald - 1905

Zeroxed pages of notes, diagrams and three photos

Geology of Elizabeth Mine, Vermont - abstract - by Peter Howard - 66 pages

New England's Mining Relics, by Collamer Abbott -4 pages

Early Copper Smelting in Vermont, by Collamer Abbott - 6 pages

The Elizabeth Mine, by Malcolm Annis -2 page Zerox

Vermont's Pioneer Copper Plant, by Collamer Abbott - 5 pages

The Vermont of Today, by Arthur Stone (notes) -4 pages

The Elixabeth Copper Mine, South Strafford - datelines (notes)

Engineering and Mining Journal, October 1953:

“This Will Run 12% Copper;”

“New Life for Vermont's 160-year-old Copper Mine,” Zerox -4 pages

LEGAL-SIZE MANILLA FOLDER: Judds' Notes. etc.

Two 3X5 Cards: Notes on Eliz. Mine and on Vermont Copper Co.; some reference lists.

Charles Judd, foreman's report on Rebuilding #3 Shaft

Accident Record: Dec. 1942 through June 14, 1956 (on back is a payroll record)

9/1/55 Appalachian Sulphides report on Unauthorized Visitors around the Plant

Dec. 18, 1957 Notice To Employees Operating Schedule for Christmas Week

1958 Appalachian Suiphides report on work completed April 3 - April 9 1958

3 Handwritten Pages lists “C. Judd Materials” printed materials etc. Most in other folders

8 Pages of various Historical Notes on Mine

Copy of Legal Notice of Increase of Capital Stock Jan. 1899

Zeroxed Copy of Herald Sept. 1905

4 Pages Maps and Diagrams of Elizabeth Mine

2 Pages Photos of Elizabeth Mine

11-Pg. Reprint of Orange County Copper Mines from Child's Orange Co. Gazetteer 1888

INCLUDES MAMLLA FOLDER WITH:

Katharine Blasdell's Columns for Over The River And Through The Years

1) Gold Mines in Lyman and Lisbon

- 2) Lion and Copper Mines: Franconia Lion Industry
- 3) A Visit To An Old-Time Copper Mine
- 4) Smith Ely's Boom Town
- 5) The Ely War
- 6) A Doctor's-eye View of the Ely Mining Village
- 7) A Doctor's-eye View of the Ely Mining Village (continued)
- 8) Pike Hill Mines in Corinth
- 9) Mining At South Strafford

Photo from Katharine Blasdell - "Where Is It?" (Buildings at South Strafford?)

MANILLA FOLDER - HISTORICAL INFO KEPT BY THE JUDDS

Copper Pyrites At Corinth (also Strafford & Ely) Copy of paper found in Odell's attic
Report on Copperas Hill & Work of New Eng. Chemical Co. (by R.H. Duncan, agent)
Elizabeth Mine Tour May 17, 1992 for Strafford Historical Society by Carrie Judd
1985 Essay Contest & Annual Meeting Report/Newsletter; SHS Financial Statement
Dec. 7, 1899 - Notes from The Herald "Largest Copper Mine in the East in 5, Strafford"
Minerals of Metallic Luster - from a Report Of Vermont State Geologist
Some Important Mine Dates From Strafford Town Report
Copy of 1897 The Articles of Association of the Elizabeth Copper Co.
Strafford History Research; & 2 pages on George McClellan Moore & Helen D. Moore
"Strafford" - Elizabeth M. F. Chandler, Town Clerk, from The Vermonter March 1907
Jan. 1947 - Elizabeth Miner typescript, "The Green Light"
Notes and Comments to Katharine Blaisdell about her drafts of mine articles
9 pages, handwritten on the Mine by Wendell Pixley
1/2 page yellow paper, stapled: Fireman's Association Agreement
V2 page, 1833 Free Will Baptists - notes of mtgs in brick schoolhouse S. Strafford

Strafford History - copy from Justin Morrill's account

Nov. 20, 1919 Strafford News from Chelsea Herald

Typed Note re Blake Cemetery headstone inscription & humorous anecdote

II. TOWN OF STRAFFORD MATERIALS

(A) MANILLA FOLDER OF STRAFFORD SOCIAL NEWS COLUMNS:

Fatal Fire in So. Strafford 1/3/68 - Death of George Cole at Strafford Creamery building

Other columns Sept. 1967 - Feb. 1968 including photos of Winter Carnival & Ski Camp

Photo of Pinnacle Mid-Vermont Ski Team

School News Column 3/23/67

Deer Kill With Bow and Arrow 11/67

Minnie Bassingthwaite's 94th Birthday Party

Photo: Mr. & Mrs. Earl Silloway, dght'r Tammie & horse-drawn Stage Coach at PTA Fair

Photos: Beth Perkins as A Child, and On her horse, "Little Secret," Jumping In A Show

Photo; Two Bobcats Killed by Two Clifford Boys

Photo: Mr. & Mrs. Harrington who gave the Ski Hill For Town's Use

Photo: Gina Avery (Boyd) was the Newton Student Weighing In Deer At Coburn's

Photo: John Thorp as a young "Frosty the Snowman"

Photo: Andersen Thorp in the Newton School Christmas Show

Photo: Rosa Tyson Receives Life Membership in SHS from president Bob Bushway

(B) MANILLA FOLDER OF STRAFFORD LOCAL NEWS CLIPPINGS

8/23/68 Newton School Designated Special Site: Praised for use of space in Tyson Gym

Article of Appreciation By Townspeople

Photo of Unitarian Universalist Church and History

Lady of Light Chapel July 1963 Dedication

United Church Lord's Acre Celebration 9/76

Suit for Tuition to Hanover High for Winthrop Bean brought by Alta Varney

South Royalton High School Graduation June 1962

Historical Society's Restoration of Town House Gallery Pews, and Photo

1977 Town Meeting's Old Positions (Fence Viewer etc.)

Jan. 29, 1953 Dial Phone Service Starts

Tad Coffin - Vermont's Athlete of the Year Award

Marriage of Beth Perkins to Walter Lowry

Dec. 25, 1958 - Photo of Royalton Town Snow Roller and article "Dec. May Be Coldest" 1920 Yearbook of Auto. Club of Vt. lists number of cars: Strafford 28, S. Strafford 27,

Vershire 32, Sharon 41, Tunbridge 58, Chelsea 86, So. Royalton 119, Bethel 143

Flood Hazard Maps - Public Hearings in Strafford

Sub-Division Regulations Studied for Revision - Jan. 31, 1979

Obituaries for Howard Gilman, 85, built mini-houses and villages, and Milo Sleeper, 86

Photo Aug. 18, 1960 - 2 College Presidents & Frank Brown, Selectman, SHS Annual Mtg

Story of Hannah Dustin's Escape From Indians - Katharine Blaisdell

Strafford's Bicentennial Celebration

(C) MANJLLA FOLDER OF LOCAL NEWS

Strafford Gets Look At Past - Town Meeting

Envelope of Photos Marked Carrie Judd of P.O. Root House

Obituary of Lillian Howe, and Randall Howe Graduation Photo

6/5/86 Anita Onofrio, 29, Nurse-Midwife Joins Practice

Obituary of Robert Ordway, 75 (b. Oct. 1904)

Obituary of Dorothy Erno (July 21, 1977 newspaper)

New \$600,000 Cardigan Mountain School Athletic and Social Center

1984 - Joseph "Scotty" Maclay, retired, returns to School at Community College of Vt.

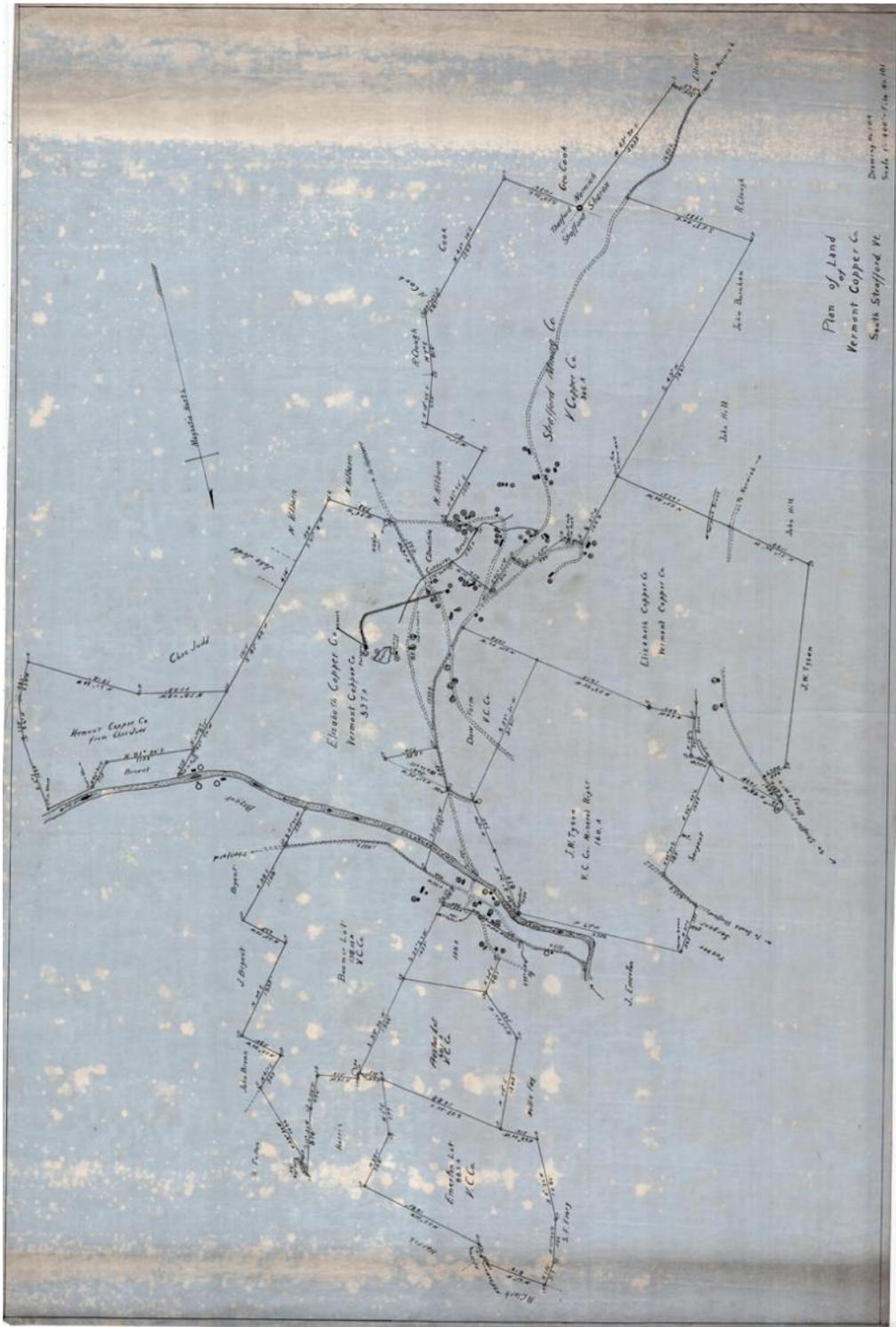
May 16, 1964 - Special Strafford Town Meeting: Record 84% Support Zoning Ordinance

May 15 Open House for Restored Town House Gallery Pews

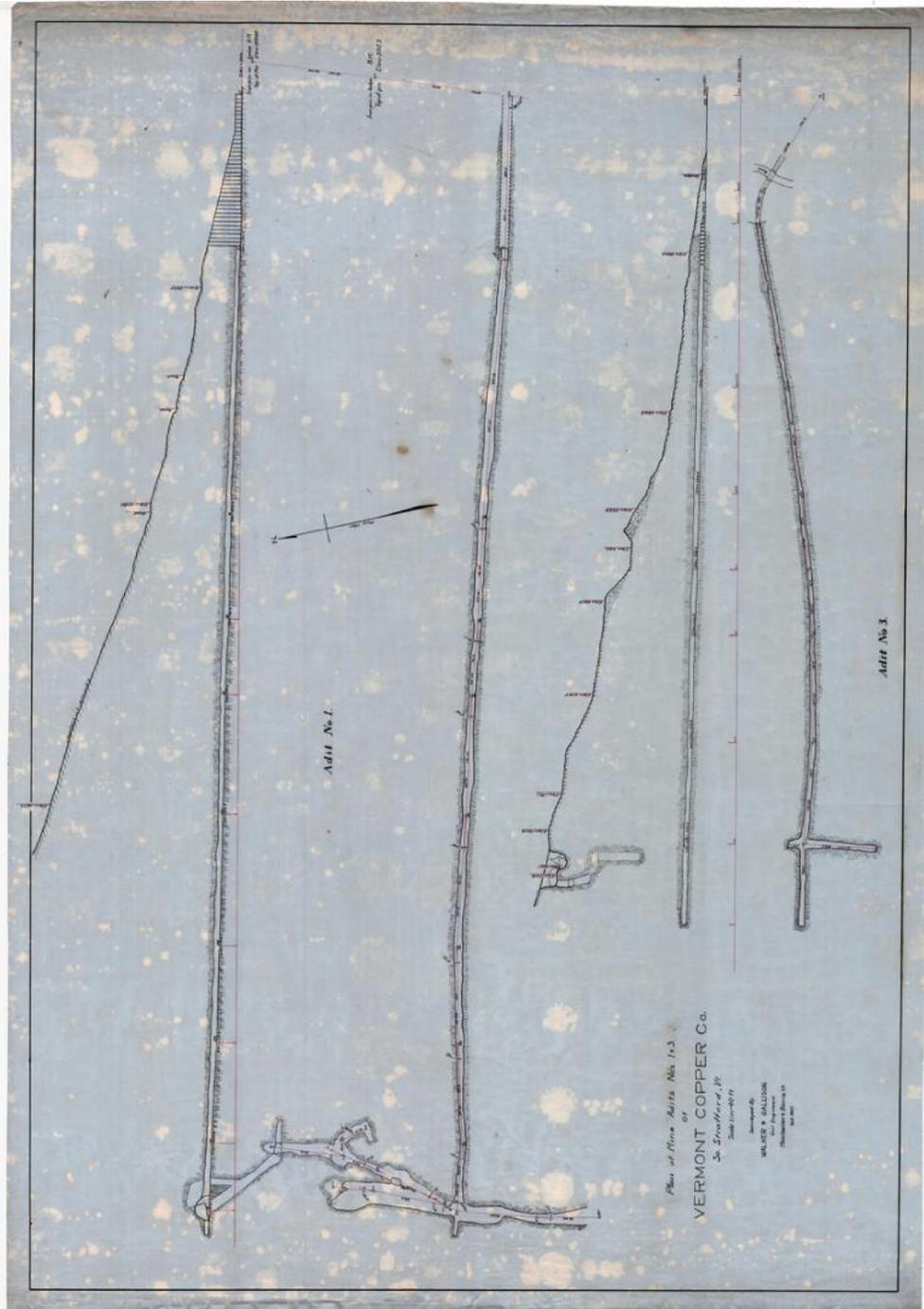
Vocational Building at Thetford Academy Being Built (Morgan Smith in Photo at Site)

APPENDIX C

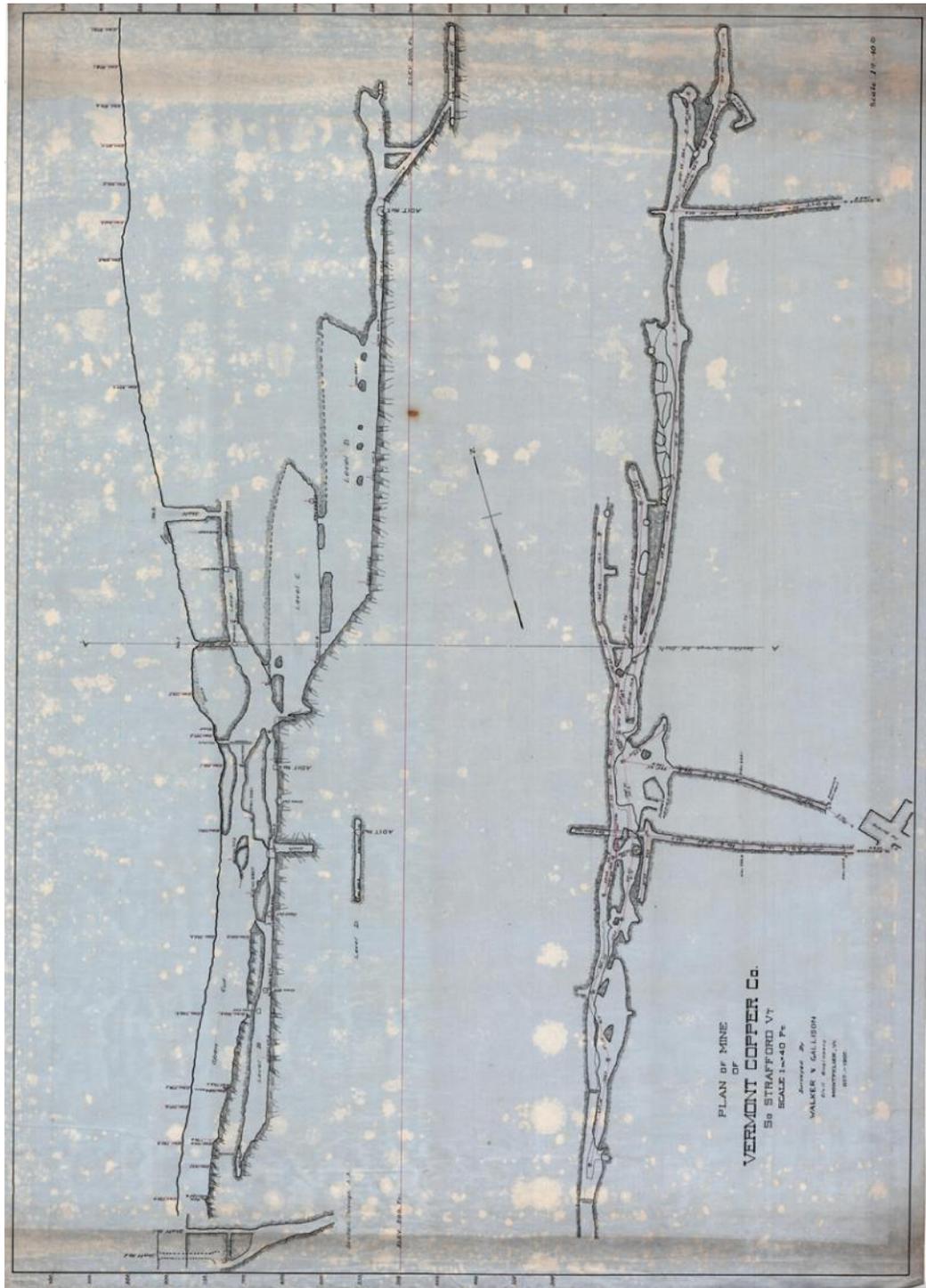
Strafford Historical Society: Elizabeth Mine Maps



Plan of Land of Vermont Copper Co., South Strafford, VT. Drawing No. 104. Scale 1"=400', File No. 101.



Plan of Mine Adits Nos. 1 & 3 of Vermont Copper Co., So. Strafford, VT. Scale 1 in=40 ft.
Surveyed by Walker & Gallison, Civil Engineers, Montpelier & Barre, VT, Oct. 1907.



Plan of Mine of Vermont Copper Co., So. Strafford, VT. Scale 1 in.=40 ft. Surveyed by Walker & Gallison, Civil Engineers, Montpelier, VT, Oct. 1907.

APPENDIX D

Strafford Historical Society, Finding Aid for: "Materials Relating to the History of Copperas and Copper Industries, Primarily in Strafford," as compiled by Gwenda Smith

ARCHIVES OF THE STRAFFORD HISTORICAL SOCIETY

MATERIALS RELATING TO THE HISTORY

OF COPPERAS AND COPPER INDUSTRIES,

PRIMARILY IN STRAFFORD

LISTING: the list gives a brief description of each item to assist in determining its potential interest and usefulness, or lack thereof.

FILING: items are filed in chronological order, with one folder for each year, generally speaking. Multiple items for any year are arbitrarily assigned a,b,c,d ranking.

NOT CURRENTLY INCLUDED are less substantial newspaper articles from about 1943, some of which may be added as time allows.

The 2003 Report of the archaeologists is the only item pertaining to the EPA Superfund project included here.

date 1556 subj Copperas production type xerox pages 14

desc Agricola. De Re Metallica. Copies of relevant pages

date 17 subj Copperas production type xerox pages

desc Diderot, Denis From his Encyclopedia, a Dover Publications translation-reprint entitled A Diderot Pictorial Encyclopedia of Trades and Industry Plate 151 describing the manufacture of vitriol (copperas); plate 152 , alum.

date 1810 a subj Census of manufacturing, Str type typescript plus pages 1 page

desc U.S. Census Bureau. Xerox copy of original ms return, as well as typed transcript, Includes reference to copperas mine and its operations and production.

date 1810b subj Copperas mine, letter revisit type ms transcript pages 1 page

desc Boyd, Alexander, student at Dartmouth College. Partial copy of ms letter at Dartmouth College Library, #81 0626.2 regarding a planned visit to the mine

date 1811 subj Copperas works, help wanted ad type xerox pages 1

desc Notice to Manufacturers. From the Independent Chronicle (Boston) 21 January 1811. Wanted, at the new established copperas manufactory ... a master workman ... Our item is from a July 1920 clipping from Herald reporting donation of the newspaper to the Harris library.

date 1817 subj Copperas works, Visit of President Monroe type typescript pages ip

desc Morrill, Justin S., undated reminiscences quoted in William Belmont Parker, *The Life and Public Services of Justin Smith Morn/I*, 1924. pages 22—23.

date 1821 subj Copperas works, article type Xerox pages 3pp /2pp

desc Locke, Dr. John. “Some account of the Copperas mines and manufactory in Strafford, Vt.” from *The American Journal of Science and Arts*, B.Silliman. Vol 111:326-330. Also a duplicate from Johnny Johnsson of the same. Also a single-page typescript of part of the article. Accessioned as SHS L80-7-1 8.

date 1823 subj Copperas works, article type xerox pages 2 pages

desc Pierce, James. “Notice of an excursion among the White Mountains ... in June 1823 ...“ in *The American Journal of Science and Arts (Silliman’s Journal)* vol VIII, No. 2, 1824. Postscript refers to method of manufacturing copperas at Strafford.

date 1824 subj Description of copperas works type Xerox

desc Thompson, Zadock, *Gazetteer of Vermont* 1824. Excerpt relating to town of Strafford, including a detailed description of the copperas manufacturing process and production.

date 1827 subj Copperas works, article type Xerox pages 3pp

desc *The Columbian Centinel* Boston, December 1, 1827, page one, under heading Vermont Manufactures. Also a one-page typescript of the same. (from egs original)

date 1831 subj Tyson, Isaac Jr. Report on chemicals type Xerox pages 15pp

desc Tyson, Isaac, Jr., in *Journal of Industrial and Engineering Chemistry*, 1 Feb 1917, “Report of the Committee on Chemistry, ...“ Domestic Industry, NY, 1831. Gift of Johnny Johnsson.

date 1832 subj Copperas works, letter type Xerox+type ges 3pp

desc Richardson, of Franconia, N.H. Letter to Mr. C.U. Shepard, appearing in *Benj. Silliman’s American Journal of Science and Arts* Vol. XXI:383-384, January 1832. Accessioned as SHS L80-7-1 9.

date 1833 subj Copperas prod, Str & Shrewsbury, report type Xerox pages 4pp

desc Binney, Col. A[mos] Excerpts from Doc. 308, Report to the Secretary of the Treasury, in compliance with a resolution of HR 19 Jan 1832. Also part of listing for Orange County manufactures. Accessioned as SHS L80-7-6.

date 1833—1834 a subj Tyson, Isaac Jr. Journal type xerox of ms pages 66 legal

desc Tyson, Isaac Jr. Manuscript journal covering operation of earliest copper smelting campaigns at Furnace Flat. Copy of original manuscript at Vermont Historical Society.

date 1833—1834 b subj Tyson, Isaac Jr. Journal type typescript pages

desc Tyson, Isaac Jr. Undated typescript of Manuscript journal at Vermont Historical Society — a “Rufdraft” prepared by a family member’s secretary before ms was donated to VHS (gift of Johnny

Johnsson 2003). (Contains occasional misreadings of difficult handwriting, but is generally a useful access to the journal..)

date 1833—1834 c subj Tyson, Isaac Jr. Journal type printout pages 19

desc Tyson, Isaac Jr. Computer printout of egs transcript of excerpts pertaining only to his work at Furnace Flat and travels related to this work. Comments in pencil by Johnny Johnsson. Not a finished work by any means.

date 1833b subj Copperas type xerox pages 3pp

desc Durand, E. "On the Alum and Copperas Manufactory of Cape Sable, Maryland," Art. III in American Journal of Pharmacy, vol 5 (1833) pp 12-16.

date 1834 subj Tyson, Isaac; Patent type Xerox pages 1

desc Tyson, Isaac Jr. "Specs. of a Patent for an improvement in the Mode of Heating and Applying Heated Air to Blast Furnaces ... Tyson ... 1834." Journal of the Franklin Institute. Vol 20:407-408 from Johnny Johnsson.

date 1835 subj Isaac Tyson's Patent, Heated Air to Blast Furnac' xerox pages 1p

desc Tyson, Isaac Jr., "Specification of a Patent for an improvement in the Mode of Heating and Applying Heated Air to Blast Furnaces." in Journal of the Franklin Institute Vol. 20 [?], pages 407-408. From Johnny Johnsson.

date 1838-10-13 subj Copperas works. artc type xerox pages 3pp

desc Anon., "The Copperas-Mine of Vermont," in The Penny Magazine of the Society for the Diffusion of Useful Knowledge (London), 13 October 1838. "The labour of four men is sufficient for the production of one hundred tons of copperas in a year [plus running a small farm in the neighbourhood]." egs original, also at Dartmouth.

date 1839 subj Copperas production type Xerox page 52

desc Hayward, John. The New England Gazetteer ... Sixth edition. Xerox copies donated by Paul Kristensen

date 1842 subj Copperas works, article type Xerox pages 1

desc Thompson, Zadock, ed. Gazetteer. Morrill, Justin S. writer of account of Sir Copperas Works. Also a duplicate. Includes reference to JSM account of copper smelting, omitted "for the want of room." Attempts to find this omitted item in ZT papers unsuccessful.

date 1844 subj Geology Vermont & NH type Xerox pages 20 pp Ltr

desc Jackson, Charles T., Final Report on the Geology and Mineralogy of the State of New Hampshire ... Concord, 1844 [includes diagram of iron blast furnace p.199] Filed with it is a page from Robinson, William F., Abandoned New England. reproducing sketch of copperas works.

date 1845 subj Copperas production type Xerox pages 3pp

desc Adams, C .B., State Geologist, First Annual Report on the Geology of the State of Vermont 1845 Pages 55 and 56. Credits Dr. Jackson's Report on the Geology of New Hampshire. Accessioned as SHS L80-7-4.

date 1861 subj Geology, Orange county copper type Xerox pages 16

desc Hitchcock, Edward, Edward Hitchcock Jr. et als. Excerpt from Vol II: 828-832, 850-859, Report on the Geology of Vermont Accessioned as SHS L80-7-5.

date 1862? subj Copperas Co. transportation item type xerox pages ip

desc Blank form for recording weight of copper ore given to teamster for delivery at Pompa Depot. Printed by Nathan B. Cobb at his house in the Upper Village and this particular specimen then used as scrap paper. Original in former Mary Marshall house. Donated to SHS by Stephen Marshall and Lissa Marshall Ganter, 2003.

date 1862 sub] Copperas and Copper ore transportation type xerox pages ip

desc Vermont Copperas Company. Printer's proof of Broadside calling for teamsters to carry ore to Pompa Depot; on reverse is proof of form on which teamster would acknowledge quantity received. Originals in Strafford Historical Society collections December 2003, gifts of Stephen Marshall and Lissa Marshall Ganter.

date subj CopperasCo.prospectus type xerox page

desc Reynolds, Wm. B., president. Statement of the Property of the Vermont Copperas Co. Strafford, State of Vermont. Includes certification of State Assayer. Essentially a prospectus for investors. Original at Massachusetts Historical Society; found by Paul White through web search, 2002.

date 1868 subj Copperas, general background history type xerox pages

desc Bishop, J. Leander. Excerpts from his Histoiy of American Manufactures.

date 1872 subj Orangeco copper, report type Typescript Paes4pp

desc Famham, Roswell G. "Copper mining in Orange County" Excerpts from a paper delivered at Burlington 1872. From First Annual Report of the Vermont State Board of Agriculture, Manufactures and Mining, pp 618-640

States that copperas was being produced at the mine and that "quantities of both the iron and, copper ores" were

tL%.L,i"- -h'L. - biJA.f..r a j44c ac4.

date 1882 subj Ely Mine in 1882 type xerox pages 3pp

desc Staunton, William Field, II, (1860-1947) with introduction by Collamer M. Abbott. “‘Not Fit for a Dog’: Memoirs of the Ely Copper Mine in 1882” In Vermont History News. vol 45, no. 4:50-53, 1994. Three small undated photographs of Ely mine.

date 1883 subj Elizabeth Mine, Orange co. article type Xerox pagpo

desc [Glenn, William presumably] W.G. “The Vermont Method of Heap-roasting copper ores.” from E&MJ8 Dec 1883, vol 36:352-353. From Johnny Johnsson.

date 1886 subj Elizabeth Mine, report type xerox pages ip

desc Howe, Henry M. “The Elizabeth Copper Mine, Vermont” in The Engineering and Mining Journal (E&MJ) of 6 November, page 317. [Vol and No data not available]

date 1886-07-03 subj Ely/Vershire type Xerox Pas3

desc Wendt, Arthur F. “The Pyrites Deposits of the Alleghanies,” in E &MJ this date, pages 4-5. Marked “Continued from page 447, Volume XLII” and “To be continued.” Drawings of furnaces etc. from Johnny Johnsson?

date subj Orange county copper, article type xerox pages 10

desc Child, Hamilton. Gazetteer of Orange County, Vt. 1762—1888. 1888. Xerox copies of pages 13 — 32 of Part First, “Copper Mines in Orange County.” Also a two-page summary of highlights, typed by Carrie R. Judd.

date 1889-01-24 subj Elizabeth Mine, article type Xerox pages ip

desc Anonymous. “A Vermont Mine.” Clipping from [West Randolph, Vt.] Herald and News Glued in old record book designated Daniel Cobb Scrapbook #2 Also microfilm printout.

Accessioned as SHS L80-7-22.

date subj Elizabeth Mine, report type Xerox p36

desc Howe, Henry M., Mining Engiineer. Report on the Elizabeth Copper Mine of Strafford, Vermont [prepared for James W. Tyson, President, Baltimore, Md.] A detailed report on the mine, its ore body, workings, smelting, costs of production, quality of copper, with several detailed schedules. Gift of JJohnsson, 2003.

date sub Geology Orange county copper type Xerox 5pp

desc Cazin, F.M.F. excerpt “The Genesis of Ore-Deposits” at Vermont Historical Society which has no bibliographical information. Date extrapolated from text; is earliest likely. Accessioned as SHS L80-7-17.

date 1893-02-16 subj Elizabeth Mine, news article type Xerox pages 4pp

desc Herald and News. "Mineral Wealth!! That Lies Buried in Vermont Hills. Strafford. A Sketch of the Town; Its Attractions and Its Resources." Vol. XX, No. 19. Full front-page article. Accessioned as SHS L80-7-21.

date 1896 subj Elymine,article type xerox pages6

desc Anonymous. "The Copper Mines of Ely-Copperfield, in the Towrof Vershire, Vermont," in The Vermonter, Vol 2, No. 2, September 1896, pages 30—35. Two copies, one somewhat reduced. This is the article that originally printed the photographs of the furnaces and of the ore dumps.

date 1897—98 subj Elizabeth Mining Company letters type bound book 480

desc Tyson, James W. Jr. Company letters from Pittsburgh (according to Josephine Fisher) and from the Elizabeth Mine and Buena Vista Farm. Bound in volume 12 ins x 10.5, "Flaxine Typewriter Letterbook." Gift of Rosa B. Tyson, 1980. Accessioned as M80-5-2.

date 1899 a.b s u bj Orange Co. copper, news article type xerox pages4 ii xl 7

des c Rolfe, E.W. for Herald and News., 7 Dec 1899, a 12-page typescript by Carrie R. Judd (1 899a)
Copied by

(Bradford) United Opinion Vol. XIX, No. 9, 15 Dec 1899, on file here as 1 899b . Several

paragraphs and blocks of text are mixed and misplaced. Description and history, with sketches by W.M.Flanders An excellent article.

date 1899c subj OrangeCo.copper,newsarticle type xerox pages1

desc Boston Globe. 8 December 1899. "Copper Mining Revived in Vermont: New Company, Amply Supplied with Capital, Developing the Ely Mine at Copperfield." Much shorter than the Herald/United Opinion article, this is still comprehensive in dealing with all the various mines. Its illustrations, "Copper Mining at South Strafford, Vt." are bungled attempts at copying those of Flanders.

date 1901 subj ElizabethMiningCompanypapers type boundbook pages

desc Patterson Teele & Dennis, Certified Public Accountants. "Report & Schedules, Elizabeth Mining Company, to December 31st, 1900." Cloth-bound volume 13 ins x 8.5 ins, containing typewritten schedules, reports, copies of deeds, etc. pertaining to the company. Gift of Rosa B. Tyson, 1980; accessioned as M80-5-1.

date 1902 subj Geology,Orangecountycopper type xerox pages1p

desc Perkins, George H., Ph.D. State Geologist and Professor of Geology at the University of Vermont, in Report of the State Geologist on the Mineral Industries and Geology of Certain Areas of Vermont, 1901-1902, "Third of this series." Pages 34-35 ref to Elizabeth Mine 1901 production figures;

date 1904 a subj Geology, Vermont, Elizabeth type xerox pages

desc Perkins, George H., Ph.D. State Geologist and Professor of Geology at the University of Vermont, Report of the State Geologist on the Mineral Industries and Geology of Certain Areas of Vermont, 1903-1904 "Fourth of this series." Copper, pages 60-66. Brief history overview; description of ore body; extracts from statement about magnetic separation by J.N. Judson.

date 1904 b subj Geology, Orange county copper type typescript pages8 pp Ltr

desc Smith, Philip Sidney. Harvard Ph.D. thesis 1904, "The Copper Sulphide Deposits of Orange County, Vermont." Brief notes by egs from copy lent by CMA.

date 1904 subj Geology, Orange county copper type Xerox pages2

desc Smyth, Henry Lloyd and Philip S. Smith. "The Copper Deposits of Orange County, Vermont" from E&MJ28 April 1904, vol. 74, pages 677-678. Provided by Johnny Johnsson.

date 1904d subj Elizabeth Mine report type microfilm printotes 30

desc Judson, John Nichols. "Statement respecting the proposed method of working the ore by magnetic separation, with some account of the property from various recognized authorities." Printout from ex-CMA microfilm at UVM subsequently reported lost or mislaid.

date 1905 sutj ElizabethMine,newsitem type xerox Paes1p

desc Herald and News article, 7n September 1905. approx half a column long, headed "Strafford Copper Mines Reopened." Mill under construction. Judson and Rowand operation with August Heckscher as pres of Elizabeth Copper company (sic). Describes process of magnetic separation invented by Rowand.

date 1906/08? subj Elizabeth Mine, Sharon power plant type xerox pages ip

desc Herald article, full column (may be missing a few lines) headed Big Electric Enterprise. Describes preparation of dam site, etc.

date 1906-01-12 subj ElyMine,newsarticle type Xerox pages4pp

desc The Boston Herald, 12 January 1906 "Vermont Copper Mine Abandoned." Front-page story continued on page two. End of Westinghouse operations.

date 1907 a subj Glenn, William news report type Xerox pages 1 p

desc "Col. Wm. Glenn Dead" and "Funeral of Col. William Glenn." From The Sun, 17 and 20 Feb 1907. From Johnny Johnsson. (Richmond, Va. paper?)

date 1907b subj ElizabethMine,newsitem type typescript pages2

desc Chandler, Elizabeth M.F., [town clerk]. "Strafford" in The Vermonter, Vol 12, March 1907 Typescript by Carrie R. Judd.

date 1907 c subj Elizabeth Mine, news item re Sharon water power type xerox pages 1

des Herald and News (Chelsea Herald edition in fact) 19 September 1907. "Plant Being Built at Sharon to Furnish Power for Stratford Mines."

date 1907d subj ElizabethMine,newsitem type microfilm pages5

desc Herald and News, 24 October 1907 full column article "Copper Development: Elaborate Work in Progress by Vermont Copper Co. in Strafford.: reporting building of a modern smelter of 300 tons capacity and describing production methods. Lists officers etc., including Heckschers, James W. Tyson. Also a typescript of the article.

date 1908a subj Elizabeth Mine,waterpower, newsitem type xerox pages1

desc Herald and News? October 1908 "Important Water Power Development" Very brief report.

date 1908b subj Orangecountycopper,article type Xerox pages3

desc Weed, Walter Harvey. Section on Appalachian States in Chapter "Copper Mines of the United States" in Principal Copper Mines of the World, 1908. Pages 261-266.

date 1908c subj Geology,Vermont,Elizabeth type xerox pages3

desc Perkins, George H., Ph.D. State Geologist and Professor of Geology at the University of Vermont, Report of the State Geologist on the Mineral Industries and Geology of Certain Areas of Vermont, 1907-1908 "Sixth of this series." Pages 55-57 review previous year; extensive quotation from a newspaper account, checked by mine manager, describes preparation of power plant at Sharon and of mine site at South Strafford.

date 1910 subj Elizabeth Mine, report type xerox pages 13pp

desc Nason, Frank L., Geologist and Mining Engineer. Report to Vermont Copper Company regarding the findings of its diamond drill work. Dated 16 May 1910. Copy of typescript in CMAbbott papers at UVM, 6-8.

date 1912 subj Geology,Orangecountycopper,report type xerox pages3

desc Perkins, George H., Ph.D. State Geologist and Professor of Geology at the University of Vermont, Report of the State Geologist on the Mineral Industries and Geology of Certain Areas of Vermont, 1911-1912 "Eighth of this series." Pages 115—117 cover copper deposits at Elizabeth and Ely; history covered in past and not repeated here; concentration on geological features including Corinth. Hitchcock Geol of Str Quad reprod pages 100—145.

date 1916 subj Geology,Orangecountycopper,report type xerox pages5

desc Jacobs, E.C. [Elbridge Churchill] in Perkins, George H., Ph.D. State Geologist and Professor of Geology at UVM Report of the State Geologist on the Mineral Industries and Geology of Vermont, 1915-1916 "Tenth of this series." Pages 192-199, chapter on "Copper Mining in Vermont" by E.C. Jacobs, UVM, with sections on Elizabeth, Ely, Corinth and "other copper mines." Harry Hunter acknowledged for info on Corinth.

date 1917 subj type pages

desc for article in The Journal of Industrial and Engineering Chemistry, 1917, vol 9, no. 2, pp 177ff see under 1831, Tyson, Isaac, Jr., "Report of the Committee on Chemistry, ..." 1831-10-26

date 1918 subj Geology,Orangecountycopper,report type xerox pages5

desc Jacobs, E.C. [Elbridge Churchill] in Perkins, George H., Ph.D. State Geologist and Professor of Geology at UVM, Report of the State Geologist on the Mineral Industries and Geology of Vermont, 1917-1918 "Eleventh of this series." Pages 141-147, "Progress in Copper Mining and Milling," by E.C. Jacobs of UVM. Reviews recent past and present situation. Last section refers to Orange, Gove and Walker properties in Strafford.

date 1920 subj Geology, Orange county copper, report type xerox pages 3pp

desc Perkins, George H., Ph.D. State Geologist and Professor of Geology at the University of Vermont, Report of the State Geologist on the Mineral Industries and Geology of Vermont, 1919-1920. "Twelfth of this series" Very brief reference to copper on pages 301-302.

date 19i subj ElizabethMine,newsarticle type xerox pages1

desc Herald? Undated newsclipping concerning lawsuit Origen Seymour vs Vermont Copper company, detailing some of the current activities and plans for operations at the mine.

date 1926 subj ElizabethMine,newsarticle type microfilm pages

desc Heraldand News, 14 October 1926, Vol. LIII, No.2—2759. "Strafford Mine Turning Out Ore: American Metal Co. Is Working Copper Vein." By a special correspondent. Article occupies a little more than two columns on the first page and another column on page 6. Includes four photographs, including one taken in the flotation mill. Microfilm very inadequate but all I have ever seen of this major article.

date 1929a subj Orangecountycopper,article type xerox

des c Stone, Arthur F., ed. The Vermont of Today with its historic background, attractions and people. 1929 Chapter XXIX, in Vol II, starting on page 523, is entitled "Income from the Rocks." The section "Copper Mining in Vermont" is by Stanley C. Wilson, pp 534-538. (Altogether rather unsatisfactory as a source.)

date 1929b subj ElizabethMine,newsitems type typescript pages2

des c Herald and News various dates, 1929-1930. Notes on local news items regarding activity at the mine.

date 1930 a subj Elizabeth Mine, Mewhirter report type xerox Paes2015

desc Mewhirter, Sidney. Copy by Collamer Abbott of an "article and report" in the collection of Stanley C. Wilson. Author was superintendent of the Elizabeth Mine in 1929 and 1930. Copied at UVM, CMA Papers.

date 1930 b subj Orange county copper, Geology, type typescript pages 2

desc Perkins, George H., Ph.D. State Geologist and Professor of Geology at the University of Vermont, Report of the State Geologist on the Mineral Industries and Geology of Vermont, 1929-1930. "Seventeenth of this series" Typed notes on items on pp 1 56f, 163, 255, perhaps more

date 1931 a subj Orange countycopper, article type xerox pages3

desc Anderson, C.S. "Mining and Milling in the Vermont Copper District" in Engineering and Mining Journal, vol. 131, no. ?, 9 March 1931, pages 208—210. Two copies, because of difficulty experienced in getting complete coverage.

date 1934 subj Orangecountycopper,article type xerox pages3pp

desc Wilson, Stanley C., Governor of Vermont, "Vermont as Mining State" in The Herald and News, Randolph, Vermont vol. LXI, No. 10 3184,. 6 December 1934. Text of a broadcast Saturday evening, 24 November 1934, over Station WBZ, Boston. (Xerox of microfilm printout)

date 1939 subj ElizabethMine,newsarticle type xerox pages2

desc Herald and News? Late December 1939.. "Copper Mining at South Strafford as last Carried on Twenty Years Ago

-- Prospects for reopening." Caption to photographs (four) refers to the Mines" "last period of renaissance, "about 1920." (Xerox of microfilm printout)

date 1940s subj TheElizabethMiner type Xeroxplus Pae550pp

desc The Elizabeth Miner. Incomplete file. Some xerox copies given by Bonnie Cray, Feb 2002.

date 1940s subj Help WantedAdforundeiroundwork type xerox pages1p

desc Vermont Copper Co. advertises jobs for 25 more underground workers. Includes form for asking a representative to call.

date 1942a subj ElizabethMinereopening,Orangecocopper type Xerox pages10

desc Jacobs, Elbridge C[hurchill]. "Reopening of the Vermont Copper Mines," in Report of the State Geologist..., Vermont 1941-42. ("23rd of series") Pages 1—19. Copied VHS Also a copy of the complete report, 84 pages in dark green paper cover. Accessioned as SHS L80-7-1.

date 1942b subj Elizabeth Mine, Orange co. copper, report type Xerox pages

desc Bureau of Mines, U.S. Dept Interior. War Minerals Report." W.M.R.2 - Copper Also a duplicate from Johnny Johnsson.

date 1942 c TDTD subj Elizabeth Mine, news article type xerox pages2

desc Herald and News. "Copper Boom in Orange County: Old Mines Bought by New Stock Company. Govt. Will Buy Entire Output."

date 1943 a subj Elizabeth Mine, report type Xerox pages5

desc Bureau of Mines, U.S. Dept Interior. "War Minerals Report." W.M.R.135 - Copper. Stated to be a digest of report of July 1943 on file at BoM. Also a duplicate from Johnny Johnsson.

date 1943 b subj Geology, Eliabeth Mine type Xerox pages

desc White, Walter S., "Geology of the Elizabeth Copper Mine, Vermont." Typescript, US Dept of the Interior, US Geological Survey, Strategic Minerals Investigations. Three blueprint maps not included as "light and not very revealing." Gift of Johnny Johnsson.

date 1943 c sub Elizabeth Mine. housing project news type xerox pages 2pp

desc The Landmark Ground to be broken soon for housing development; \$175,000, sturdy, permanent homes (described in some detail). Good details also of operations etc. Mine now employing nearly 200 men with 40 more about to be added.

date 1943 d subj Report on startup of operations, Elizabeth type typescript pages 4pp

des c White River Valley Herald 1 November 1 943article "Copper Mine in Full Operation / President Ellis Has a Successor" Typed by Carrie R. Judd. Starts on the last page of article "General Manager for Copper Co

date 1943d subj Elizabeth Mine,newsitem type xerox pages3pp

desc The Landmark 20 May 1943 "Weapons of War From the Hill of Vermont," with four photographs, two of which feature Governor William H. Wills. Includes an overall view of buildings, a cut of two miners drilling, a cut of Governor, George A. Ellis and Stanley C. Wilson with a map, and cut showing Governor, VCC general manager and vp Norden, Ellis and H.M. Kingsbury, geologist and mining engineer.

date 1943 e subj Elizabeth Mine, Help Wanted type xerox pages ip

desc The Landmark Display ad "War Labor Board O.K.'s Higher Wages for Vermront Copper Company.. "100 Men ... wanted at once for construction work, experience unnecessary." "Earn \$48.53 for sixty-three hour Week. Etc.

date 1943 f subj Elizabeth Mine, Help Wanted type xerox pages ip

des c Herald? Display ad "War and Post-War Work!! Vermont Copper Co. ... has jobs . .

date 1944 a subj Elizabeth Mine, geology, operaons, report type booklet pages 4Opp

desc Jacobs, Elbridge C[hurchill]. "The Vermont Copper Company, Inc." in Report of the State Geologist Vermont 1 943-44 "Twenty-fourth of this series." Pages 1-13. General review of past history. Detailed info on operations such as flotation mill. Accessioned as L80-7-2. Also xerox copies, one lacking frontispiece.

date 1944 a subj Elizabeth mine geology type booklet pages 4Opp

desc Doll, Charles G. "A Preliminary Report on the geology of the Strafford Quadrangle, Vermont," in Report of the State Geologist...., Vermont 1943-44 "Twenty-fourth of this series." Pages 14—28. Pocket maps.

date 1944 b subj Newsarticleon Elizabeth Mine ops type Original and pages 6pp

desc Cummings, Chas. R. "Impressions of the Copper Mine" in The Vermonter, The State Magazine, White River Junction, Vt., Vol. 49, No. 4: 73-80. Accessioned as SHS L80-7-3.

date 1944c subj ElizabethMine type xerox Pa9es6pp Ltr

desc Herald. "Vermont Copper Company's Big Mining Enterprise Now Well Established at South Strafford, Vt . 14 December 1944. "Dame Nature, prodigal in many ways Major 2-page spread with illustrations. Also a typescript of the article (14 pages) by Carrie R. Judd.

date 1944d subj Orangecountycopper,geology type xerox pages37

desc White, W[alter] S[tanley] and J.H. Eric "Preliminary Report, Geology of the Orange County Copper District, Vermont." U.S. Dept of the Interior, U.S.G.S., 1944. [Strategic minerals investigations, preliminary report. I Lacks the illustrations, but some of them are in Map Room at BakerBerry Library Also here: a broadside, "Strategic Minerals Investigations I Preliminary Maps," which has one map plus an abstract of the full report. -- &L4.O fri A P.5

date 1945 subj Elizabeth Mine, processing type typescript pages ip

desc Johnson, Helmer A. , Mill Superintendent. Two articles for The Elizabeth Miner: Milling or Concentration of Copper Ore," and "Sampling and Assaying." Carrie R. Judd typescript. Also a xerox copy of an undated article from the Herald consisting of a "somewhat condensed" version of the first item.

date 1947a subj ElizabethMine,article type xerox pages1p

desc Herald undated clip "Stratford Copper Mine Written Up," reports that previous Sunday's Boston Herald carried an article by Paul Giguere about U.S. Bureau of Mines surveys and prospects for the mine. Article reprinted evidently in full. Refers to "Copper's Hill."

date 1947 b subj Elizabeth Mine, reports type xerox pages3

desc Bureau of Mines, U.S. Department of the Interior. Xerox of pages 456, 457 and 1390 from Minerals Yearbook, 1947.

date 1948 a subj Elizabeth Mine, statement of Chairman of Board type typescript pages8

desc Ellis, George Adams, Chairman of the Board of Vermont Copper Company, Inc. "Statement." Also covers Ely and Corinth mines. Reviews experience since 1942 and states that the company is unable to advance further moneys.

date 1948 b subj Elizabeth Mine, Safety Instructions type xerox booklet pages 12

desc Vermont Copper Co., Inc. Safety Rules and Instructions Second edition, February 1948

date 1949 a sub Elizabeth Mine, processing type xerox pages2

desc Johnson, Helmer A., mill superintendent. "Planned Changes in Concentration" in The Elizabeth Miner, April 1949

date 1949 b subj Elizabeth Mine, reorganization type xerox pages 2

desc Benson, Clarence B. company treasurer. "Regarding the Organization and Future Plans of the Company" in he Elizabeth Miner, April 1949.

date 1949 c subj Elizabeth Mine, reports type pages

desc Bureau of Mines, U.S. Department of the Interior. Xerox of pages 466 and 467, from Minerals Yearbook, 1949. Gift of Johnny Johnsson.

date 1949d subj U.S. Mining Industry in Wodd War II type Xerox pages6

des c Morgan, John Davis, Jr., The Domestic Mining Industiy of the United States in World War II... Xerox of several pages (CMA long ms refers at page 309.)

date 1949 e subj Elizabeth Mine, Iron Ore Reserves type xerox pages 5+

desc Atkins, R.D., chief engineer. Preliminary Study of Probable Iron Ore Reserves, August 1949. Copy of M75-5-1

date 1950 a subj GeologyOiangeCo. type Xerox pages20 +

desc Hadley, Jarvis B. "Geology of the Bradford-Thetford Area, Orange County,Vt." Vermont Geological Survey, Bulletin No. 1. 1950. Original at Morrill Mem & Harris Lib. Excerpts only

date 1950b subj Elizabeth Mine, article type xerox pages5 +cover

desc Benson, B.C., J.C. Wangaard and H.A. Johnson. "Elizabeth Mine Reorganized For Efficient Production: Realistic Changes in Mine, Mill and Management Turn Loss into Profit." in Mining Congress Journal vol. 36, no. 7, July 1950, pages 18—23. From Matt Kierstead, July 2003.

date 1952 a (plus) subj Orange county copper, article type typescript page56

desc Bassingthwaighte, George E. [I assume] "The Copper Belt: History and Production." A report of 1952 research for the VCC on mine property and mining rights. Typescript by Carrie Judd includes "updated" production figures and a note by Town Clerk on 1954 transfer of property to Appalachian Sulphides. Indications that material has been omitted; ref to the "full report," which Carrie evidently had in her possession. Perhaps also at UVM/CMA. Not

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date 1952b subj U.S.copperinWoddWarII type xerox pages3

desc Bureau of Mines, U.S. Dept of the Interior, with USGS for the National Security Resources Board. 1952

date 19 subj ElizabethMine,article type Xerox Paes4/5pp

desc Lutjen, George P. and John H. Kearney, "New Life for Vermont's 160-Year Old Copper Mine." from E&MJ vol.

154: 72-75, Illustrated. Copied at Morrill Mem & Harris Library. (Also page 152 with another small item about the

Elizabeth Mine.) Filed with the article is an item from the White River Herald, typed (and perhaps written?) by Carrie

R. Judd, reporting on the article, with quotations. Accessioned as SHS L80-7-3.

date 1954 a subj Elizabeth Mine, geology type Xerox pages 3pp

desc McKinsty, H.E. and Aimo K. Mikkola. "The Elizabeth Copper Mine, Vermont" presented at SEG etc. from Economic Geology, Vol 49: 11-30, Signed by Aimo Mikkola to Gordon Philbrick. Gift to SHS from his widow, Eleanor Philbrick, 2001.

date 1954b subj Elizabeth Mine, geology type Xerox pages 6 pages

desc McKinsty, H.E. as leader of Economic Geology trip to Elizabeth Mine 9—10 October 1954, comments on two selected stops only. Gift of Matt Kierstead, July 2003

date 1956 subj U.S.Coppersupplyanddemand,1950s type Xerox pages6

desc McMahon, A.D., and Gertrude N. Greenspoon, "Copper" in Minerals Yearbook, 1956, vol I or three, pages

409-419. Published by US Dept of the Interior, Bureau of Mines, Division of Minerals. Reviews all aspects of US copper production, primarily in 1950s with a few earlier years included.

date 1957a subj ElizabethMine,article type Xerox pages4pp

desc Topics, A publication of the New England Telephone & Telegraph Co. Vol 49, No. 10: 28-30. Illustrated article, "Copper Mine in Vermont." Copied at Morrill Memorial & Harris Library. Accessioned as SHS L81 -1-1.

date 1957b subj ElizabethMine,article type Xerox Pa9es3pp

desc Napolitan, Joseph. "Only Copper Mine in New England." in Worcester Sunday Telegram April 21, 1957, Feature Parade Section pages 6—8.

date 1958 subj ElizabethMine,alsoEly,article type Xerox Pa9es8pp

desc Wilson, Charles Morrow. "Royal Red: Ore from America's oldest [sic] Copper Mine has served the world's changing needs since 1793 [sic]" from Vermont Life VolXII [?], No.3, pp 14-21. Photographs by

C.M. Abbott. Highly questionable source for early history; drawings by Hubert Rogers of contemporary workers very interesting.

date 1964 a subj Tyson, Isaac Jr. Furnace Flat, article type xerox pages

desc Abbott, Collamer M. "Vermont's Pioneer Copper Plant" from New-England Galaxy, Fall 1964, pp 33-41 Isaac Tyson Jr. at Furnace Flat Accessioned as L80-7-13

date 1964 b Elizabeth Mine, mineral ghts Pat Mines Inc type typescript pages 2

desc List of rights in Strafford owned by Pat Mines Inc. of Toronto, showing acreages and current landowners, compiled by George E. Bassingthwaighte. Xerox copies of same.

date 1964 b subj Orange county copper, history type xerox pages 475+

desc Abbott, Collamer M. "Green Mountain Copper" A copy of his "long" manuscript at the Bailey/Howe Library, University of Vermont. Abbreviated version at 1973d.

date 1965a subj Tyson,IsaacJr.FurnaceFlatsrnelting type xerox pages

desc Abbott, Collamer M. "Early Copper Smelting in Vermont" from Vermont History, vol XXXIII, No.1, January 1965, pp

233-242 Described as a revised form of an essay originally appeanng in the New-England Galaxy, Fall 1964. Includes footnotes and citations. Accessioned as L80-7-14

date 1965b subj Tyson,IsaacJr. type xerox pages8

desc Abbott, Collamer M. "Isaac Tyson, Jr., Pioneer Mining Engineer and Metallurgist," from Mar,4and Historical Magazine, vol. 60, No. 1, March 1965, pp 15-25. With footnotes. Accessioned as L80-7-1 6.

date subj Orange countycopper, mining relics type xerox pages4

desc Abbott, Collamer M. "New England's Mining Relics" from New-England Galaxy, Winter 1966, pp 12-18 Photo of carbide lamp is courtesy of Roland Higgins. Accessioned as L80-7-12

date ig subj Tyson,IsaacJr. type xerox pag10

desc Abbott, Collamer M. "Isaac Tyson, Jr.: Prioneer Industrialist" from Business Histoiy Review (Harvard Graduate School of Business Administration) vol XLII, No.1, Spring 1968, pp 67-83. Includes footnotes. Accessioned as L80-7-1 5

date 19a subj Geology, copperas, Strafford and Shrewsbury type Xerox pages4

desc Doll, Charles G., "Report on the Cuttingsville Pyrrhotite Deposit, Cuttingsville, Vermont" from Vermont Geological Survey, Economic Geology no. 4: 5, 34, 72-73. Vermont Department of Wter Resources, 1969. A few elected pages only, including references/bibliography.

date 19b subj Geology Elizabeth etc.. type Xerox pages20 -30

desc Howard, Peter F. The Geology of the Elizabeth Mine, Vermont. Economic Geology No. 5. Vermont Geological Survey. Department of Water Resources, Montpelier, 1969. Plus maps. Excerpts only. from original at DC Kresge Lib. Duplicate also but lacking maps?f

date 1970 subj Orangecountycopper,article type xerox pages

desc Abbott, Collamer M. "Cousin Jacks and Vermont Copper." from New-England Galaxy, Summer 1970, pages

19-28. Role of Cornish men in Vermont copper mining generally. Accessioned as L80-7-9

date 1971 a subj Orange county copper, article type xerox pages 14pp

desc Abbott, Collamer M. "Boston Money and Appalachian Copper" in Michigan Histoiy LV/III :217-242, 1971. Scholarly article. Gift of author.

date 1971 b subj Orange countycopper, article type xerox pages 25

desc Abbott, Collamer M. "Copper Mining in the Eastern United States During the Nineteenth Centur?" in International Review of the Histor,' of Banking, No. 4:425-448, 1971. Scholarly article. Gift of author.

date 1972a subj Orangecountycopper,article type xerox pages7

desc Abbott, Collamer M. "Bread or Blood! Labor Revolt in a Vermont Copper Camp" from New-England Galaxy, Fall 1972 pp 3-14 "Camp" is Ely Access ioned as L80-7-1 1

date 1972b subj El;izabeth Mine, talk type xerox pages6 pages

desc Judd, Carrie R. "A Pictorial Visit to the Elizabeth Mine," in Stories of Stratford's Past as told to the third and fourth graders of Newton School., fall 1972. Comments to accompany a slide show to Ingrid Webb's class.

date 1973a subj Orangecountycopper,article type xerox

desc Abbott, Collamer M. "Thomas Pollard — Cornish Miner" in International Review of the Histoiy of Banking, No. 6:169-1 78, 1973. Scholarly article. Gift of author.

date 1973b subj Orangecountycopper,article type xerox pages2

desc Abbott, Collamer M. "Cornish Miners in Appalachian Copper Camps" in International Review of the Histor,' of Banking, No. 7: 199-219, 1973. Scholarly article. Gift of author.

date 1973c subj Elizabeth Mine(andVermontgenerally),article type xerox pages12

desc Slayton, Tom. "Red Dust and the Bucolic Plague: The Prospects of Copper Mining in Vermont," in Echo Vermont, An Environmental Quarterly Vol. 1, #2 (last issue?) Spring 1973, Charlotte McCartney ed. Illustrations are two great photographs of the copperas area. Copied from an original in CMA papers at UVM, 6—21.

date 1973 subj Elizabeth Mine, article type xerox pages2

desc A.P. (not otherwise identified) "The Strafford Mine," in Echo Vermont, An Environmental Quarterly Vol. 1, #2 (last issue?) Spring 1973, Charlotte McCartney ed. Copied from an original in CMA papers at UVM, 6-21.

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date 1973c subj ConthMine type xerox pages2

desc Buffard, Carolyn. "The Corinth Mine" in Echo Vermont, An Environmental Quarterly Vol. 1, #2 (last issue?) Spring 1973, Charlotte McCartney ed. Copied from an original in CMA papers at UVM, 6-21.

date 1973c subj Mining,environmentalistconcerns type xerox pages3

desc [McCartney, Charlotte.] Editorial, "There's No Hiding Place Down Here." in Echo Vermont, An Environmental Quarterly Vol. 1, #2 (last issue?) Spring 1973. pages 1, 2, 39. Copied from an original in CMA papers at UVM, 6—21.

date 1973d subj Orangecountycopper, history type booklet

desc Abbott, Collamer M. Green Mountain Copper: The Story of Vermont's Red Metal." Collection of articles previously published on serial form in the White River Valley Herald.

Full-length manuscript at 1964b.

date 1974? subj ElyMine, article type xerox pages7

desc Abbott, Collamer M. "A Vermont Mining Village in the 1870s." from New-England Galaxy, [need date], post 1973] pages 23—35 Village is Ely (includes photo credited to Strafford HistSoc from our Stanley C. Wilson box, which means CMA had access to that at some point in the past) Accessioned as L80-7-10

date 1976 subj CopperasWorks type Xerox pages2pp

desc Robinson, William F. Abandoned New England. Excerpt: page reproduces diagram of copperas works 1844 from Jackson report, with which it is filed. (Book is highly collectible; sold for about \$125 on eBay in June 2002.

date 1980a subj Elizabeth,Ely,etc.articles type xerox pages

desc Willard, Kathleen. Articles include "The rise and fall of Ely" (includes Strafford); "Working the mines: then features the Elizabeth Mine almost exclusively, especially Charles Judd; an article on Vermont mining generally and one on talc mining specifically. In weekly Valley News publication Momentum Vol 1, No. 25. 19 November

1980.

date 1980 b subj Tyson,IsaacJr. type xerox of ms page518

desc Wilson, Sperry. "Isaac Tyson." Historical essay, 1980. Newton School 8th grade student.

date 1980d subj GuidetoCotlamerAbbottPapers,UVM type xerox pages32

desc Gelinas, Mary. "A Guide to the Collamer Abbott Papers at the Bailey/Howe Library, University of Vermont" December 1980.

date 1980d subj GuidetoVermontCopperCompanyPapers,UVM type xerox pages10

desc Gelinas, Mary. "A Guide to the Records of the Vermont Copper Company at the Bailey/Howe Library, University of Vermont" Nov. 1980. Also an Internet list of the Vermont Copper Co. Collection "1 853-1861" with most of the materials dated in 1943-1958 era. (This collection obviously includes materials transferred from Collamer Abbott's Papers as well as records of one or more companies doing business in Vershire in previous century.)

date 1982 subj Orange county copperk article type xerox pages21

desc Blaisdell, Katharine. Over the River and Through the Years. Book Four, Mills and Mines. From articles published 1981 in The Journal Opinion, Bradford, etc. Excerpt here of pages 46-85, with "Copper Mining at South Stratford" beginning at page 76. Ely and Corinth mines here also, as well as xerox of Strafford article as it appeared in newspaper.

date 1985 subj ElizabethMine,articles type booklet pages188

desc Annis, Malcolm, Ph.D. "The Elizabeth Mine" plus "Important Dates" on inside covers of Strafford Town Report of 1984. Also contains eggs "Historical Notes," excerpts from selected original sources, on pages 43—47. Cover reproduces May 1946 cover of The Ellzabeth Miner. Mine photographs scattered throughout.

date 1985 subj Elizabeth Mine, articles type booklet pages 188

desc Smith, Gwenda "Historical Notes," excerpts from selected original sources, on pages 43—47 of Strafford Town Report of 1984.

date 1985-10 subj Generalessayon Strafford, including Elizabeth mine type original mag pages 10-12pp

desc Clark, Edie; photography by Richard Brown; "Strafford" in "This New England" section of magazine Yankee

date subj Vermont copper history type bOOk pages

desc Meeks, Harold A., Vermont Land and Resources, New England.Press, 1986. Pages 81-44, 90-96 refer. [Need to make xerox copies of relevant pages.

date 1992 subj Elizabeth Mine, remarks atsitetour type typescript pages4

desc Pixley, Wendell. Text of prepared brief remarks for Strafford Historical Society tour of the Elizabeth Mine, May 1992. Typed and donated by Hazel Lewis.

date 1993 ubj Geology, Vermont Copper Belt type Xerox pages26 (72)

desc Slack, John F. and Terry W. Offield, eds. "Besshi-type Massive Sulfide Deposits of the Vermont Copper Belt." in SEG Guide Book, vol 17, 1993 Site visit by SEG, review of history, geology.

date 1998 a subj Flotation mills type Book pages 92pp

desc Bunyak, Dawn. A Survey of Flotation Mining in the Twentieth-century Metals Industry. [Does not include Eliz because info evidently not provided when requested from State.]

date 1998b subj Tyson, Isaac Jr., article type xerox pages16

desc Johnsson, Johnny. "The History of the Patapasco Copper Mines, Maryland and the Discovery of Carrolite" in Matrix: A Journal of the History of Minerals, vol. 6 no. 2, Summer 1998. Gift of the author.

1998 c Elizabeth Mine, notes, reports, records original paper 64 pp Pixley, Wendell I. Materials given to Phyl Harmon during her oral history project, with some of them dating from the last years of operation, when Pixley was Acting Chief Engineer. Also notes presumably prepared for the oral history: reminiscences of schoolboys exploring the mine in the 1930s, details of sinking the 1947(?) shaft, drillers' pattern for opening a raise, and a note on Buster Banker. Maps and sections removed to Maps -- see separate list.

1999 a Elizabeth Mine, Helmer Johnson news report xerox

Brief item with blo referring to work at Vermont Copper Co. from Mining Engineering, June 1999, page 91. From Johnny Johnsson

1999 b Elizabeth Mine, article xerox plus 1

oversize

Smith, Gwenda. "The Significance of Copperas Hill and the Elizabeth Mine." In The Herald, 25 November

1999.

Note: as a result of having been widely passed around in typescript format, this item is generally cited as an

unpublished manuscript. Also a copy of the computer printout or typescript.

20(Y) Ely Mine, article www printout 20+

Donovan, Paul J. "A Short History of the Ely Mine." (www.angeltire.com/vtf/pjdonovan/ElyMine/ely.3.html). Written by an enthusiast but riddled with errors, this is nevertheless being filed here as a potentially useful source for those who will use it with care!

2001 a Elizabeth & Orange County, talk comp printout 27 pp +

Kierstead, Matthew A., "The Elizabeth Mine and the Orange County, Vermont, Copper Mining Belt." Text of illustrated lecture of 16 September 2001 at Barrett Memorial Hall, Vermont Archaeology Week.

2001 b Elizabeth Mine, 1880-1902 article xerox 13pp

Johnsson, Johnny. "Vermont's Elizabeth Copper Mine: The Tyson Years, 1880-1902" from The Mining History Journal [of the Mining History Association] pages 43-65. Illustrated with several photographs, maps. (Similar but not identical to item 2002b) Also a typescript of a paper for 1999 MHA meeting gMng narrative to accompany slide presentation. Gifts of author, various dates.

2001 c Geology, Orange county copper, Elizabeth Mine book 294

Hammarstrom, Jane M. and Robert R. Seal II, eds. "Environmental Geochemistry and Mining History of Massive Sulfide Deposits in the Vermont Copper Belt," in Guidebook No. 35, Society of Economic Geologists, Inc. 2001.

2001 c Orange county copper, Elizabeth, Ely in book

Kierstead, Matthew A., "History and Historical Resources of the Vermont Copper Belt," in Guidebook No. 35, Society of Economic Geologists, Inc. 2001, pages 165—191.

various Ely Mine, Papers of Stanley C. Wilson (C) various

One pocket file contains printed materials regarding litigation over Ely Mine properties and a letter from the Vermont Historical Society returning articles lent to it by SC Wilson for microfilming purposes. The articles listed are also in the package excepting a longitudinal section of the Elizabeth Mine (here at 1949) and the nine photographs, which are in another package filed next to the pocket file. IN OVERSIZE BOX

MAPS

M 1858 Detail from Walling's Map of Orange County xerox 1

Walling, H.F. Map of Orange County, Vermont, 1858. Detail of southeastern corner of town of Strafford, showing Vermont Copperas Co. sites on the hill and at the river. Also a xerox copy of the southern half of the map of the whole town.

M 1874 Plan of property of the Vermont Copperas Co.

Vermont Copperas Company, plan of property. Original at Dartmouth College, MS # 002386. The key document for the earlier years. Five pages of 11 x 17 paper. Also copy annotated by Collamer Abbott marks points A through Q which he listed as primary historic sites that should be "saved and documented."

M 1877 Detail from Beers Atlas map of Strafford xerox 1

Beers. Atlas of Orange County, Vermont, 1877. Detail of southeastern corner showing Vermont Copperas Co. sites on the hill and at the river.

M 1886 Rough sketch of longitudinal section of Eliz Mine

"From original report of H.M. Howe. About 1886." Carries notation of location of Old Cleveland Mine with initials J.N.J., presumably Judson. In two sections, perhaps not at same reduction, one horizontal orientation and the other vertical. Reference to "proposed adit" suggests this was made before adit was started. Source: Collamer Abbott papers at UVM.

M 1 890s Lands and Mining Rights, Elizabeth Copper Mine 1

Elizabeth Copper Mine. "Lands and Mining Rights ... in Strafford, Vt." Undated but placed in 1 890s because of furnace located on Blaisdell/Sargent Brook Also a copy of the left half of this map. Source: Collamer Abbott papers at UVM.

M 1 890s Rough sketch of longitudinal section of Eliz Mine

Elizabeth Mining Company. "Rough sketch of longitudinal section of Eliz Mine." Southern end of property with references to Howe, presumably mining engineer Henry M. Howe who studied the mine for J.W. Tyson and reported his findings in 1890. In three sections. "Adit" on northern section may suggest later date if that should be the 1898 adit.

M 1905 (?) a "General Plan" here in two parts, earlier Vermont Copper Co.

(Heckscher era) Sketch of Tyson mill area, with stable, blacksmith's shop, adit, transformer house, laborers house, foreman's office, mill (with adjoining boiler house, bins, compressor room, machine shop), old furnace building, mule barn, roadways, brook. Source: Collamer Abbott papers at UVM.

M 1905 (?) b "General Plan" here in two parts, earlier Vermont Copper Co.

(Heckscher era). Continues sketch of "a," showing location of chimney, flue, bins, furnace, reservoir, boardinghouse, road, brook, rail track on trestle, coke storage, and more. Source: Collamer Abbott papers at UVM. (The parts were unfortunately copied at different scales and can't quite be taped or glued

together. Match up the Old Furnace and Mule Barn near the bottom of “a” with the same buildings at the top of “b.”)

M 1908 large Plan of land of the Vermont Copper Company (Heckscher) large, folded

Actually a partial plan only, as some land off the edges was evidently omitted. I have to confess that this map was made by me, egs, in 1998 according to the notation thereon, but I have no record of the original from which I copied it. It may well have been the “Vermont Copper Company map of 1907” which Peggy Thorp gave the SHS in 1995 but which is not currently to be found. The map appears to show the various properties which August Heckscher was buying in October 1907. See Strafford Land Records book 231, pages 463—466, for a complete description.

M 1908 small Plat of lands of the Vermont Copper Co., South Strafford, Vt. small

This covers the same territory as the large map but appears to have been drawn up separately. Again, it represents the properties purchased by August Heckscher in 1908.

M 1918 a Sketch of Ompompanoosuc in Furnace Flat area

Sketch shows River, old furnace building on north side of river, road and bridge nearby, pump house on south bank of river, Copperas Brook (unnamed) entering below. Source: Collamer Abbott papers at UVM.

M 1918b VCC-1918

Vermont Copper Co. sketch of area from Tyson mill to reservoir and perhaps chimney in the valley. Shows many of the same buildings as in previous sketch of Tyson mill area (“General Plan” of circa 1905) but continues down into valley and is evidently later in date. Also shows a pipeline from reservoir to a location on the hill and from there down to the mill and to the boardinghouse. Source: Collamer Abbott papers at UVM.

M 1925 Map, Anahra Realty Company (Heckscher)

Anahra Realty Company map, 1925. Copy of a map in eight sections which do not entirely align. Also a sketch by egs on one page, attempting to clarify the overall picture but omitting property owners’ names, property lines, etc.

Source: Collamer Abbott papers at UVM.

M 1944 a Map related to White and Eric in Research materials large

White, W[alter] S[tanley] and J.H. Eric. Report is called “Preliminary Report, Geology of the Orange County Copper

District, Vermont,” USGS 1944 and is filed at 1944d in Research Materials. This large map is “Preliminary Map Plate 1” from that report.

M 1944 b Map related to White and Eric in Research materials 2-page size

White, W[alter] S[tanley] and J.H. Eric. Report is called "Preliminary Report, Geology of the Orange County Copper District, Vermont," USGS 1944 and is filed at 1944d in Research Materials. This map is "Index Map of East-Central Vermont showing location of copper mines " and is an enlargement of Figure 1 in 944d.

M 1945 Ely Mine Plan of Mining Property, 1297 acres large, folded

Ely Mining Property. I am dating it 1945 because label shows that it was compiled from surveys made at various dates from 1939 through 1945 (including one by White and Eric in 1943). Donated by Wendell Pixley during Phyl Harmon's oral history project; marked 6 by Phyl.

M 1949 Vertical longitudinal projection of ore zone

Vermont Copper Company, Inc. From Open Cut northward, shows mined portion of ore zone at that time.

See Research Materials at 1949e.

M 1957 A & B Longitudinal section of Elizabeth Mine large, folded

Longitudinal section from open cut to beyond Route 132. Donated by Wendell Pixley during Phyl Harmon's oral history project. Another key document. Item A, marked 8B by Phyl, has pencil notations by Pixley. Also a small portion of mine section marked 7 by Phyl.

M 1969 Survey map of L.H. Cook land, "Copper Mine" xerox 1

Survey map of land of L.H. Cook, 1961—1969.. (Cook bought from Appalachian Sulphides Inc after the mine closed and sold parcels off in 1969.) A rather confusing map, especially as regards identification of buildings marked 1,2,3,4 or unmarked, but numerals preceded by symbol # evidently indicate lot numbers for the sale. Original presumably in town records.

APPENDIX E

Chapter 5 and Appendix F, *Archaeological Data Recovery, Upper and Lower Copperas Factories and Intercopperas Areas and Monitoring Mitigation for a Non-Time-Critical Removal Action (NTCRA), Elizabeth Mine Site (VT-OR-28), South Strafford and Thetford, Vermont* (Cherau, Kierstead and Timms, 2013) Prepared for U.S. Army Corps of Engineers, Concord, MA. Prepared by: PAL, Inc., Pawtucket, RI

3937 **CHAPTER FIVE**

3938

3939 **RESULTS OF CONSTRUCTION MONITORING**

3940

3941

3942 The 2009 and 2010 data recovery fieldwork was supplemented by construction (mine waste removal)
3943 monitoring. Mine waste consisted of barren and sulfide ore-bearing mine development (overburden)
3944 rock, lumps of pyrrhotite (iron sulfide) and chalcopyrite (iron-copper sulfide)Obearing pyrrhotite ore,
3945 weathered ore roast bed and heap leaching pile material and associated affected soil and sediment, all
3946 lying on glacial till or directly on bedrock. Removal of these materials included historic masonry and/or
3947 timber structural remains associated with mining activity. The removal monitoring was conducted in
3948 several areas within TP 3 (see Figure 2-2). Monitoring resulted in observations that supplemented and in
3949 some cases significantly informed interpretation of the data recorded in the adjacent and overlapping data
3950 recovery areas (see Chapter 6). This chapter reports the results and interpretations of the monitoring for
3951 the North Berm, Sedimentation Basin area, Copperas Brook Corridor area (see Figure 4-3), and a portion
3952 of the Ore Roasting and Leaching area, which contained resources associated with the final stages of
3953 processing raw copperas liquor into finished copperas crystals. The Ore Roasting and Leaching area
3954 predominantly contained remains of structures associated with the preceding stages of generating,
3955 conveying and storing the raw liquor. The field reports for the remainder of the monitoring in the Ore
3956 Roasting and Leaching Area and the Pine Grove Drainage Trench, as well as the Upper Adit/Cob
3957 Shop/Blacksmith Shop site and the Tyson No. 1 Shaft site, which were associated with ore mining as
3958 opposed to processing for copperas, are included in Appendix F.

3959

3960 **North Berm**

3961

3962 The North Berm was as an approximately 40 ft (12.2 m) by 60 ft (18.2 m) mound located at the foot of
3963 Copperas Hill, west of Mine Road, approximately 60 ft (18.2 m) east of the Upper Copperas Factory
3964 remains and north of Copperas Brook (see Figures 2-13 and 4-3). The North Berm, and the flanking
3965 South Berm opposite it to the south across Copperas Brook were not identified as discrete components of
3966 the Copperas Factories subsite in the PAL 2003 report. Both berms were discovered and found to contain
3967 copperas manufacturing features as part of the 2009 data recovery test trenching. The North Berm had to
3968 be removed during the week of July 20, 2009 as part of construction of the adjacent Sedimentation Basin;
3969 the South Berm was retained and preserved in exchange through consultation with the VT State
3970 Archaeologist. North Berm data recovery was conducted at the top and on the east slope of the mound,
3971 where a brick and stone masonry structure surrounded by bright red soil and containing pieces of cast iron
3972 was found in trench TR-5-UC (see Chapter 4 discussion).

3973

3974 The subsequent removal monitoring took less than one day and consisted of observing a bulldozer with a
3975 tall blade bisect the berm from north to south in narrow west-to-east passes that provided the opportunity
3976 to view it in section as it was removed. The first portion of the masonry structure encountered consisted
3977 of a series of north-south oriented parallel walls of brick and stone with reddened earth laid on
3978 foundations of split slabs and blocks of metamorphic schist that increased in size with depth and rested on
3979 large rounded boulders (Figure 5-1). The surrounding soil was bright red. The brick structure included
3980 the stone wall and arched brick remains (FEA-4-UC in TR-7-UC) partially excavated during data
3981 recovery. Proceeding south two parallel vertical brick walls resting on rectangular stone blocks and
3982 separated by a vertical column of black charcoal and ash were encountered (Figure 5-2). Proceeding
3983 south the backhoe then encountered a cast iron plate approximately 12 inches (30.4 cm) on a side with a

3984 row of common brick laid along its east side and an approximately 3.5 ft (106.6 cm) long wrought iron
3985 bar lying along its west side (Figure 5-3). These structural remains were found relatively high up in the
3986 berm, at the surface in the bright red soil that had been previously recorded in TR-6-UC during data
3987 recovery. Deeper in the berm, below these structural remains, a stone wall incorporating two long narrow
3988 split granite blocks with triangular cape chisel marks, large round boulders, and flat schist slabs were
3989 encountered (Figure 5-4). One of the granite blocks had a square cast iron plate adhered to one side.
3990 Further removal of the berm proceeding south uncovered a stack of irregularly-shaped cast iron plates,
3991 many with rounded corners and edges as if they had been melted (Figure 5-5). Several cut rectangular
3992 granite blocks with rough finished faces were displaced by the bulldozer blade. The blade bisected a
3993 deposit of black charcoal and ash arranged in concentric synclinal layers toward the south extremity of the
3994 structural remains removed by the bulldozer (Figure 5-6). Several cast and forged iron furnace grate bars
3995 were encountered during the removal of the North Berm (Figure 5-7). Once the berm had been removed,
3996 further machine excavation east of the berm uncovered and removed several northwest-southeast oriented
3997 timbers approximately 20 ft (6 m) long and approximately 1 ft (30.4 cm) in diameter (Figure 5-8).

3998

3999 The bright red soil in the top of the mound over the masonry structures is similar to the red hematite soils
4000 observed in waste material throughout the site in locations where heat was applied to the iron-rich soil and
4001 waste material including in the ore roasting piles and around other copperas liquor boiler features.

4002

4003 The descending vertical sequence of brick and increasingly larger split and rounded stones found in the
4004 masonry construction for specialized masonry structures at TP 3, particularly the boilers at the copperas
4005 factories, corresponds with contemporaneous practice for general construction of large outdoor ovens.
4006 According to an 1882 technical volume on construction of large bread ovens for military field conditions,

4007 “Permanent ovens are usually made of bricks or refractory stone, sometimes adobe. It frequently
4008 occurs that bricks are not readily obtainable, and may require distant and expensive transportation,
4009 while stone can be conveniently and easily secured. When stone are not too friable they can be used
4010 for external work—sides, back, division walls and chimneys—and fillings, but the lining of the furnace
4011 and oven-chamber should be made of brick or refractory stone; the foundation of rubble-stone or
4012 brick, preferably the former” (Bell 1882: 39).

4013

4014 The presence of the masonry arch and flue, iron structural remains and ash deposits also identified in the
4015 data recovery investigations all suggest that the structure was a boiler for concentrating copperas liquor.
4016 A copperas boiler is described in “An Account of the Way of Making English Green-Copperas,” from a
4017 late seventeenth-century volume of the *Philosophical Transactions* of the Royal Society.

4018

4019 “...the liquor is pumped into a boiler of lead, about eight feet square...which is thus ordered.
4020 First they lay long pieces of cast iron, about twelve inches from each other, and twenty four
4021 inches above the surface of the fire. Then crosswise they lay ordinary flat iron bars, as close as
4022 they can lie, the sides being made up with brick-work. In the middle of the bottom of this boiler
4023 is laid a trough of lead...” (Colwall 1678: 1058).

4024

4025 This description is useful for visualizing the possible arrangement and function of features and associated
4026 structural remains observed during the monitoring. The vertical brick walls may have been part of the
4027 boiler firebox or copperas vessel heating chamber. The observed rounded brick opening is comparable to
4028 a firebox or ash pit door arch (not to be confused with an interior “fire arch” which was a transverse vault
4029 in the roof at the head of the horizontal draft flue under the boiler pan). The vertical, charcoal-lined open
4030 shaft resembles an ash pit or a draft stack at the top of a boiler as depicted in the mid-eighteenth-century

4031 Diderot illustration (see Figure 3-4). The cast iron plates that ranged in size from palm-sized to over 1 ft
4032 (30.4 cm) square, and varied in thickness from under an inch to approximately 2 inches (5 cm) may be
4033 analogous to the iron supports for the lead copperas liquor boiling supports noted in the seventeenth-
4034 century *Philosophical Transactions* account. The boiler firebox grate bars may have served their named
4035 intended function or have been used as boiler vessel supports inside a brick boiler chamber.

4036
4037 A technical illustration that is also helpful in visualizing how the rectangular walls and firebox grate
4038 system (but not the draft system) of a copperas liquor boiler may have been constructed is Diderot's
4039 eighteenth-century illustration of a granulated sugar furnace (Diderot 1751: Plate Plate 41, Sugar V). In
4040 this illustration the furnace is a rectangular brick structure with a row of thick iron grates set into the walls
4041 above a simple firebox. The only notable difference in the sugar furnace is the frontal location of the
4042 draft stack, presumably located to provide a much cooler fire to heat, but not boil or burn the sugar in the
4043 granulation containers. The front draft stack rises from the top of, and is integral to and supported by, the
4044 furnace, and not from the ground (Figure 5-9).

4045
4046 **Sedimentation Basin**

4047
4048 The Sedimentation Basin area straddles the sharp bend in Mine Road immediately east of the Upper
4049 Factory, immediately north of the Lower Factory and immediately northeast of the Inter-Copperas factory
4050 area. This area contained a swampy wetland fed by Copperas Brook and drainage from Copperas Hill
4051 through the Inter-Copperas Factory Area to the southwest. Deposits of mine waste flanking and under
4052 Mine Road had to be removed from the buried original banks of Copperas Brook to construct a rock-lined
4053 basin to collect potential sediments from the temporary removal activities upslope on the open area of TP
4054 3. The original Mine Road was a packed clay and gravel road. The proximity of a portion of the basin to

4055 the documented factory sites required PAL monitoring of the removal excavations in this area during the
4056 week of July 20, 2009. The road removal and replacement was a fast-track project as the sedimentation
4057 basin and new road had to be completed by the end of August to accommodate resumption of local school
4058 bus traffic.

4059

4060 The stratigraphy in the Sedimentation Basin area consisted of black organic muck and peat underlying
4061 yellow-orange sandy mine waste washed from the open slope of TP 3 (Figures 5-10 and 5-11). This
4062 material was excavated to glacial till to a total depth of as much as 17 feet (5.1 m). The stratigraphy
4063 became more complex containing lenses of different colors and textures of mine waste as removal of the
4064 roadbed progressed north toward the area opposite the Deep Adit and Office within the North Village
4065 subsite. One block of soapstone was found below the South Berm. The area east of the North Berm
4066 contained the greatest concentration of structural remains, almost entirely wood, and in both soil strata.
4067 These included a variety of timbers of varying lengths ranging from pine and birch trunks with the bark
4068 still on to square sawn beams up to 1 ft (30.4 cm) square. Close to the North Berm, several long,
4069 horizontal round east-west-oriented tree trunk timbers were pulled from the area at the base of the berm.

4070

4071 Closer to the road to the east, several of the round timbers were found arranged parallel to each other,
4072 roughly transverse to the road axis (Figure 5-12). One area in particular contained a dense concentration
4073 of timbers as well as planks. Several unusual, short, thick logs from 2 to 3 feet (60.9 to 91.1 cm) in
4074 diameter with chisel-shaped hewn ends were uncovered (Figure 5-13). Wood excavated from the organic
4075 layer was stained black on the outside but well-preserved inside. Several barrel staves were also
4076 observed. As removal of the road and flanking material progressed north the soil strata became more
4077 complex. An area of intact thick plank floor supported by short beveled-end logs and transverse planks
4078 and beams was encountered. Above the planks was a 4-inch (10.1 cm) thick stratum of brilliant orange

4079 gelatinous clay (Figure 5-14). A section of clay lying over black organic muck exhibited thin, sharply-
4080 defined, irregularly-spaced, light and dark orange bands (Figure 5-15). The waste in this area and to the
4081 north contained lenses of black peat, deep red soil, orange clay, a mixture of yellow-white clayey soil and
4082 black rocks, capped by the compacted clay and gravel road surface fill (Figure 5-16). Structural remains
4083 encountered included a few long round and square timbers as well as two large, long narrow cut granite
4084 blocks.

4085

4086 The stratigraphy indicated that portions of the Sedimentation Basin area had once been wetland that was
4087 subsequently buried by eroded and transported mine waste alluvium from the open area of TP 3 to the
4088 west. The parallel arrangement of some timbers transverse to the roadway may have been the remains of
4089 a corduroy road that was built across a former wetland or a small bridge over the Copperas Brook
4090 channel. The short, thick logs with the beveled ends resembled similar logs encountered in the removal
4091 monitoring in the Copperas Brook Corridor, at the southeast corner of the substructure supporting the
4092 timbers and plank deck in the bed of the brook. These logs may have been associated with structural
4093 foundations. The barrel staves may be associated with copperas packing house operations, however they
4094 were found loose in the waste material deposits. Wood stave barrels were generic nineteenth-century
4095 containers and the copperas was reportedly shipped in large, heavy casks weighing from 500 to 2,000 lbs
4096 (Duncan 1871:1085–1088; Thompson 1842:167–168). The presence of the fine-grained orange clay,
4097 particularly containing the thin distinct bands, indicates that the water in part of the Mine Road area was
4098 once deep and still enough to carry and deposit fine mineral grain particles. The presence of the orange
4099 clay above a small area of horizontal wood plank supported by timbers suggests that the deck may have
4100 been a floor or vessel that received water either intentionally to collect fine mineral grains or that was
4101 submerged in water draining from TP 3. Fine brightly-colored metallic oxides were historically used as
4102 pigments in paint manufacture. The Vermont Copperas Company was making 4 tons of paint according

4103 to the 1850 U.S. Census of Manufacturers, and the New England Chemical Company operated two
4104 copperas plants at TP 3 and a paint works at Furnace Flats site after 1867 (Abbott *GMC* 1964:273–276).
4105 The more complex soil stratigraphy and presence of cut granite blocks in that area may indicate industrial
4106 construction and activity. The block of soapstone found below the South Berm was likely brought to the
4107 site for use as refractory furnace lining; similar material is found at copper smelting sites at the Elizabeth
4108 Mine including Furnace Flats (Cherau et al. 2003:108).

4109

4110 **Copperas Brook Corridor**

4111

4112 The Copperas Brook Corridor, which passed the south side of the 2009 Upper Factory data recovery area,
4113 was not identified in the PAL 2003 report as a discrete component of the Copperas Factories subsite. The
4114 Brook Corridor began at a series of exposed timbers approximately 30 ft (9.1 m) southwest of the Upper
4115 Factory stone wall, at the west end of an approximately 90 ft (27.4 m) long narrow “island” that divided
4116 the brook into two, north and south channels (see Figures 2-5 and 4-3). The south channel collected
4117 drainage from the south and central portions of the Ore Roasting and Leaching area and the north channel
4118 collected drainage from the north portion of that area. The combined channels and island widened to
4119 approximately 40 ft (12.1 m) before joining south of TR-4-BC in a narrow channel with timbers and
4120 planks in the bed that passed over two approximately 6-8 ft (1.8 to 2.4 m) high north-south oriented stone
4121 walls (see Figure 2-6) before meeting the level area now occupied by the Sedimentation Basin.

4122

4123 Prior to the beginning of mining and copperas manufacturing about 1809, the east side of Copperas Hill
4124 formed the original headwaters of a brook that flowed east from the bottom of the hill. It appears that the
4125 brook was a surface feature west of Mine Road before mining began, when it passed through the future
4126 factory site and then flowed through a wetland. After 1809, manipulation of the hillside took place to

4127 direct the drainage of the copperas liquor toward the reservoirs and factories located in the narrow
4128 “declivity quite below the mine” (Locke 1821:326–330). After copperas manufacturing ended about
4129 1882, rain and uncontrolled runoff on the barren slope remained focused toward the Upper Factory. The
4130 runoff carved the gully at the top of what became known as “Copperas Brook” through the remains of one
4131 or more of the several copperas factories that historically received and processed the controlled runoff
4132 from the hillside. As part of mine cleanup construction operations, waste rock in the Brook Corridor had
4133 to be removed and the bedrock had to be partially excavated to create an adequate channel to convey
4134 runoff from the surface of the reclaimed TP 3 slope above to the west. The bed of Copperas Brook south
4135 of the Upper Factory contained previously-identified visible remains of brick structures and a sloping grid
4136 of heavy timbers and planks (see Figure 2-2). PAL conducted data recovery in the Copperas Brook
4137 Corridor in the summer of 2010 (see Chapter 4 discussion). After the data recovery, removal of the
4138 Brook Corridor was conducted in two separate campaigns. The bulk of the corridor removal south and
4139 southeast of the Upper Factory (“lower section”) was monitored during the week of August 2, 2010. The
4140 remainder of the corridor removal southwest of the Upper Factory where a temporary cleanup haul road
4141 was also removed (“upper section”) was monitored during the week of August 16, 2010. The following
4142 description begins with the latter work, proceeding from west to east.

4143

4144 **Upper Section**

4145

4146 Removal of mine waste and the fill forming the temporary haul road southwest of the Upper Factory at
4147 the top of the Copperas Brook north channel during the week of August 16, 2010 revealed wood and
4148 masonry structural remains. This area contained a previously-identified, partially exposed, long, round
4149 timber and associated planks embedded in mine waste lying on a roughly north-south axis west of the
4150 brook. This timber was mapped during the 2002 field investigations (see Figures 2-2 and 2-4). Removal

4151 north of the timber exposed similar round timbers ranging from 2 to 2.5 ft (61-76 cm) in diameter
4152 extending 67 ft (20.4 m) on the same alignment. Some of these timbers had a flat planed side with angled
4153 planks lying against them. Removal revealed what appeared to be a northeast corner of this structure
4154 consisting of an intersecting square timber and planks extending at an oblique angle at least 20 ft (6.1 m)
4155 to the northwest.

4156
4157 Mine waste removal east of this location uncovered a plank platform that was recorded with the Total
4158 Station and in photographs and a plan view drawing. The feature consisted of a floor or deck measuring
4159 7.2 ft (2.2 m) east-west by 4.5 ft (1.4 m) north-south consisting of three level horizontal parallel planks
4160 with a 2 inch (5 cm) high vertical plank lip attached to the north edge (Figure 5-17). At least one
4161 additional plank on the south side of the structure was removed by the backhoe prior to clearing and
4162 measuring. At the west end of the level portion of the deck a shorter section sloped down to the west
4163 along the south face of the exposed square timber. The level deck planks rested on a cribwork of square
4164 sawn timbers ranging from .5 ft (15 cm) to 1 ft (30 cm) thick consisting of three visible transverse square
4165 floor beams resting on two longitudinal square stringers which in turn rested on another set of transverse
4166 beams (Figure 5-18). The underside of the upper floor beams were notched at the ends resting on the
4167 stringers below. Removal of the angled section of planks and soil below the level part of the deck
4168 revealed that the stringers were connected to the bottom set of beams with vertical wood pegs. One of the
4169 lower beams had a horizontal rectangular mortise hole in its south end. The exposed lower beam on the
4170 west side of the structure was supported by stacked rough field stone and glacial till. Exposed soil below
4171 the east edge of the deck at the east side of the structure consisted of gelatinous thinly banded silty clay
4172 ranging in color from yellowish red (5YR 4/6), dark reddish brown (5YR 3/4), yellow (10YR 7/6), and a
4173 light brownish gray (10YR 6/2) that contained lumps of an ashy black (10YR 2/1) material (Figure 5-19).
4174

4175 The area containing the large round timbers mapped in 2002 and excavated during monitoring, and the
4176 plank deck feature observed during monitoring are located at the foot of the open ore roasting and heap
4177 leaching area, immediately above the Upper Factory. This is an area noted in historical accounts
4178 throughout the life of the copperas operation as the location of a “plank-lined cistern” or collection
4179 reservoir(s) at the foot of the bedrock trenches for diverting the copperas liquor that had been naturally
4180 partially concentrated by evaporation:

4181
4182 “.... The water passing through becomes highly impregnated with copperas, and at the bottom of
4183 the hill is received into drains which convey it into reservoirs. From there it is let off into the
4184 furnace boilers...”(*Niles Weekly Register* 1835:395).

4185
4186 “...water, from a fountain on the summit of the hill, is made to run upon and leach this mass of
4187 crude sulphate of iron. The lye is now drawn off into large wooden reservoirs, and thence into the
4188 leaden vats as fast as wanted” (Thompson 1842:167–168).

4189
4190 “...copperas is dissolved and passes with the liquor into reservoirs prepared to receive it. The
4191 liquor which is now very strongly impregnated with copperas, is conducted into leaden boilers...”
4192 (Hitchcock 1861:829–832).

4193
4194 “...From the lower evaporator the liquor passes directly to the factories where it is received in
4195 large reservoirs, whence it is drawn into the evaporating pans as needed” (Duncan 1871:1085–
4196 1088).

4197

4198 The exposed timber mapped in 2002 had been tentatively interpreted as a possible dam component for a
4199 reservoir based on its location above the factory, materials and orientation (Cherau et al. 2003). The
4200 additional large round timbers and plank deck feature revealed during monitoring indicated the
4201 continuation of the timber structure and a possible corner opposite the Upper Factory. The planks placed
4202 along the flat side of the timber may have been part of a side wall for a “plank-lined cistern.” Monitoring
4203 did not reveal any masonry foundation for the timbers or prepared masonry or wood interior floor. The
4204 section of plank deck at the apparent northeast corner of the structure may have been a sluice or passage
4205 for directing the stored copperas liquor into the boilers inside the west side of the factory. The deck’s
4206 timber substructure is robust and apparently designed to carry great weight and/or resist movement. The
4207 planks are simply butted together rather than joined by tongue or spline and groove which would have
4208 swelled when wet and helped seal them. The inclined planks at the west end of the deck structure slope
4209 down to the west, opposite and counterintuitive to the east-to-west direction that the copperas liquor
4210 followed downhill on its path to the factory. A second possible interpretation for the timber structure and
4211 plank deck is that they are part of a factory outbuilding, however, monitoring did not reveal any masonry
4212 foundation or wood interior floor.

4213
4214 Mine waste removal monitoring south of the plank deck feature uncovered structural remains
4215 approximately 15 ft (4.5 m) south, at the top of the Copperas Brook north channel. The sandy mine waste
4216 in this area where runoff from the ore roasting and leaching area gathered was bonded with iron oxide
4217 forming “ferricrete,” a tough rusty conglomerate. Removal in this area revealed a rough 10 ft (3 m) long
4218 east-west oriented fieldstone wall extending toward the large round timber found to the west, and ending
4219 at an east-west oriented wood beam to the east at the start of the north channel. The channel bed north of
4220 the wall contained heavy timber construction consisting of large diameter 2.5 to 3 ft (76-91 cm) east-west
4221 oriented logs supporting smaller, .5 to 1 ft (15.2 cm to 30.4 cm) diameter, north-south oriented, parallel

4222 wood beams supporting another upper layer of crossed east-west and north-south timbers. The upper
4223 timbers were located approximately 2 ft (60.9 cm) apart and set into notches in the timbers below. This
4224 timber crib arrangement was filled with stone and also contained an open void (Figure 5-20). The upper
4225 surface appeared to slope slightly to the east as it followed the brook channel. The only artifact collected
4226 from monitoring in this area was a portion of a wood wagon/cart wheel including attached sections of
4227 hub, spokes and rim found west of the timber crib feature (Figure 5-21).

4228
4229 The structural remains in this area appeared to be the westernmost extent of a sloping apron of heavy
4230 timbers and beams supporting a thick plank deck that was exposed in the north and south channels of
4231 Copperas Brook and in FEA-2-UC in 2009 data recovery TR-2-UC (see Chapter 4 discussion). This
4232 structure appeared to be supported in the brook channel area by timber cribs and rock walls. These
4233 structural remains can be interpreted as being associated with the Upper Factory or one of the other
4234 factories known to have been built at or near the Upper Factory location. It could be part of extensive site
4235 preparation engineering required to provide a stable factory substructure for the tiers of masonry process
4236 vessels in the wet environment of the sloping ravine where the copperas-bearing hillside runoff gathered.
4237 It may or may not have played a direct or indirect role in conveying copperas liquor. It could also be the
4238 floor of a copperas liquor reservoir for a factory that once stood below the Upper Factory, possibly
4239 associated with the copperas processing vessel remains found at the North Berm and/or South Berm.

4240
4241 Removal of the temporary haul road west of the Lower Copperas factory exposed additional areas
4242 containing the same fill layers exposed in TR-11-UC, suggesting the area behind the factory may have
4243 been intentionally prepared for construction of the outdoor copperas storage cisterns noted in the
4244 historical accounts. Removal of mine waste in the area subjected to data recovery immediately below the
4245 Pine Grove exposed a level section of buried wood plank underlying a stratum of homogenous fine

4246 orange-red clay covered by a stratum of yellow sandy material. Like the similar clays lying on plank
4247 observed in the removal in the sedimentation basin, they appear to have been deposited intentionally on
4248 the planks, possibly by water, although no regular banding was observed in the clay (Figure 5-22).

4249

4250 **Lower Section**

4251

4252 Removal of mine waste south and east of the Upper Factory during the week of August 2, 2010 revealed
4253 wood and masonry features. Removal was accomplished by filling in the Copperas Brook north channel
4254 to create a ramp for a backhoe to reach the area at the bottom of the brook corridor at the “waterfall” at
4255 the easternmost tier of timber and stone where it met the completed Sedimentation Basin. Excavation
4256 then began southeast of TR-3-BC and removed that trench and FEA-5-BC, TR-4-BC and FEA-4-BC and
4257 FEA-6-BC, TR-5-BC and FEA-7-BC and the waste material below them, then removed the stone wall in
4258 the brook southeast of TR-4 BC and retreated uphill to the west, removing the tiers of stone walls and
4259 timber structure in the north brook channel and the “island” separating the north and south channels
4260 including TR-6-BC, FEA-1-BC, and EU-2-BC. The backhoe operator constructed boulder revetment on
4261 the north and south sides of the new brook bank as work progressed uphill. The new bedrock brook
4262 channel was deepened and straightened by cutting a trench in the bedrock with a pneumatic hammer.

4263

4264 Mine waste removal in the TR-3-BC/FEA-5-BC area encountered stratigraphy consisting of a yellow and
4265 gray till overlain by lenses of black ash or cinder, bright red decayed brick and brick fragments, and
4266 yellow fine-grained sandy waste material (Figure 5-23). Artifacts encountered included an approximately
4267 2-ft (60.9 cm) long, 10-inch (25.4 cm) square unidentified forged iron bar and an unidentified bent 1-in
4268 (25.4 mm) square wrought iron rod, possibly a tool (Figure 5-24). As removal progressed west and closer
4269 to FEA-7-BC in TR-5-BC, an approximately 10-inch (25.4 cm) diameter horizontal round log with a

4270 hollowed out center was encountered at the interface of the till and the ash/brick layers above (Figure 5-
4271 24). Removal uncovered additional timbers and wide planks and a large rounded boulder in this area. The
4272 stratigraphy in places contained distinct, sharply-bound strata of ash and brick. At the point that
4273 excavation revealed the deepest intact stratigraphic column it consisted of a lower stratum of yellow
4274 stained till, an approximately 1-ft (30.4 cm) thick light brown sandy stratum, a horizontal layer of wood
4275 plank, an approximately 2-ft (60.9 cm) thick stratum of ash and brick lenses, an approximately 3-ft (91.4
4276 cm) thick orange sandy stratum, and a thin layer of topsoil (Figure 5-25). As removal progressed
4277 westward toward FEA-7-BC, the plank and colorful ash and brick stratum pinched out and was replaced
4278 by a stratum of light brown sand and gravel overlain by the thick orange sandy stratum (Figure 5-26).

4279

4280 The layers of black ash and cinder and decayed red brick can be interpreted as fuel waste and structural
4281 debris from a furnace, possibly a copperas liquor boiler, apparently laying on a constructed level wood
4282 plank floor surface. The ash layer was approximately 60 ft (18.2 m) southwest of the North Berm boiler
4283 feature. The strata and plank sequence are similar to those found in nearby TR-9-UC and FEA-5-BC (see
4284 below), suggesting a widespread waste deposit. The elevation of the ash layer in FEA-5-BC was between
4285 2 ft (60.9 cm) and 4 ft (121.9 cm) lower than the top of the boiler feature FEA-4-UC in TR-5-UC and 4 ft
4286 (121.9 cm) higher than the boiler fire arch structure found in TR-7-UC. The consistent diameter of the
4287 log's hollowed interior and consistent width of the longitudinal opening in the side suggest that it may
4288 have been intentionally hollowed out. It is questionable if it was used for copperas liquor transfer inside
4289 the factory; considering the low pH of the boiled process liquor, the trough would had to have been lined
4290 with lead to prevent rapid deterioration from the action of the acid. The level, north-south orientation of
4291 the timber is counterintuitive for the gravity-assisted flow pattern understood to be a fundamental
4292 component of operations. Additional round and square timbers with reasonable integrity but missing their

4293 upper surfaces and/or heartwood cores, and therefore resembling troughs or conduits, were found
4294 elsewhere in the Upper Factory during data recovery (see Chapter 4 discussion).

4295
4296 Removal in the area including FEA-7-BC in TR-5-BC revealed timber and bedrock structural elements
4297 supporting a feature identified and documented during the 2010 data recovery and identified as a copperas
4298 crystallizer (see Chapter 4 discussion). The backhoe scraped along the east side of the north-south timber
4299 located at the east side of the crystallizer brick floor layer, dislodging that timber and others along the
4300 west side of the crystallizer feature. The PAL monitor directed the backhoe operator to remove the brick
4301 layer in shallow passes revealing a layer of additional north-south oriented logs or timbers below the brick
4302 layer. The backhoe bucket encountered a horizontal void at the east edge of the crystallizer feature.
4303 Machine excavation ceased and the monitor shovel excavated the void to reveal two intact east-west
4304 oriented approximately 1-ft (30.4 cm) square timbers located approximately 4 ft (121.9 cm) apart, resting
4305 on a flat ledge cut into the bedrock and supporting the flat layer of north-south oriented timbers that
4306 supported the brick crystallizer layer above (Figure 5-27). The west side of the void ended at a 90-degree
4307 transverse horizontal square timber located approximately 4 ft (121.9 cm) from the void entrance.

4308
4309 Exposure of the void under the crystallizer provided a glimpse into factory construction methods,
4310 indicating use of heavy east-west timbers on flattened bedrock ledge for support of this copperas vessel.
4311 The flat bedrock was one of at least two man-made flat areas identified during the data recovery and
4312 monitoring at the Upper Factory, the other one located in the bed of Copperas Brook (see below). The
4313 dimensions and spacing of the timbers also resembles the timber structure found during monitoring of the
4314 upper section of the brook described above (see Figure 5-20). The level bedrock and timber construction
4315 indicates that the bottoms of at least some copperas vessels and the factory levels they rested on were

4316 level and not sloped on an angle like the timber and plank structure seen in the bed of Copperas Brook
4317 and FEA-2-UC in TR-2-UC.

4318

4319 Filling in the Copperas Brook north channel to create the temporary backhoe ramp required removal of
4320 the brick-strewn “island” that separated the north and south brook channels. Elevations on the island
4321 stepped down from west to east in rough mounds or levels with clusters of common brick on them (Figure
4322 5-28). One of these brick clusters was explored in EU-2-BC as part of the data recovery. The portion of
4323 the island to the east was mapped and partially excavated as TR-6-BC, where the remaining brick mounds
4324 were recorded as FEA-2-BC (see Chapter 4 discussion). The brick mounds exhibited slumped and
4325 distorted brick coursing; the upper of the two deposits included bricks laid in an east-west row (Figure 5-
4326 29), and the lower one included a small section of wall (Figure 5-30) and a small uneven “apron” of
4327 bricks slumped over the irregular ground surface (Figure 5-31). Many bricks had a layer of white mortar
4328 adhering to their surfaces. The excavated brick and timber features in EU-2-BC and the two lower
4329 mounds of brick were flanked to the north and south sides by decayed east-west oriented timbers that
4330 sloped downhill to the east at a shallow angle (Figure 5-32). These timbers rested on decayed north-south
4331 oriented timbers in a matrix of intercalated red-brown sandy soil lenses resting on the brick-strewn layer
4332 of planks sloping to the east that rested on the larger system of heavy timber beams and stringers
4333 underlying the north and parts of the south brook channels (Figure 5-33). A small area of level ground
4334 covered with what appeared to be a skim coat of mortar and decayed planks was located immediately
4335 south of the lower brick-covered mound (Figure 5-34).

4336

4337 Removal monitoring observations confirmed that the bricks were in a thin layer of yellow sandy soil and
4338 the timbers were in and above a stratum of soil lenses interpreted as a prep layer, and the bricks were not
4339 structural masonry piers descending to piles or bedrock (Figure 5-35). These observations support the

4340 interpretation of the brick and timber structural remains in FEA-2-BC as the possible remains of copperas
4341 crystallizer vessels. The remaining brick coursing in small lengths and sections of wall, inclusion of
4342 mortar, thinness of the brick deposit, and relationship to similar underlying soil, crossed timber and plank
4343 structural systems are similar to different aspects of the crystallizers found in TR-3-UC and TR-5-BC.
4344 The small area of level ground indicates another area where the substructure or floor of the factory was
4345 level, and in the vicinity of crystallizers.

4346

4347 The next step in the machine removal of the Copperas Brook Corridor was removal of the brook channel
4348 bed from east to west, retreating up the temporary fill ramp, removing visible structural remains including
4349 two approximately 6 ft to 8 ft (1.8 m to 2.4 m) high stone walls, heavy timbers, the ‘island’ between the
4350 north and south channels, and the timber and plank structure in the brook bed to a point west of the stone
4351 foundation at the top of the Upper Factory.

4352

4353 The backhoe began removing material at the easternmost point of the Brook Corridor, immediately north
4354 of the easternmost of two north-south oriented stone walls that form small waterfalls in the brook. The
4355 backhoe removed several large, east-west oriented, level, parallel tree trunk timbers approximately 2 to 3
4356 ft (60.9 to 91.4 cm) in diameter at three different elevations in the hillside east of TR-4-BC. The two
4357 lowest trunks were resting on what appeared to be horizontal prepared shelves in the bedrock ledge. The
4358 trunks consistently exhibited stages of decay, with well-preserved wood at the bottom, grading into
4359 orange rotted wood at the tops (Figure 5-36) The trunk timbers rested on and extended east from buried
4360 stone walls. The walls had been made of split pieces of schist that had decayed to a soft, yellow clayey
4361 and blue granular consistency. As the excavation proceeded south into the brook channel and west to the
4362 second stone wall, the upper layers of sandy sediment were solidified in an iron oxide matrix (ferricrete)
4363 (Figure 5-37).

4364 The backhoe continued to encounter decayed stones and east-west timbers, which were nested in clusters
4365 of varying diameters in places. Several of the timbers were up to approximately 15 ft (4.5 m) long and 3 ft
4366 (91.4 cm) in diameter and had the ends sawn in chisel-shaped bevels (Figure 5-38). Long north-south
4367 round timbers were also encountered. The timbers just under the brook bed surface were encased in
4368 ferricrete, which broke off leaving impressions of the timbers. Once removal reached the east tip of the
4369 channel island, at the second stone wall, where the sloping grid of timbers and planks lay in the bed of the
4370 brook, major structural remains were encountered. At the lowest exposed elevation were east-west
4371 oriented timbers in a red coarse sand below decayed stones, transverse timbers and planks encased in
4372 ferricrete. The timbers included round logs as well as square hewn or sawn timbers with square or
4373 beveled notches in their ends. The timbers were not joined at the notches and simply appeared to have
4374 been recycled for use in building the cribwork structure (Figure 5-39). Three wood barrel staves in an
4375 excellent state of preservation were found loose in the excavated material (Figure 5-40). As excavation
4376 proceeded west the layer of red sand became the matrix for a wall of schist stones that had become
4377 softened from the action of low ph water so that the stones and matrix broke apart as a homogenous mass
4378 revealing their cross section (Figure 5-41). When the full height of this structural system was exposed it
4379 formed an almost 10 ft (3 m) high wall with large east-west timbers and round granite boulders at the
4380 bottom. These remains supported an approximately 4 to 5 ft (1.2 to 1.5 m) thick layer of decayed schist
4381 stones under an approximately 1 ft (30.4 cm) square long north-south timber backed by a layer of brown
4382 sand under an approximately 2 ft (60.9 cm) high section of mixed small rectangular stones and small
4383 north-south beams surrounding east-west oriented round timbers (Figure 5-42). This structure was
4384 capped by the east-west oriented plank layer exposed in the bed of the brook, and extended upslope to the
4385 west under the brook and the exposed and excavated crystallizers on the island between the brook
4386 channels.
4387

4388 The structural remains removed from the bed of Copperas Brook opposite and below the Upper Factory
4389 stone wall appear to be the eastern continuation of the sloping apron of heavy timbers and beams
4390 encountered during removal monitoring of the temporary haul road to the west. This structure is also
4391 similar to that encountered in TR-2-UC (see Chapter 4). The dense network of timbers and stone walls in
4392 the southeast corner of the structure appear to be the structural underpinnings of the southeast corner of a
4393 building. These structural remains can be interpreted as being associated with the Upper Factory or one
4394 of the other factories known to have been built at or near the Upper Factory location. It could be part of
4395 extensive site preparation engineering required to provide a stable factory substructure for the tiers of
4396 masonry process vessels in the wet environment of the sloping ravine where the copperas-bearing hillside
4397 runoff gathered. It may or may not have played a direct or indirect role in conveying copperas liquor. It
4398 could also be the floor of a copperas liquor reservoir for a factory that once stood below the Upper
4399 Factory, possibly associated with the copperas processing vessel remains found at the North Berm and/or
4400 South Berm.

4401

4402 **Ore Roasting and Leaching Area**

4403

4404 The Ore Roasting and Leaching area refers to the roughly triangular area of open barren hillside east of
4405 the North Open Cut and west of the Upper Copperas Factory, bisected by Copperas Road. This area is
4406 sometimes considered “TP 3” but that name also technically refers to the larger cleanup area including the
4407 open hillside but also extending east beyond Mine Road (see Figure 1-3). PAL assisted Weston
4408 Solutions, Inc. with archaeological monitoring of geotechnical test pits on TP 3 in 2006. This monitoring
4409 indicated that ore roasting took place in a broader area across the hillside than indicated by the presence
4410 of characteristic red hematite waste material visible at the surface, and revealed the unusually colorful soil

4411 stratigraphy associated with the roasting and leaching and subsequent chemical alteration of the waste
4412 material (see Appendix E).

4413

4414 PAL monitored removal of mine waste from much of the open hillside during the winter of 2009-2010.

4415 The presence of the characteristic red hematite waste material at the surface and in the removal

4416 excavations further indicated that ore roasting and leaching took place across a large portion of the

4417 hillside below the North Open Cut, and narrowed toward the Upper Copperas Factory. Monitoring across

4418 the hillside revealed the remains of roast beds, ore leaching piles, timber and masonry structures and

4419 copperas liquor conveyance features, as well as artifacts including mine car track, pipe, cable, and wood

4420 troughs. The objective of the EPA cleanup removal was to remove mine waste until either clean glacial

4421 till or bedrock was reached. This methodology resulted in removal of waste to bedrock on the majority of

4422 the hillside south of the Upper (1831) Adit/Cob Shop/Blacksmith Shop area, and removal to till and

4423 capping with crushed rock in the area to the north. This transition zone may reflect the northern extent of

4424 the “prepared bed or bottom upon which the ore is burnt and leached...upon the hillside just below the

4425 vein...prepared by simply scraping the earth clean from the ledge...nearly an acre in extent...called the

4426 leaching ground” in the 1871 description of the works (Duncan 1871:1085–1088). The mouth of the

4427 Upper (1831) Adit (see Figure 2-15) and a vertical shaft (see Figure 2-16) were also located, opened, and

4428 temporarily sealed pending installation of grates to allow bat passage and safe public viewing and

4429 interpretation. The monitoring field notes and photographs are included in this report as Appendix F.

4430

4431 Monitoring in the Ore Roasting and Leaching Area during the week of January 11, 2010 included a

4432 mound covered with dense brick scatter near the center of the slope, approximately 100 ft (30.4)

4433 southwest of the Upper Adit and approximately 50 ft (15.2 m) west of Copperas Road. The PAL monitor

4434 observed the Caterpillar backhoe encountering timbers, posts, beams and planks within the mound. As

4435 excavation continued the beams and posts appeared to be interlocked making it difficult to expose the
4436 structure. Shallower passes with the arm of the backhoe exposed a concentration of bricks. Further
4437 excavation revealed intact portions of north and west brick walls. The monitor directed the backhoe
4438 operator to make narrow north to south passes across the feature to bisect it. Excavation revealed pieces
4439 of cast iron bar and plate, burned common brick, deep red soils, and vitrified red clay. Large rectilinear
4440 blocks of split granite were observed in the center of the structure (Figure 5-43). A forged wrought iron
4441 bar was also encountered (Figure 5-44). Wood beams with mortise and tenon joints, possibly supports for
4442 the structure, were found around the feature. As removal progressed extensive horizontal deposits of red
4443 mine waste and black ash were encountered.

4444

4445 The only documentation of a structure at this location is an 1845 “Sketch of the Copperas Works,
4446 Strafford, Vermont” by geologist Charles T. Jackson that appears in C.B. Adams’ *First Annual Report on*
4447 *the Geology of the State of Vermont* (see Figure 3-8). The feature in question appears to correspond with
4448 the building “*b* the cobbing shed” which is shown between “*a*” the mine and what appears to be Copperas
4449 Road, above “*c* the roasting heaps and *d* the factory” which is shown at the bottom of the sketch (Adams
4450 1845:56). The feature in question could be interpreted as the remains of a heat-related masonry structure
4451 inside the cobbing shed such as a blacksmith’s forge for heating, sharpening and annealing the drills and
4452 other tools used for mining the ore, or possibly a boiler for heating the structure, which had one chimney
4453 as indicated in the Jackson sketch. Blacksmith’s shops were ubiquitous structures at hard rock mines,
4454 commonly located close to the mine workings. No other buildings are indicated in the Jackson sketch.
4455 The masonry materials, iron artifacts and extensive red and black soils are also consistent with the
4456 materials and scale of structures interpreted as copperas liquor boilers within the Upper Copperas Factory
4457 and North Berm (see Chapter 4). Considering the apparent size of the structural remains, it is also
4458 reasonable to interpret it as a copperas liquor boiler, possibly part of an undocumented early, smaller

4459 copperas factory located higher on the side of Copperas Hill, closer to the source of ore at the North Open

4460 Cut.

APPENDIX F

**MINE WASTE REMOVAL MONITORING 2009-2010 FIELD NOTES (TYSON SHAFT,
1831 ADIT/COB SHOP/BLACKSMITH SHOP AND ORE ROASTING AND LEACHING
AREA) AND PHOTOGRAPHS (ALL AREAS)**

Elizabeth Mine TP-3 Monitoring
WO 12/7/09
Matt Kierstead

12/8/09: Monitoring was conducted in two areas.

1. Vertical plank feature, treeline east of Tyson Shaft (survey point taken by Northwoods). Feature was previously identified by Weston/Northwoods and set aside for PAL monitoring. Guided machine excavation through mine waste uncovered a rectangular feature approximately 5 or 6 ft wide consisting of vertical planks and small timbers driven down into till. The feature held water at a level above the surrounding water table. One distinctive piece of wood measured approximately 4 ft long and had one semicircular side, one straight side, and two beveled ends. No artifacts were found or recovered. The feature does not appear on any historic maps. The function of the feature is unknown; it may have been a well or cistern.

2. 1831 Adit, immediately west of the Cob Shop/Blacksmith Shop plateau west of Copperas Road (survey point taken by Northwoods). Adit is indicated on 1874 map of Copperas Works. Guided machine excavation immediately broke through the roof of the buried timber and plank approach tunnel where it meets the bedrock tunnel. Combined machine and hand excavation further cleared the remaining timber and plank portal structure at the soil/bedrock tunnel interface. Continued machine excavation broke through a ferricrete dam in the tunnel mouth, releasing several thousand gallons of water. Once the flow subsided, photos of the timber portal structure and tunnel interior were taken. The arched tunnel ceiling and walls are encrusted with hematite/goetheite stalactites. The floor of the tunnel has been raised approximately two feet by an accumulation of silt and ferricrete.

Elizabeth Mine TP-3 Monitoring
Week of 12/21/2009
Erin Timms

Monitoring was conducted north and east of the Cob Shop/Blacksmith Shop and in the area of the Blacksmith/ Cob shop on the plateau west of Copperas Road adjacent to the 1831 Adit.

Removal of waste rock to the north and east of the Blacksmith/Cobb shop revealed little evidence of other cultural material. During the intensive Phase I survey a concentration of blue-gray clay soil was identified in this general area. Building materials, hardware, planks, and cribbing were absent in this area. Waste rock was removed down to glacial till.

Large timbers were identified adjacent to the east temporary loading station in RU-2. Large timbers were found southwest of the loading station. Iron banding was found adjacent to the timbers. Planks, wooden timbers, and stone building material were identified during the removal of the northwest section of the blacksmith shop. Red vitrified soils and roasted ore were identified in the Blacksmith/Cob shop area.

Elizabeth Mine TP-3 Monitoring
Week of 12/28/09
Matt Kierstead

Monitoring was conducted at the Cob Shop/Blacksmith Shop plateau west of Copperas Road and at the adjacent 1831 Adit.

Monitoring at the Cob Shop/Blacksmith Shop plateau consisted of observing south-to-north passes of a Caterpillar D7 bulldozer and photographing the swath and disturbed materials. The area immediately east of the 1831 Adit contained numerous flat schist stones. A north-south oriented section of timber, apparently a building sill, was found resting on a wall of split schist blocks. Additional square and round wood posts and flat planks of various sizes were uncovered in the area close to the east retaining wall at the east lip of the plateau. A concentration of dark soil in the north section was removed and a large concentration of broken ore was removed in the south section. Several loose sections of eroded mine car rail were removed and stockpiled across Copperas Road at the south end of the "Big Yellow" pile of waste rock for later retrieval. No other artifacts were found.

Monitoring at the 1831 Adit consisted of observing backhoe removal of soil, ferricrete and loose rock from the areas next to and above the adit. The wood portal structure at the soil/bedrock interface was photographed and carefully dismantled using the backhoe claw. Several square timbers and round yellow birch logs that held up the plank roof tunnel were set aside and photographed. Once the soil, loose rock and wood were removed, the bedrock opening and tunnel interior were photographed.

Erin Timms
Elizabeth Mine Monitoring
WO 1-4-2010

Tailings removal continued with TP-3 with excavations starting in the RU-3 area approximately 100 feet south of Adit #2. Red clayey soils associated with roasting were found in this area followed by a layer of wood or wood staining that was preceded by mottled clayey soils. Excavation continued down to ledge rock. Monitoring activities focused on eastern portion of RU-3. A concentration of large timbers beams and posts were found in this area. Below the wood layer similar to the roasting bed (WO 1/11/2010) was a gelatinous heavily mottled clay. In some areas planks were found at the interface between the red vitrified clayey soils and the heavily mottled gelatinous soils. Below the wood layer excavation became difficult as equipment began to sink in the heavily mottled gelatinous soils. Bricks were found in this area but none were found in situ. The area was excavated using a combination of northeast passes using a D7 CAT bulldozer and a CAT 342D excavator.

Elizabeth Mine Monitoring
WO 1-18-2010
Erin Timms

1-20-2010

PAL archaeologist arrived at Elizabeth Mine around 11 a.m. Monitoring began with what remained of the exposed timber roasting bed structure due south of the boiler feature in RU-3. Excavation of this area began the day before and was stopped due to the large amount of timbers and planks were reportedly removed without PAL presence. An approximate 3 foot by 50 foot section earthen berm and exposed timbers were left along the hillside with a 40 x 60 foot section aligning the road. Roasted ores were present in these areas. Two beams were encountered running a general north-south direction with planks above running a northeast-southwest direction. The heaps were heterogeneous with stratified layers of roasted ores. Soils above the wood layer consisted of a red silty clay (roasted tailings) followed by a yellow silty sand (possible leached tailings). Below the wood layer the strata consisted of a black ashy organic layer with possible sintered ore inclusions. The layer is similar to what was found across the center of TP-3 found above a heavily mottled wet layer of tailings followed by bedrock.

1-21-2010

Monitoring continued the following day along the east bank of the north open cut. The removal of the temporary road and tailings along the cut revealed a concentration of timbers and iron pipes and mine car rails. Several planks were found in situ including a platform structure with planks running a general north-south orientation with round support timbers below. One plank was found running east-west from the north open cut just north of one of the large roasting beds. The plank was vertical with horizontal planks running in north-south direction off the east-west plank. Square beams with an east-west orientation were found underneath the north-south wood planking. One upright post was encountered at the north-east side of the top of the conical roasting bed.

Elizabeth Mine Monitoring
WO 1-25-2010
Erin Timms
1-25-2010- rainy day

1-26-2010 & 1-27-2010

After a rain delay, excavation continued south along the north open cut. Excavations revealed a series of upright posts (6-8) at the top of the conical roasting bed. The posts were at a 30 to 45 degree angle following the slope of the roasting mound. Irregular large pieces of ore averaging 6 inches and larger were found at the top of the mound intermixed with a light yellowish brown tailings. The stratum that followed was yellow compacted tailings with ore ranging from 2-3 inches in diameter. The next stratum was red roasted tailings with minimal chunks of ore. Some smaller piles of mostly black roasted ore were also located around and the roasting bed. A monitoring well for the EPA cleanup was removed with some historic pipes that may have been used to water the roasting beds. The pipes may have run from the dam on the west side of the North Cut radiating out to the roasting beds on the east side of the North Open Cut. Pieces of mine car rail and a tangle of iron or steel cable were removed from the east side of the roasting bed. Both were found within the same area at the east side of the roasting bed. The rails appeared to be running in a east-west direction to a cut notch on the west side of the north open cut (possible adit) within the bed rock.

Elizabeth Mine Monitoring
WO 2-1-10
Erin Timms

2-2-10 to 2-5-10

A combined machine excavation with a D6 bulldozer and a 345C excavator began removing the tailings pile referred to as big yellow in RU-5. The tailings pile is east of Copperas Brook and the Upper Copperas factory. The tailings pile is adjacent to a ravine to the south with many exposed broken timbers. At the surface the pile consisted of yellow tailings. Excavation into the tailings pile revealed red roasted soils and timbers associated with roasting activities. Two beams were identified at the interface between the red and yellow tailings along the southern profile. The beams seemed to be placed at an angle following the conical shape of the roast bed. During excavation large amounts of blue copperas salts were encountered. One large iron artifact was encountered approx. 2 feet below grade at the interface between the red roasted soils and the yellow tailings. Earlier work at Elizabeth Mine has suspected that the yellow tailings may have been from one of the later Tyson era mining periods. The tailings pile and ravine were littered with artifacts from what appears to be a 20th century dump site. Radiator hoses and machine made bottles were found within the yellow tailings. Excavation continued exposing multiple levels of wood planking along the west profile. Large pieces of ore and smaller black roasted ores were encountered, as well as, the residual red, purple and white clayey soils found in these roast beds. The piles seem to be stratified with a fair consistency with wood plank layers separating the various stages of ore decomposition. On the last day of excavation, a wood trough was found in situ running north-south from the south side of the tailings pile into the wood lined ravine. The trough is approx. 20 feet northeast of one of the brick evaporators.

Elizabeth Mine Monitoring
WO 2-8-10
Erin Timms

2-8-10 to 2-9-10

A combined machine excavation with a D6 bulldozer and a 345C excavator began removing the tailings pile south of the wood lined ravine in RU-4. At the surface the tailings pile consisted of dark reddish brown to black sintered ore. East of the black sintered ore pile was a yellowish-brown pile that was removed at the same time. Excavation had already begun by the time PAL personnel arrived on site. Excavation revealed a large amount of metal and glass artifacts throughout the tailings that had not been encountered in other roasting beds. The many of the artifacts encountered appear to be a part of the 20th century dump site. A leaf spring for a truck, radiator hoses, and a rubber tire tube as well as machine made bottles was encountered near the top of the pile. Some of the metal artifacts were found at greater depths within the stratified roasted ores. One specialized brick was encountered, large amounts of iron/steel cable, various spikes and terracotta pipe, and iron piping were found at various depths with in the roast bed. Wood planks and beams were encountered that were consistent with the other roast beds. Excavation continued down through various levels of wood and ore until reaching bedrock.

Monitoring continued in RU-5 in between domestic foundations northwest of the upper factory. Excavation within this area revealed very few features. Two round timbers were found in the bank approximately 2 feet below grade on the south-west side off of Copperas Road. One square beam was also encountered southwest along the slope. Approx. 2-3 feet of yellowish-brown tailings and soil were removed down to till. The absence of mining features in this area would indicate minimal use other than possible domestic. No domestic artifacts were encountered in the tailings removal. Excavations ceased at the southwest foundation to northeast and the ravine to southwest.

Elizabeth Mine Monitoring
WO 2-22-10
Erin Timms

2-22-10

PAL staff arrived on site Monday morning. Excavation of RU-5 continued with Copperas Road Removal. A stratified roasting bed was being removed. Excavation into the pile revealed large timbers in the southwest corner. Plank decking was found in this area as well as slated planks/horizontal laths that were supported by upright square posts. Three large beams were found in the southwest profile staged at different elevations following the shape of the roasting pile. Excavation continued down to bedrock. Excavation ceased 20 feet before the bend in the temporary haul road and Copperas Road.

2-23-10

PAL monitored the excavation of one roasting bed with exposed timbers and a ridge suspected to be roasted ores in RU-4. The roasting bed was excavated in a circular pattern bisecting the northwest side of the ridge nose of the roasting bed. The bed was located adjacent to two streams north and west and east of the pile assumed to be apart of the conveyance for copperas liquor. Guided excavation with a smaller Ascera 140SR backhoe pulled back roasted ores trying to maintain a fairly level surface. The excavation of the top of the pile revealed disarticulated wood members removed with the frozen top layer. As ore and timbers were removed a wood wheel spoke like pattern became evident. Wood timbers radiated out of the center towards the brook. Another possible wooden ring was identified approx. 15 feet from the center of the pile. Upright timber posts supported the slatted planks or horizontal laths that divided the pile into wedges. Excavation ceased to the west and northwest due to raising water table. Clayey heavily mottled soils were encountered in this area. To the north excavations ceased at bedrock. The roasting bed was not as tall as other roasting beds encountered in RU-4 and RU-5. Only two distinct soil strata occurred within the roasting bed with one black organic layer separating the two. The roasting bed was the furthest eastern bed in RU-4.

Excavation of a suspected roast bed proved to be a natural stone ridge with predominately natural soils. Stone outcrops appeared high along the northwestern side of the ridge nose. One excavation trench was placed to the south. The trenching showed a thin layer of roasted soils on the western side of the ridge followed by a brown silty loam similar to soils identified in the inter-copperas area followed by till. Excavation continued at the top of the ridge with natural soils at the top followed by bedrock. The backhoe operator confirmed that when a trench was placed along the crest the week prior rich brown natural soils were encountered followed by shallow bedrock.

Excavations continued around the possible bank barn foundations. At the request of Weston contractors monitoring was to remove more tailings around the foundations trimming back the bank. Excavations began northeast of the foundations. Large boulders for a possible floor and a heavy concentration of artifacts were encountered. Excavation ceased due to the large amount of cultural material. Excavations continued on the northeast bank. One trench was placed along the island away from the foundation. No material was found. This area will be removed once the drainage areas around the foundation can be stabilized. Excavations continued on the southwest bank. Yellow tailings and large pieces of ore were removed from the southwest bank. A few timbers were encountered in the southwest corner of the pile. The timbers were at a 20-25 degree angle and were consistent with supports found in other roasting beds.

Elizabeth Mine TP-3 Monitoring
Week of 4-12-10
Matt Kierstead

Monitoring was conducted at the Tyson Shaft #1 Site at the north edge of TP-3, north of the North Open Cut. The PAL Senior Industrial Historian arrived at 12 noon on 4-14-10 and monitored until 5:00 p.m. Monitoring resumed at 7:00 a.m. on 4-15-10 and ended at 12:00 noon. Monitoring consisted of observing a Caterpillar 3300L with a 60 ft long arm and straight-edged bucket remove a section of a steeply-sloping pile of weathered waste rock in an oval area east of the suspected collapsed shaft, a shallow pit with decayed large horizontal timbers extending east from its west edge. Excavation in the upper portion of the pile yielded an occasional loose piece of broken wood, none of which appeared to be in situ. As work moved from south to north, the excavator eventually encountered a hard resistive horizontal black layer that only yielded to prying from the edge. At PAL's direction the operator cleared as much of the area as possible at once to determine its extent. The surface was level and consisted of a hard, approximately 1 ft thick layer of roughly fist sized pieces of ore cemented with black pyrrhotite ore fines. Two, 4" square red oak timbers were embedded in the floor, one oriented in an E-W direction and another N-S. The floor appeared to have a distinct east edge. Only approximately 15 ft by 10 ft could be exposed. Excavation could not proceed west as it was outside the reach of the excavator. It could not proceed north as it would have required removal of a larger birch tree with a survey spike in it (once the purpose of this spike is determined by Northwoods, it may be able to be removed allowing further waste rock removal and determination of the extent or footprint of the floor). A wrought iron strap approximately 2 inches wide with a triangular hole in it protrudes from the ground between the excavation limit and the tree. Working south of the floor area, immediately east of the suspected collapsed shaft, the excavator extracted several E-W oriented, horizontally placed round timbers opposite the in-situ exposed decayed timbers protruding from the opposite side of the pit. Excavation at this level also yielded other round timbers, pieces of 4" square timber, 1" thick plank, and several flat rectangular pieces of un-weathered schist.

The floor area corresponds with the shed east of the enclosed headframe in the 1880s photo of the Tyson Shaft. Sorted piles of rock and a waste disposal trestle in this area in the photo suggest that this was the ore cobbing house. The hard black layer of ore pieces and fines appears to be the working floor of the cobbing shop.

Elizabeth Mine TP-3 Monitoring
Week of 5-3-10 (Thursday, May 6)
Matt Kierstead

Monitoring was completed on the east side of the Tyson Shaft #1 Site at the north edge of TP-3, north of the North Open Cut. The PAL Senior Industrial Historian arrived at 9:00 a.m. and monitored until noon. Monitoring consisted of observing a Caterpillar 3300L with a 60 ft long arm and straight-edged bucket remove the remains of the section of waste rock east of the Tyson Shaft monitored during the week of 4-12-10. Excavation yielded one loose piece of broken wood, not in situ. The excavator again encountered the hard resistive horizontal black layer of ore cemented with black pyrrhotite ore fines. Only approximately 15 ft by 10 ft was exposed. Excavation could not proceed west as it was outside the reach of the excavator. It proceeded north to the large birch tree with a survey spike in it. The wrought iron strap approximately 2 inches wide with a triangular hole in it protruding from the ground was removed and photographed. The area between the previous northern excavation limit and the birch tree contained many large round granite boulders. It also contained a shallow-buried row of three flat rectangular split schist blocks on top of a one-foot thick layer of waste rock on till. The area corresponds with the shed east of the enclosed headframe in the 1880s photo of the Tyson Shaft. Sorted piles of rock and a waste disposal trestle in this area in the photo suggest that this was the ore cobbing house. The hard black layer of ore pieces and fines appears to be the working floor of the cobbing shop. The row of split schist blocks appears to have been a simple foundation support for a timber sill of the north wall of the cobbing house.

On the west side of the shaft pit, an approximately 2 ft high, 1" diameter, threaded iron machinery mounting pin was identified at the southwest edge of the collapsed pit, in the area of the Tyson's boiler/steam engine/shaft hoist house. The pin was flagged with striped flagging tape.

Two industrial waste piles were identified southwest of the shaft pit; a pile of bituminous coal ash and boiler grate clinker, and a pile of bituminous coal ash and coke several feet west. The possibly correspond to the Tyson's boiler/steam engine/shaft hoist house and blacksmith shop, respectively.

Elizabeth Mine TP-3 Monitoring
Week of 5-10-10
Matt Kierstead

Monitoring was resumed at the Tyson Shaft #1 Site at the north edge of TP-3, north of the North Open Cut. Waste rock removal was in the area of archaeological concern west of the shaft, where the Tyson's 1880s blacksmith shop and boiler/steam engine/shaft hoist house were located west of the shaft pit. The PAL Senior Industrial Historian arrived at 12 noon on 5-11-10 and monitored until 5:00 p.m. Monitoring resumed at 7:00 a.m. on 5-12-10 and ended at 5:00 p.m. Monitoring consisted of observing a Caterpillar 3300L with a 60 ft long arm and straight-edged bucket remove a section of a deep, steeply-sloping pile of weathered waste rock in an oval area west of the suspected collapsed shaft. The bucket reach extended to a point approximately 10 ft west of the threaded iron machinery mounting pin flagged earlier in the monitoring campaign in this area. Documentation consisted of digital photography.

A limited number of haul trucks using a long access route allowed for slower, more careful use of the excavator in this area between truck loading episodes. The excavator was used to take long, shallow, east-to-west passes down to gray undisturbed till. The remains of two buildings were found. Excavation in the area at the eastern extent of the excavator immediately uncovered a shallow-buried, approximately 1 ft square, large horizontal wood timber extending east and apparently attached to the flagged threaded machinery pin. Approximately 10 ft north of the timber, excavation revealed layered masonry construction consisting of a single layer of hand-struck red brick that may be a floor surface, above a layer of increasingly large flat rounded boulders and tabular schist slabs.

Several feet west of the above feature, excavation uncovered portions of a small, square, crude stone foundation consisting of east-west and north-south rows of flat rounded boulders and squared off schist slabs. The interior contained a scatter of wrought iron artifacts including large and small angle iron brackets, spikes, straps, two horseshoes, a hook, a short length of pipe, and two cast iron fragments of what appear to be furnace door frames. A deposit of bituminous coal was found in the area immediately north of the foundation.

The excavated area corresponds with area of the shed and building west of the enclosed headframe shown in the 1880s photo of the Tyson Shaft. The area where the iron artifacts and coal pile were found appears to be the location of the blacksmith shop, likely the small free-standing shed in the photograph. The large horizontal east-west timber, stone foundations and brick floor that uncovered to the east appear to correspond with the west end of the boiler/steam engine/shaft hoist house. Excavation of this area to the east will be conducted once clearance is obtained to place excavation equipment in the current exclusion zone over the mine workings.

PAL was also asked to briefly monitor waste rock removal in a small area at the south end of the east edge of the North Open cut where excavation had been stopped earlier in the week when several parallel, east-west-oriented wood planks and timbers were encountered by an excavator. The wood was located in waste rock fill in a notch cut into the east edge of the North Open Cut

that may have been a large historic crosscut, possibly for WW II-/1950s-era truck haulage. Careful removal of the wood revealed that it was a stacked pile of oak planks of various dimensions and lengths, birch poles, several timbers with regularly-spaced, shallow notches, and a few short lengths of 2-inch diameter iron pipe. The materials were loosely stacked and did not appear to be connected or part of a structure. It appears they were piled in the notch area for storage and subsequently covered with a mound of mine waste possibly placed to block entrance to the notch for safety.

Elizabeth Mine TP-3 Monitoring
Week of 6-7-10
Matt Kierstead

Monitoring was resumed at the Tyson Shaft #1 Site at the north edge of TP-3, north of the North Open Cut. Waste rock removal continued in the area of archaeological concern west of the shaft, where the Tyson's 1880s blacksmith shop and boiler/steam engine/shaft hoist house were located west of the shaft pit. The PAL Senior Industrial Historian arrived at 7:30 a.m. and monitored until 12:00 p.m. Monitoring consisted of observing a Caterpillar 3300L with a 60 ft long arm and toothed bucket remove the remainder of the waste rock in the area immediately west of the suspected collapsed shaft. The machine exclusion zone was narrowed, allowing excavation into the area of the collapsed shaft pit. Documentation consisted of digital photography.

The use of only one haul truck using a long access route allowed for slower use of the excavator in this area between truck loading episodes, however, use of the toothed bucket (the straight edged grading bucket used previously was broken) made for greater disturbance. The excavator continued taking take long, shallow, east-to-west passes down to gray undisturbed till. Excavation uncovered the full extent of the two large east-west oriented wood timbers that had their east ends partially exposed at the west lip of the shaft pit. These two timbers were tree trunks approximately two feet in diameter that has been sawn flat on two opposing sides. The remains of several wrought iron pins with larger square retaining washers were observed in the timbers. The area surrounding these timbers contained a scatter of metal artifacts including wrought iron threaded pins, straps, brackets, spikes, bolts and hardware. The area also included several lengths of 1" to 2" diameter iron pipe, one with a bronze faucet at one end. Artifacts also included a broken pickaxe head, and a metal loop with a worn bottom suggesting wear from a rope, cable, chain, etc. A particularly unusual artifact was an approximately 8" diameter cast iron ball with a flat bottom and a broken loop at the top, interpreted as a possible hoist counterweight or piece of rock breaking machinery.

The excavated area corresponds with area of the building west of the enclosed headframe shown in the 1880s photo of the Tyson Shaft. The area where the iron artifacts were found appears to be the location of the boiler room/steam engine hoist house in the photograph. The large horizontal east-west timbers appear to be the sills of the heavy timber headframe that held the hoist cable sheave wheel(s) over the shaft mouth. The lack of expected heavy masonry pads, piers, floor, etc. suggests that these structures were dismantled and possibly recycled elsewhere.

Excavation in pursuit of locating the shaft cap could not be conducted as the excavator could not reach the required area. The machine was slated to be moved to the east side of the shaft to continue excavations.

Elizabeth Mine TP-3 Monitoring
Week of 6-14-10
Matt Kierstead

Monitoring was resumed at the Tyson Shaft #1 Site at the north edge of TP-3, north of the North Open Cut. Waste rock removal continued in and on the east side of the shaft collapse pit, where some sort of shaft cap structure was anticipated. The PAL Senior Industrial Historian was participating in site mapping at the Copperas Brook Corridor and monitored briefly mid-day when wood was encountered at the bottom of an approximately 15 ft deep pit excavated by the Caterpillar 3300L with a 60 ft long arm and toothed bucket. Documentation consisted of digital photography.

Excavation uncovered a flat circular cluster of parallel large east-west oriented square timbers. The timbers deflected downward easily under the gentle pressure of the excavator bucket, indicating a void beneath them. The structure was roughly centered where the bottom of the removed collapse pit had been, in line with the two parallel heavy shaft headframe sill timbers encountered previously. The sides of the cap were delineated by the excavator, but excavation beyond the top surface was not possible because of the depth of the hole and steepness and instability of the pit walls.

APPENDIX F

Summary Report, World War II Buildings Demolition and Waste Rock Removal Monitoring, Elizabeth Mine Site, Strafford and Thetford, Vermont. (Kierstead, Matthew A., 2012). Prepared for U.S. Army Corps of Engineers, Concord, MA. Prepared by: PAL, Inc., Pawtucket, RI.

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SUMMARY REPORT

**WORLD WAR II BUILDINGS DEMOLITION AND
WASTE ROCK REMOVAL MONITORING
ELIZABETH MINE SUPERFUND SITE**

South Strafford, VT

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1.0 Introduction

Nobis Engineering, Inc. (Nobis), in partnership with Weston Solutions, Inc. (Weston), conducted building demolition and mine waste rock removal (work) under contract with the U.S. Environmental Protection Agency (EPA) in the World War II buildings area at the Elizabeth Mine Superfund site at South Strafford, VT during November and December 2011. The ca. 1942 buildings, some already collapsed, and some requiring asbestos abatement, were in deteriorated condition and deemed a safety hazard. PAL, under contract to Nobis, conducted demolition monitoring during critical phases of the work in the WWII buildings area. The purpose of the monitoring was to provide photographic documentation of the work and discoveries, assist with retrieval of mining-related artifacts for onsite storage by the property owner, insure best practices to protect building foundations and associated features, and assist site cleanup staff in making decisions about demolition or retention of features and post-demolition cover design.

This summary report provides a brief site description and an explanation of the monitoring methodology. It presents the results of the monitoring including notable discoveries, disposition of artifacts, and recommendations. Accounts of daily monitoring activities are presented in the Daily Logs (Appendix A). The logs include indexes to dated and numbered digital photographs provided on an attached compact disc (Appendix B).

2.0 Site Description

The WWII-era buildings were arranged in two tiers on man-made terraces east of Mine Road (Figure 1). The buildings were of temporary World War II emergency construction with asphalt roll and shingle roofs, sawn timber roof trusses and wall joists, gypsum board and asphalt shingle sheathing, and non-reinforced concrete raised foundations and slab floors. Several buildings had already collapsed or had been demolished prior to this work campaign. At the time of demolition, the remaining standing buildings in the upper tier of mine support buildings included, from north to south: the Assay Laboratory (an occupied rental property not included in the work), the Office/Warehouse, Machine Shop/Workshop, Air Compressor Building, and Change House and Core Storage Shed. The remaining standing buildings in the lower tier of ore processing buildings included, from north to south: the Thickener (and Filter/Dryer) building, the Concentration (Flotation) Mill, and the Garage. The Thickener and Concentration buildings were framed using heavy timbers salvaged ca. 1942 from an unused granite cutting shed in Bethel, VT. The lower tier area also included exposed and buried ore crusher plant foundations, mine railroad and conveyor trestle support trestle piers, dry-laid stone walls, storage tank saddles, etc. Some of the buildings contained non-friable asbestos-containing materials (ACM) in the form of roll roofing, window glazing, etc.

3.0 Methodology

The monitoring was conducted by PAL Senior Industrial Historian Matthew Kierstead on November 7-11, 14-17, and December 5-7, 2011. Monitoring consisted of observing heavy equipment operators demolish the buildings and remove the debris to an adjacent stockpile area east of the upper tier buildings for burial and remove mine waste materials from inside and outside the foundations. Digital high-resolution photographs were taken of the landscape, buildings, demolition activity, artifacts, etc. The monitor coordinated with Nobis, Weston Solutions, Inc. (Weston), and U.S. Army Corps of Engineers (Corps) site supervisory personnel on daily activities, safety, and work progress and issues. The PAL monitor worked closely with the Northwoods Excavating, Inc. (Northwoods) machine operators regarding excavation approach and technique in critical areas so that artifacts could be retrieved, photographs taken, and in-situ building foundations left undamaged. The PAL monitor identified artifacts for salvage, some of which were relocated to remaining building foundation slabs or placed in explosive storage containers donated and brought on site by Pike Industries, Inc. The PAL monitor coordinated with property owner

Stanley Parker, who was assisted by Scott Reilly of Pike Industries, regarding location and transfer of artifacts to the storage containers. During the two weeks of monitoring in November the buildings underwent removal of ACM. The PAL monitor coordinated with Weston safety personnel and the ACM crew supervisor regarding safe viewing locations. During ACM removal the monitor observed demolition through binoculars from vantage points outside the ACM exclusion zone, with periodic approval to enter for photography and inspection. Daily Logs summarizing monitoring activity were filed with Nobis. The Daily Logs are included in Appendix A of this report. Field photos were edited and images selected to accompany the Daily Logs. These photos are provided on CD in Appendix B of the report. DVDs containing all photographs taken during the monitoring were provided to Nobis and the property owner (Appendix C).

4.0 Building Demolition and Monitoring Results

The Daily Logs and photographs include all monitoring results. Numerous artifacts were retrieved from the buildings and relocated to adjacent building foundation slabs or the storage containers. The monitoring included some particularly noteworthy events and/or unexpected findings, summarized below by tier and by building. The PAL monitor photographed most of the retrieved artifacts. No artifact inventory was made by the PAL monitor as that task was not included in the monitoring work scope. The described location of artifacts reflects their disposition at the end of the monitoring campaign. Some artifacts may have been moved subsequently. The status of a property owner-generated artifact inventory, if any, is unknown.

Upper Tier Buildings

The upper tier buildings were originally scheduled for demolition in spring 2012; demolition was rescheduled for this fall 2011 campaign to take advantage of the availability of the ACM contractor. At the time of demolition, the remaining standing work area buildings in the upper tier of mine support buildings included, from north to south, the Office/Warehouse, Machine Shop/Workshop, Air Compressor Building, Change House and Core Storage Shed. As originally planned, the Change House was to be demolished and the Machine Shop left standing for property owner use including storage of large-scale historic mining artifacts. During demolition, inspection of the buildings revealed that the Change House was in better structural condition and negotiations with the property resulted in reversal of the demolition plans for these two buildings.

Office/Warehouse

The Office/Warehouse front (east) porch had been demolished prior to monitoring as it presented a hazard to site service vehicles. This demolition also resulted in the inward collapse of the east wall, revealing rows of tilted storage shelves and numerous artifacts. During demolition, the property owner Stan Parker, assisted by his brother and Scott Reilly (Pike) coordinated with the Northwoods machine operator and were periodically allowed to access the demolished portions of the building to retrieve many dozens of artifacts, including tools, electrical and mechanical parts, signage, paperwork, etc. The artifacts were moved by the owner to the onsite storage containers. The two-story concrete walk-in safe tower in the northwest corner of the building and its wood frame gable roof were left intact along with the low concrete walls and foundation slab, which was cleaned and swept.

Machine Shop/Workshop

The adjacent Machine Shop/Workshop contained a diesel-powered mine locomotive in the southwest corner and overhead machine line shafting and pulleys on the roof trusses along the east wall. Prior to demolition a machine operator pulled the locomotive horizontally out of the building with a chain and

then lifted it and moved it to the adjacent Air Compressor Building's concrete foundation slab. The line shafting was carefully removed during removal of the roof and also relocated to the Air Compressor Building slab. Once the demolition debris were removed and the foundation slab swept, the PAL monitor photographed remaining features including the bases for the blacksmith's gas-fired forge and anvil, and a rectangular area of end-grain wood blocks, possibly for a drop forge. The west third of the foundation included a covered basement and access stairway, which were filled with stone to the top of the foundation as a safety precaution. This building's floor slab is in better condition than the adjacent Air Compressor Building slab and the PAL monitor recommended it as a better location for the location of large salvaged artifacts.

Air Compressor Building

The Air Compressor Building roof had previously collapsed from heavy snow load. The collapsed roof was lying on top of partially exposed air compressor, tanks, pipes and electrical equipment. Closer inspection indicated the presence of additional large artifacts under the collapsed roof. The PAL monitor observed the careful removal of the roof using combined machine and hand clearing. Removal revealed an intact Ingersoll-Rand Imperial Type 10 compressor with an approximately 10 ft diameter flywheel and its associated plumbing and electrical equipment. The compressor was left in place. Associated electrical equipment including a circuit breaker and Westinghouse switch cabinet contained asbestos and possible PCBs and could not be retained. Additional artifacts included two, four-wheeled shop carts, large pulleys, a hanging beam scale, and a large dial indicator for a mine hoist or truck scale. A 4,000 cfm Roots-type air pump (apparently used to provide fresh air underground), a safe, and an 1890s patented Mead-Morrison compressed air hoist were also salvaged. The PAL monitor attached orange flagging to artifacts of mining significance. The concrete foundation slab incorporated cast trenches and filled rectangular voids that have settled and cracked over time, resulting in an uneven floor surface. The PAL monitor recommended the smoother floor slab of the Machine Shop/Workshop as a better location for the location of large salvaged artifacts.

Change House

The Change House was left standing per negotiations with the property owner. No artifacts were removed or relocated from or to the building during the monitoring campaign. The property owner proposes to stabilize the structure, possibly with materials assistance from EPA. The significant Change House mining-related artifacts had already been flagged, photographed and inventoried by PAL as part of earlier work previous to the monitoring campaign.

Core Storage Shed

The open-sided Core Storage Shed at the south end of the upper tier buildings contained several large plastic froth flotation tubs, metal tanks, and other ore processing plant artifacts. The PAL monitor, property owner and Scott Reilly identified mining artifacts for salvage. The property owner removed them and placed them adjacent to the structure, which was subsequently demolished.

Lower Tier Buildings

The remaining standing buildings in the lower tier of ore processing buildings included, from north to south, the Thickener (and Filter/Dryer) building, the Concentration (Flotation) Mill, and the Garage. The Thickener and Concentration buildings were framed using heavy timbers salvaged ca. 1942 from an unused granite cutting shed in Bethel, VT. The lower tier area also included exposed and buried ore crusher plant foundations, mine railroad and conveyor trestle support trestle piers, dry-laid stone walls, storage tank saddles, etc.

Thickener (and Filter/Dryer) Building

Demolition of the Thickener Building required removal of the array of vertical concrete tank support posts in the ground floor of the main building, which were photographed by the PAL monitor. The supports for the adjacent pyrrhotite tank, which consisted of parallel diagonal concrete walls, had been damaged by previous demolition activities. Removal of debris from an alley between the tank room and the copper ore bin revealed an Oliver pump, a smaller pump, and a Fairbanks scale for weighing ore transport trucks. This mechanical equipment was cleaned, photographed and left in place. Several representative heavy structural timbers were salvaged at the request of the property owner. It was also thought that some of these timbers might be of interpretive value for showing the robust construction of the mill. As the debris was removed from around and over the copper ore storage bin, it became apparent that the structure was intact and its twelve heavy timber bents were laterally stabilized by the remaining bin floor structure and horizontal and diagonal braces on its west side, information provided to Corps by the PAL monitor in a field sketch (Figure 2). The PAL monitor suggested that this structure be left in place to better interpret the building's function and heavy timber construction elements. A U.S. Army Corps engineer inspected the structure and concurred that it could be safely left in place. The PAL monitor recommended an overhanging metal roof be placed on this structure to keep the elements away from the wood and prolong its life. The easternmost wall of the building, a freestanding wall that originally supported the east side of the pyrrhotite ore bin, had to be removed as part of waste rock removal. The PAL monitor photographed and measured the wall, and Weston staff took GPS points at its corners before it was demolished. Numerous loose metal artifacts were stockpiled for relocation to the storage containers by the property owner.

Concentration (Flotation) Mill

The Concentration Mill was already largely collapsed prior to commencement of demolition. Demolition included salvage of several representative long roof timbers at the request of the property owner. The machine operator attempted to save a large banded wood stave flotation reagent mixing tank perched in the upper southwest corner of the building; however, the tank could not be removed intact as it was connected to the debris by extensive plumbing. The PAL monitor photographed the tank before it was demolished. Removal of the collapsed ca. 1948 auxiliary ore storage silo remains on the south side of the building revealed a multi-sided concrete base with three conveyor hopper openings in its upper surface. The PAL monitor photographed the exposed openings before they were backfilled. Weston staff took GPS points around the perimeter of the structure. The east wall of the building foundation, which did not appear to incorporate steel reinforcing rods, was broken and leaning away from the floor slab. This wall was deemed a safety hazard and was demolished. Numerous loose metal artifacts were stockpiled for relocation to the storage containers by the property owner.

1942 Crusher Building

Most of the foundations of the ca. 1942 Crusher Building were already exposed prior to the beginning waste rock removal. Additional waste rock removal at the west edge, the site of its associated ore bin revealed a steel ore chute and the concrete floor and support timbers of the bin. These resources were photographed by the PAL monitor and GPS points were taken by Weston staff.

Garage

Demolition of the garage revealed that it had a dirt floor. The foundation walls did not incorporate steel reinforcing rods, and were cracked and bending. The walls were also surrounded by mine waste, some associated with the late nineteenth-century Tyson ore roast bed complex (see below).

Lower Tier: Additional Discoveries

1949 Crusher Plant

Waste rock removal in the northwest portion of the lower tier area revealed the buried foundations of the ca. 1949 crusher plant, including the concrete and timber ore bin structure and associated machinery bases. These resources were photographed by the PAL monitor and GPS points were taken by Weston staff. Because the slope in this area which is immediately east of the Assay Laboratory was steep and unstable, the foundations were buried as part of slope stabilization. One unusual feature recorded during monitoring was intact sections of narrow gauge mine car railway with wrought iron rails, bolted strap joint bars, and round timber ties on approximately one yard centers. This buried mine railway track was in situ north and south of the crusher. The gauge of the rail, location, axis, and depth of burial suggested that it may have been part of the ore handling system associated with August Heckscher's last, ca. WWI-era smelting campaign, and may have connected the early (Tyson) ore processing mill outside the 1898 Adit with the smelter site on the slope to the north.

Tyson Ore Roast Beds

Waste rock removal along the east edge of the lower tier buildings encountered the late nineteenth-century Tyson-era operations ore roast beds; the distinctive black, red and orange banded ore roast bed soil profile was visible for at least 100 feet on a north-south axis where waste rock had been removed at the Garage foundation and north and south of the east end of the Thickeners/Dryer Building.

5.0 Additional Monitoring Campaign Task

Coordination on Cover Design

Demolition of the lower tier ore processing buildings exposed massive concrete foundation walls, tiered levels of concrete slab floors, concrete machinery mounting piers and pads, and a timber ore storage bin support structure, all previously hidden by the buildings and their collapse debris. The forms and relationships of these structural features clearly express the relative locations of the ore storage, transportation and processing machinery within the buildings, information only previously interpreted in the written process description and flow chart drawing (Sheet 4 of 4) in the PAL WWII-era HAER documentation (Figure 3). The PAL monitor concluded that long-term visibility of this landscape is of potential interpretive value. The PAL monitor spoke to Nobis/Weston and Corps staff regarding the plans for site grading and cover after waste rock removal and recommended an approach that would inhibit growth of vegetation, especially trees that could damage the foundations and obscure them from view in future. The PAL monitor provided a sketch plan for placement of crushed rock around the foundations and extending out at a 45-degree angle from them to the west toe of TP-1 to provide an enhanced view of the foundations, particularly from the east (top of west edge of TP-1).

Tyson Ore Mill Site

The Tyson Ore Mill Site, located at the northwest corner of TP-2, contains exposed and presumably buried features including stone walls and concrete foundations and machinery pads. These features were previously recorded by PAL during the reconnaissance survey (PAL 2002) and again more recently by Total Station electronic transit when additional concrete features were exposed by test trenching in the mill area. The PAL monitor examined proposed project grading plans to determine where excavation and/or filling would be taking place. PAL was concerned that waste rock removal and re-contouring in this area would impact the mill remains. The area of concern for Tyson Mill remains will not be

excavated, rather, it will be covered by fill. Based on current grading plans, PAL does not recommend any further monitoring or mapping in the Tyson Mill area.

South Mine Shaft Site Inspection

During the World War II building demolition monitoring, Nobis/Weston staff asked the PAL monitor to accompany them to the South Mine site to inspect the waste rock removal limits and underground workings heavy equipment safety exclusion zone to determine possible impacts to historic mining resources around the shaft site, a watered depression immediately south of Copperas Road. Other than vertical planks previously observed at times of low water and a scattering of mostly non-sulfidic shaft development rock, no other visible historic resources are visible in the vicinity of the shaft, which appears to have been an abortive element of the early, short-lived and mostly surface mining at the South Mine. The PAL monitor determined that given the nature of the resource and the buffer provided by the underground workings heavy equipment safety exclusion zone, no further monitoring or documentation was required at the shaft.

Review of Judd Collection

The Strafford Historical Society (SHS) recently received a donation of Elizabeth Mine-related materials. The SHS inventory for the "CARRIE AND CHARLES JUDD HISTORICAL ARTICLES ON STRAFFORD AND ON THE ELIZABETH MINE" (Donated by Richard Josler, Sept. 2011) is included in Appendix D of this report. The PAL Senior Industrial Historian visited the SHS archives for three hours on December 7, 2011 to briefly inspect this new collection. The collection was originally the property of Charles Judd. Judd was the longest-serving employee of the Elizabeth Mine in its last period of operation, 1942 to 1958. After first working as a carpenter on the mine buildings, he worked underground as a rigger and timber boss, in charge of shoring up excavated areas as needed. By the time the mine closed, he was assistant mine supervisor and in charge of all underground operations. The collection contains many dozens of newspaper article clippings, too numerous to read on this short visit. Perusal of the article headlines and several articles relevant to the WW II-era ore processing indicated that the articles contain information on mine-related planning, personalities, and activity in the period before, during and after WW II. The collection also includes previously unseen photographs of 1940s-1950s operations, including several photographs showing the locations of machinery on the concrete piers inside the ore processing mill buildings. This collection appears to have the potential to add some depth to current understanding of the WWII-era operations at the mine.

6.0 Recommendations

Recordation

The WWII building foundations should be a focus of the next round of aerial photography, and should be photographed from above and at oblique angles from as low an altitude as is safe and practical.

The demolition of the WWII "lower tier" ore processing buildings exposed structures that clearly express important information about ore movement and processing previously only shown in the HAER documentation drawings. This new information could be presented through inclusion of several additional large-format 4 x 5 black-and-white film photographs of the exposed "lower tier" building foundations from surrounding elevated vantage points, and of the exposed mechanical equipment in the upper and lower tier buildings. The HAER narrative could also be revised to note the new equipment and supplemented with a diagram showing the actual physical locations of the ore processing equipment on the support piers within the foundations. The lower tier ore processing building foundation walls, machinery pads and piers should be mapped, and the machines and process flow should be plotted on

photos and/or maps of the foundations as was done for the Ely Mine flotation mill in PAL's report for that site. Should the existing Historic American Engineering Record (HAER) documentation of the WWII-era resources be repackaged for submittal to HAER and the Library of Congress, inclusion of this new photography and mapping narrative should be considered.

Protection for Ore Bin Timber Supports

The lower tier Thickener Building pyrrhotite iron ore storage bin timber supports that were retained in situ should be protected from the elements by the construction of an overhanging metal shed roof shelter to keep rain and snow away from the timbers to prolong the life of the structure.

Judd Collection

Should the existing Historic American Engineering Record (HAER) documentation of the WWII-era resources be repackaged for submittal to HAER and the Library of Congress (see above), review and inclusion of the SHS Judd material in the HAER written narrative should be considered.

References Cited

O'Brien, Dennis and Matthew Kierstead

- 2003 *Vermont Copper Company, Inc. Elizabeth Mine 1942-1958*. Historic American Engineering Record, Elizabeth Mine Recording Project, South Strafford, VT. Four sheets. PAL Report No. 1237.04. Submitted to the Army Corps of Engineers, Concord, MA.

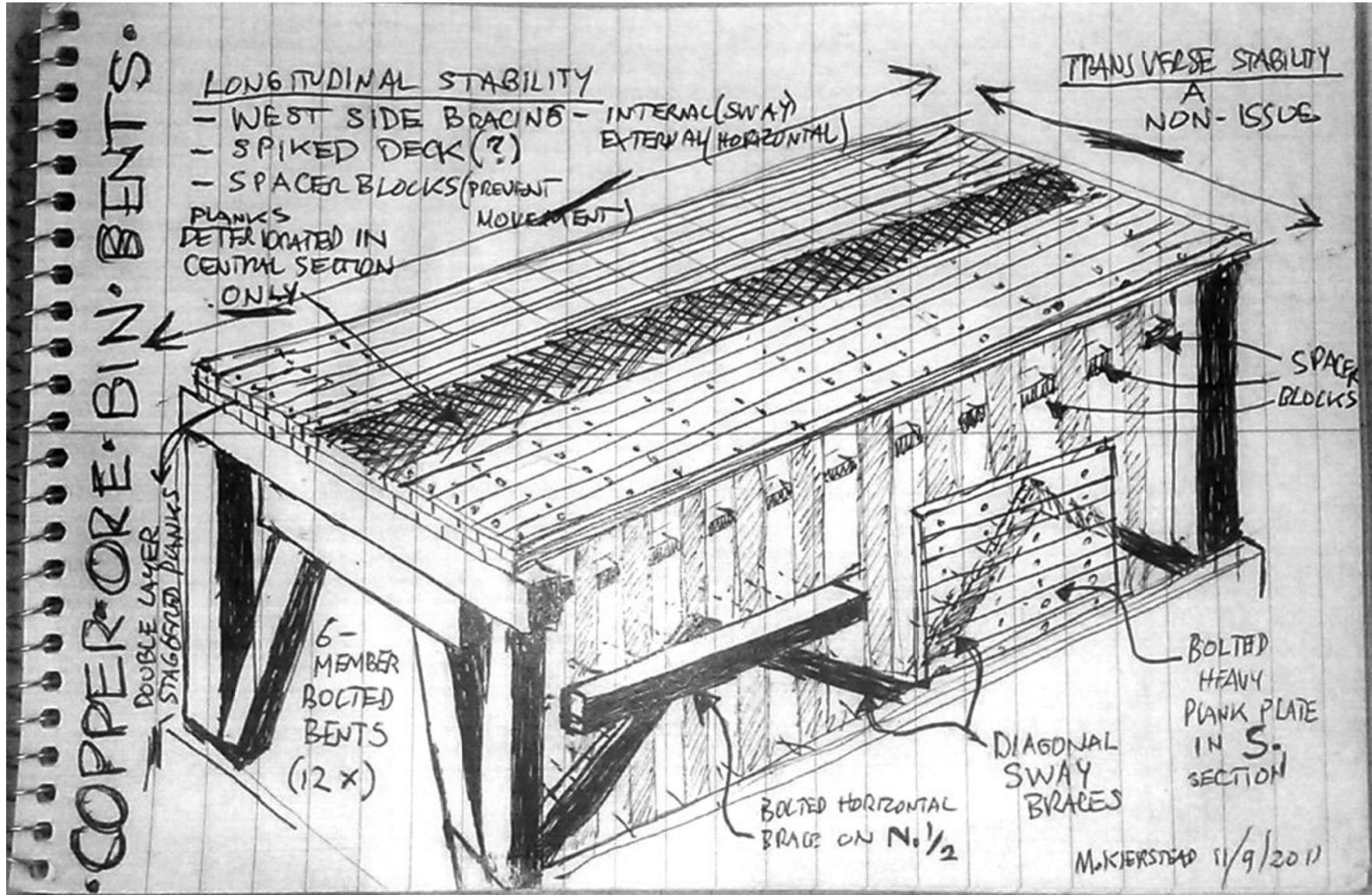


Figure 2. Elizabeth Mine: WW II Ore Concentration Mill, 2011 field sketch of copper ore concentrate bin timber support structure.

APPENDIX A

DAILY MONITORING FIELDWORK LOGS, NOVEMBER-DECEMBER 2011



DAILY SURVEY LOG

DATE: 11/7/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	60 degrees and sunny
Hours worked:	8 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL Cultural Resource Monitor (CRM) Matt Kierstead signed in at 8:15 a.m. and proceeded to the WWII lower buildings. Kierstead took existing conditions photographs of the Garage, Flotation Mill, Thickener Building and crusher piers while asbestos monitoring equipment was set up and other site preparations were made. Ed Benton of Weston Solutions provided oversight. Tim Ulman of Northwoods Excavating operated the backhoe and directed heavy equipment. Demolition began with the Garage which was wetted down, crushed with the backhoe and the debris trucked to the disposal area directly southwest. Property owner Stan Parker retrieved several truck parts prior to demolition. The PAL monitor observed the demolition and took digital pictures. No significant historic mining artifacts were anticipated or found. Once the debris was cleared it was apparent that the rear (west) wall has bowed to the east and is cracked in places. The floor is dirt, not concrete. The foundation was left standing but may not be a good candidate for preservation based on condition. After the Garage was</p>

demolished the crew broke for lunch.

After lunch work began on the Flotation Mill, which required removal of non-friable asbestos-containing material (ACM). The PAL monitor watched Tim Ulman lift, sort and load wetted collapsed building materials from the east and south exterior and east interior bay of the building into dump trucks from a safe distance outside the ACM exclusion zone using binoculars, and also took photographs. No significant portable size artifacts were observed. The PAL monitor and Tim Ulman discussed the possibility of salvaging a large plank stave flotation reagent mixing tank perched on the east face of the standing remains of the mill. Subsequent removal of adjacent collapsed building materials caused the tank to move and revealed that its condition and integration with the mill frame and plumbing would make removal impossible without destroying the tank. Once ACM removal was stopped the PAL monitor was allowed to approach the tank to take detail photographs. Additional photos of the tank will be taken Tuesday a.m.

The PAL monitor discussed the possibility of leaving the Thickenner Building chalcopyrite ore storage bin timber support structure in place for interpretation if safe and practical. The monitor discussed this with Benton and also Mario Ilagan of Weston, and followed up with a call to Ed Hathaway (EPA). Discussion will continue on site Tuesday. The PAL monitor signed out at 4:15 p.m.

Index to Photos:

1. Garage and Thickenner Building (L to R), looking SW
2. Concentration Mill and Thicker Building, looking NW
3. Building demolition debris stockpile area, with Office/Warehouse, Concentration Mill and Thickenner Building, looking N
4. Garage looking NW



DAILY SURVEY LOG

	<ol style="list-style-type: none">5. Garage demolition, looking W6. Cleared garage foundation (note bow in W wall), looking NW7. 1942 Crusher Building foundations, looking NW8. Crushed ore conveyor belt trestle piers and tank saddles, looking W9. Concentration Mill ruins, looking NW10. Concentrating Mill flotation reagent tank, looking NW
Out of Scope Work:	None



DAILY SURVEY LOG

DATE: 11/8/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	60 degrees and sunny
Hours worked:	9.25 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL CRM Kierstead signed in at 6:45 a.m. and proceeded to the WWII buildings where demolition and ACM removal with Weston (Benton) oversight and Northwoods (Ulman) machine operation continued. Kierstead continued observation, photography and artifact salvage in coordination with Benton, Ulman and the ACM removal crew.</p> <p>Benton, Ilagan and Chris Caisse (US Army Corps) concurred regarding the Thickener Building ore bin timber support retention approach and instructed Ulman to strip surrounding structure to expose supports to determine if retention is possible. Debris was removed from the pyrrhotite thickener area and Kierstead was allowed to photograph the building interior from an opening in the North wall. The building was demolished from West to east. Several long horizontal timbers were carefully removed and stockpiled at the owner's request. Ulman removed two of the ore bin walls exposing and cleaning its sloping plank floors for Kierstead to photograph from outside the ACM exclusion zone</p>

with a telephoto lens. Debris removal on the east side of the bin revealed water heater parts, possibly associated with the ore concentrate dryer, as well as a steel narrow gauge mine car axle with flanged wheels. The heater parts will be removed by the ACM crew; the mine car axle will be given to the property owner. Clearing around the rest of the bin supports to determine how they are connected and if they can be left in situ will continue on Wednesday.

Demolition of the Flotation Mill was also conducted. Ulman first stripped the roof off the rear (west) shed to allow Kierstead to photograph two wood stave flotation reagent mixing tanks. Demolition then proceeded rapidly from West to east. The wood tank identified Monday could not be salvaged. A steel valve wheel was retrieved and relocated to the property owner's storage area.

Kierstead walked the Lower Buildings with Benton to discuss the select areas where PAL monitoring of waste rock removal should be conducted. These critical areas include the two crusher plant foundations and the concrete piers and tank saddles, all North of the Flotation Mill and West of the Thickener Building.

At close of work both Lower Tier WWII buildings were largely demolished, debris wetted and crushed and removal to the stockpile underway. Monitoring Wednesday will include observing for artifacts in debris including known machinery in the Thickener Building and resolution of retention of its timber ore bin bents.

The PAL monitor signed out at 4:00 p.m.

Index to Photos:

1. Thickener Building interior, wood framing, looking S
2. Thickener Building interior, tank support piers, looking S

DAILY SURVEY LOG

	<p>3. Thickener Building demolition, looking S</p> <p>4. Thickener Building Demolition, looking NE</p> <p>5. Garage foundation, Concentration Mill and Thickener Building (L to R), looking NW</p> <p>6. Ca. 1949 Crusher foundation in foreground with Thickener Building demolition in background, looking SE</p> <p>7. Thickener Building copper ore bin, partial demolition, looking SE</p> <p>8. 1942 Crusher foundations, looking S</p> <p>9. Concentration Mill demolition of west lean-to shed, looking NE</p> <p>10. Concentration Mill, west lean-to shed, flotation chemical tubs, looking SE</p>
Out of Scope Work:	None



DAILY SURVEY LOG

DATE: 11/9/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	60 degrees and sunny
Hours worked:	8.75 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL CRM Kierstead arrived at the site at 6:25 a.m. Demolition monitoring and photographic documentation at the lower tier WWII buildings continued.</p> <p>At the Thickener Building, several artifacts were retrieved including two narrow gauge mine car axle and wheel sets and approximately one dozen long timbers, previously part of the Bethel, VT granite shed, that were placed in the property owner's salvage area. The multiple rows of concrete posts that originally supported the copper ore thickener were exposed and photographed before they are impacted further by debris excavation. The piers are fragile and it is unlikely all will remain upright during debris removal or can be retained. The metal tank and sectional cast iron boiler, possibly part of the ore drying equipment, contained asbestos and were handled by the ACM contractor. All artifacts were photographed by the PAL CRM. The fourteen standing timber ore bin support bents were cleared of surrounding debris and will be inspected by Corps and Weston</p>

staff Thursday to decide if they possess structural stability and can be retained.

The Flotation Mill's east wall was found to be in poor condition and was removed. The east section of the south wall was bent inward to the North by the weight and motion of the backhoe. The stepped sections of south wall extending West are leaning into the foundation from the weight of soil and waste rock outside the wall. The PAL CRM discussed the impacts to walls with Northwoods' Tim Ulman. The walls appear to contain little or no reinforcing bar where they meet the floors and are prone to breakage at the joint from weight and pressure. Access to interior debris is difficult without a long arm excavator which is cost prohibitive. Effort will be made to avoid backhoe tracks on top of walls where possible. The upper portion of decayed ore from the south auxiliary ore silo was removed for backhoe access, revealing multiple steel rod hoops that held the concrete bin staves together.

Both buildings had been cleared of most of the demolition debris by the end of the day. Both, as well as the adjacent primary crusher foundations, clearly present their tiered construction and gravity-aided process flow when viewed from TP-1.

Demolition of the upper tier of WWII buildings, originally slated for next spring, is now slated for next week. Kierstead discussed specific monitoring needs for those buildings with Weston's Benton and Ilagan. Waste rock removal monitoring priorities now also include observing excavation east of the Garage foundation to confirm location of ca. 1900 Tyson ore roast beds. Schedules for this work need to be refined.

The PAL CRM left the site at 4:00 p.m.

Index to Photos:

1. Lower tier area after building demolition, looking NW
2. Tank, heater and timbers salvaged from Thickener Building,

DAILY SURVEY LOG

	<p>looking NW</p> <p>3. Thickener Building tank support piers, agitator motor support beam tower, and copper ore bin supports, looking E</p> <p>4. Flotation tank agitators recovered from Concentration Mill, looking W</p> <p>5. Thickener Building agitator motor support beam towers and copper ore bin supports, looking SE</p> <p>6. Thickener Building copper ore bin supports, looking NW</p> <p>7. Mine car axle and wheels found in Thickener Building</p> <p>8. Concentration Mill demolition, looking NW</p>
Out of Scope Work:	None



DAILY SURVEY LOG

DATE: 11/10/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	55 degrees and sunny
Hours worked:	9 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL CRM Kierstead arrived at 6:30 a.m. Monitoring of WWII lower tier building demolition continued. The monitor watched with binoculars from elevated spots outside the ACM exclusion zone with periodic approval to enter for photography and inspection.</p> <p>Morning work focused on the interior of the Thickener Building. A smaller, tracked backhoe was used and timbers and concrete piers were used to build up a ramp to cross the North foundation wall without damaging it. All interior concrete thickener support piers were removed to facilitate removal of several truckloads of ACM and soil. The tracked excavator was equipped with a straight edged cleanup bucket with thumb which enabled floors to be scraped clean. The bay between the ore bin supports and main interior foundation contains a compressor or pump as well as what appears to be a beam scale. This area is recommended for hand clearing to protect the machinery.</p>

DAILY SURVEY LOG

The operator and ACM removal crew worked together to clear demolition debris and ACM from multiple areas within, between and outside different levels of both buildings. Two steel ball mill grinding balls were found and left at the owner's storage area. Numerous large industrial artifacts are now scattered around the foundations in piles, awaiting relocation to the owner's storage area. The monitor observed a sheet metal flotation reagent mixing hopper in the debris stockpile area; it was moved to the edge of the haul road for safety.

Afternoon work focused on the Flotation Mill. The operator and ACM crew removed debris from the upper level bays which are filled with water to unknown depth. They are proposed to be filled with soil for safety. Ulman conducted excavation of the auxiliary crushed ore bin at the SW corner, removing ore, broken concrete staves and iron binder hoops. Excavation to the bottom uncovered three rectangular ore chutes above a conveyor pit. The chutes and pit were filled for safety and will be excavated Friday. It is unclear if the floor with the chute openings will be retained or demolished.

The monitor examined the standing copper ore storage bin supports to determine presence and type of longitudinal bracing to support the idea of leaving the supports in place. The monitor drew the attached sketch which he shared with Caisse (Army Corps). The monitor inspected the structure with Caisse, Ilagan and Shelby. All concur that the structure appears stable. Corps will bring in a structural engineer to confirm. Retention will require hand cleaning to removed loose elevated debris.

The Upper Tier buildings are now slated for demolition next week; Kierstead will be there to monitor.

The PAL monitor left the site at 3:30 p.m.

Index to Photos:

1. Hole containing timbers at site of 1949 Crusher

DAILY SURVEY LOG

	<ol style="list-style-type: none"> 2. Steel flotation reagent mixing hopper from Concentration Mill 3. Ore roasting soils east of garage 4. Ore grinding mill grinding ball found near Concentrating Mill 5. Lower Tier demolition progress, looking S 6. Concentration Mill foundation, looking W 7. Thickener Building foundation, looking NE 8. Concentration Mill ore silo, conveyor pockets 9. Concentration Mill conveyor chute door 10. Office/Warehouse, looking SW
Out of Scope Work:	None



DAILY SURVEY LOG

DATE: 11/11/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	45 degrees and sunny
Hours worked:	5.5 hours on site (holiday)
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL Monitor Matt Kierstead arrived on site at 6:30 a.m. and proceeded to the lower Tier WWII buildings. Demolition debris and ACM removal resumed in the southwest corner of the Flotation Mill, using a smaller excavator with a flat blade cleanup bucket with a thumb. The monitor observed from outside the ACM removal exclusion zone and coordinated with the ACM crew on entry for photography. The machine operator built an earth ramp to reach the debris in the south portion of the Upper bays of the mill. The operator used the bucket to clean oxidized ore from the concrete floor of the collapsed ore bin, exposing the three rectangular conveyor chute openings. The PAL CRM was permitted to approach the cleared floor to photograph the openings.</p> <p>The lower tier buildings ACM and debris removal moved to the timber copper ore bin structure at the east side of the Thickener Building. The excavator was used to remove a flathead truck engine and transmission and a derelict vehicle from beneath the</p>

structure. Debris was removed from the bay West of the structure, revealing the beam scale for the truck weight measuring scale. The PAL Monitor was permitted to enter and photograph the scale. The ACM crew and machine operator continued to clean off the structure to remove loose debris and expose the compressor or pump located northeast of the structure. The builder's plate indicates that it was made by Oliver in California. Additional photography of the pump, scale, bin and foundations will be performed on Monday.

Now that the lower Tier WWII buildings are cleared of debris, the locations and relationships of the ore processing machinery that was removed is now apparent. PAL recommends that the foundations be a focus of the next round of aerial photography, and that the machinery locations and process flow be plotted on photos or drawings of the foundations as was done for the Ely Mine Flotation Mill in PAL's report for that site.

Kierstead spoke to Caisse (Corps) regarding the plans for site grading and cover after waste rock removal so as to best inhibit vegetation, especially trees, that could damage the foundations and obscure them from view in future. Caisse will discuss possible alternatives with Ed Hathaway (EPA).

The PAL CRM left the site at 12:00 p.m.

Index to Photos:

1. Concentration Mill ore silo conveyor chute pockets, looking SE
2. Conveyor outlet to mill, looking S
3. Concentration Mill foundation, looking NE
4. Concentration Mill foundation, looking SW
5. Thickener Building, ore truck weighing scale, looking NE



DAILY SURVEY LOG

Out of Scope Work:	None
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DAILY SURVEY LOG

DATE: 11/14/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	55 degrees and sunny
Hours worked:	9.5 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>The PAL CRM arrived on site at 6:30 a.m. Demolition and ACM removal monitoring began today at the Upper Tier of WWII buildings. Work today focused on the already collapsed Compressor Building. The ACM crew taped off the exclusion zone and set up air monitoring equipment. PAL Monitor Kierstead observed the activity from the slope West of the building. The ruins were thoroughly wetted by the water truck before and several times during debris removal, conducted with a backhoe with toothed bucket and thumb from the east side of the foundation. All debris was treated as ACM and moved to the stockpile in lined trucks.</p> <p>As debris removal progressed from east to West numerous artifacts were encountered. Kierstead communicated with the ACM crew and machine operator to identify and stockpile mining-related artifacts as well as other metal artifacts salvaged for the property owner. Mining artifacts included two wheeled shop carts, large pulleys, a hanging beam scale, and a large dial</p>

indicator for a mine hoist or truck scale. A 4,000 cfm Roots blower, apparently used to provide fresh air underground, a safe, and an 1890s patented Mead-Morrison compressed air hoist were also salvaged. Removal of the collapsed roof uncovered a large Ingersoll-Rand Imperial Type 10 air compressor with an approximately 10 ft diameter flywheel. The compressor will remain in place. Associated electrical equipment including a circuit breaker and Westinghouse cabinet contained asbestos and possible PCBs and could not be retained. The PAL Monitor was permitted entry to the work area to photograph the artifacts when deemed safe by the ACM crew.

The debris was removed from all but small areas outside the walls by the end of the day. As no protective ramp was built over the east foundation, two slots were ground into the wall by the backhoe treads. Some walls have settled, and the concrete slab floor has several cracks and heaved sections.

The monitor left the site at 4:00 p.m. Demolition of the Office Building/Warehouse is anticipated for Tuesday. The owner has identified several artifacts for salvage and will be on site to help identify them. The Wash House will now be left standing instead of the Machine Shop as originally planned; it is unclear when the demolition of the latter building will take place.

Index to Photos:

1. Office/Warehouse looking NW
2. Machine Shop looking SW
3. Change House looking SE
4. Compressor House ruins looking NE
5. Air compressor after partial clearing, looking E
6. Compressor electrical equipment, looking SW

DAILY SURVEY LOG

	<ul style="list-style-type: none">7. Roots-type air pump8. Compressed air hoist9. Hoist or scale indicator dial10. Shop cart11. Safe
Out of Scope Work:	None



DAILY SURVEY LOG

DATE: 11/15/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	50 degrees and sunny
Hours worked:	5.5 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>The PAL CRM arrived on site at 6:30 a.m. The ACM crew completed cleanup at the Compressor Building. PAL CRM Kierstead completed photography of the foundation, compressor and other artifacts at the Compressor Building.</p> <p>Demolition then proceeded immediately north to the Machine Shop/Blacksmith Shop. The machine operator dragged a diesel mine locomotive out of the building and then lifted it with chains and deposited it on the exposed concrete slab foundation of the Compressor Building. The ACM crew, PAL CRM and property owner identified overhead lineshafting, a chainfall for salvage and the blacksmith's forge base for avoidance. Demolition then proceeded from south to north.</p> <p>CRM Kierstead discussed the demolition approach for the Office/Warehouse, to be demolished tomorrow (Wednesday). Tim Ulman will carefully remove debris from the collapsed Warehouse allowing PAL to observe and direct salvage as well as</p>



DAILY SURVEY LOG

	<p>allow the property owner the opportunity to retrieve artifacts. The walk-in safe tower will remain in place if structurally safe.</p> <p>As there were no remaining critical monitoring issues with the Machine Shop/Blacksmith Shop, the PAL CRM left the site at 12:00 p.m.</p> <p>Index to Photos:</p> <ol style="list-style-type: none"> 1. Machine Shop floor showing mine rail service track, looking E 2. Mine locomotive being readied for transfer to Compressor House floor, looking SE 3. Locomotive 4. Compressor House floor looking S 5. Air compressor intakes, looking SE 6. Ingersoll-Rand Imperial Type 10 compressor, looking SE 7. Compressor looking NW 8. Compressor looking SW 9. Demolition of Machine Shop, looking NW
Out of Scope Work:	None

DATE: 11/16/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	45 degrees and sunny
Hours worked:	5.5 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL CRM Kierstead arrived on site at 6:30 a.m. and proceeded to the Upper Tier WWII buildings. The ACM crew began work by completing cleanup at the Machine Shop/Blacksmith Shop Building. Kierstead photographed the foundation and details including the bases of the blacksmith forge, anvil and a rectangular area of end grain wood blocks in the floor that may have been for a forge hammer.</p> <p>Activity moved to the adjacent Office/Warehouse. Operator Ulman removed the ACM sheathed porch roof and debris along the east edge and the south wall, exposing the interior storage shelves. Property owner Stan Parker and brother Ed were permitted to enter to retrieve items from the shelves, mostly replacement mechanical parts. Kierstead photographed several of the artifacts. Demolition ended early to accommodate an employee lunch for the Northwoods equipment operators.</p> <p>CRM Kierstead and property owner Parker then inspected the</p>

open sided shed south of the Change House (Washhouse) for artifacts for salvage. Identified artifacts include three cylindrical steel vessels and several thick plastic rectangular flotation tubs.

Kierstead consulted with Ilagan (Weston) and Parker regarding moving the ore skip, electric locomotive and locomotive drive wheels to the Machine Shop/Backsmith Shop foundation slab as well as the mining-related large artifacts found in the Compressor Building. The Machine Shop floor slab is in better condition and would provide a location for the owner to clean and tarp the artifacts. This activity may be conducted this week or during the waste rock removal campaign, pending availability of mechanical and labor resources.

At the invitation of Parker, Kierstead inspected the artifact storage containers provided by Pike Industries. Two of the three containers contain a wide variety of mostly mine-related artifacts. The status of inventory is unknown.

The PAL CRM departed the site at 12:00 p.m.

Index to Photos:

1. Machine Shop floor, looking SW
2. Machine Shop floor, blacksmiths anvil and gas forge bases, looking SE
3. Machine Shop floor, possible drop forge base, looking NE
4. Machine Shop, N basement entrance, looking SW
5. Core Shed, looking N
6. Office/Warehouse demolition, looking SW
7. Office/Warehouse demolition, looking W
8. Mine employee ID tags (previously retrieved by Stan Parker)

	<p>9. Mine Co. sign</p> <p>10. Safety glasses</p> <p>11. On-site artifact storage containers, looking E</p> <p>12. Mine signs</p> <p>13. Artifact storage container, interior view</p> <p>14. Artifact storage container, interior view</p> <p>15. Artifact storage container, interior view</p> <p>16. Artifact storage container, interior view</p> <p>17. Artifact storage container, interior view</p> <p>18. Artifact storage container, interior view</p> <p>19. Artifact storage container, interior view</p> <p>20. Artifact storage container, interior view</p> <p>21. Salvaged ore processing buildings timbers, looking E</p>
<p>Out of Scope Work:</p>	<p>None</p>



DAILY SURVEY LOG

DATE: 11/17/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	45 degrees and sunny
Hours worked:	6.0 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL CRM Kierstead arrived on site at 6:30 a.m. and proceeded to the Upper Tier WWII Buildings. Kierstead went to the Compressor Building and flagged mining-related artifacts: 2 carts, the locomotive, winch, blower and dial indicator, for relocation to the Machine Shop slab. Kierstead also took additional notes and photographs of blacksmithing and materials handling features within the foundation.</p> <p>Operator Ulman commenced careful demolition of the Warehouse section of the Office/Warehouse Building while Kierstead observed. The ACM crew removed HAZMAT including drums, cans, bottles, lamp ballasts, etc. Property Owner Stan Parker, assisted by Pike Industries Scott Reilly were periodically allowed to cross the debris to retrieve a wide selection of mechanical spare parts, tools, signs, papers, etc. for relocation to Parker's onsite storage containers. Demolition proceed to the adjacent Office Building section. Ulman collapsed the building, carefully leaving</p>

the two-story safe tower and its roof intact.

Parker and Reilly located and flagged additional mining artifacts for salvage in the vicinity of the bend in the road by the Washhouse. Retrieval and relocation of the large artifacts was originally scheduled for Friday but may be postponed until the lower buildings waste rock removal phase after Thanksgiving.

The PAL CRM left the site at 12:30 p.m. Friday activities will include a visit from a Corps structural engineer to assess the integrity of the copper ore bin supports for possible retention.

Index to Photos:

1. Compressor House floor, looking NW
2. Compressor House floor, looking NE
3. Machine Shop line shafting
4. Office/Warehouse demolition, looking NW
5. Office/Warehouse demolition, looking N
6. Office/Warehouse demolition, looking NW
7. Office safe tower, looking SW
8. Salvaged mine locomotive trolley poles and wires, Warehouse
9. Salvaged items, Warehouse
10. Salvaged items, Warehouse



Public Archaeology Laboratory

DAILY SURVEY LOG

Out of Scope Work:	None
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DAILY SURVEY LOG

DATE: 12/5/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	55 degrees and overcast
Hours worked:	10.0 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL Cultural Resource Monitor (CRM) Matt Kierstead arrived on site at 6:30 a.m. and proceeded to the WWII lower (ore processing) buildings to monitor waste rock removal at the ore crusher foundations. While the heavy equipment operators mobilized Kierstead conducted photographic documentation of other features cleared the previous week including the 1949 ore silo foundation, the 1943 crusher plant interior floor area and dry laid stone walls flanking the collapsed ore bin, and the pumps and truck scale in the Thickener/Dryer Building. As predicted, waste rock removal along the east edge of the buildings encountered the late 19th century Tyson operations ore roast beds; the distinctive black, red and orange banded soil was visible where waste rock had been removed at the garage foundation and north and south of the Thickener/Dryer Building. The presence of this waste material will require removal of the freestanding east concrete pyrrhotite bin wall, which was also photographed and will be measured by the PAL CRM.</p>

Waste rock (WR) removal began at the south side of the north (1949) crusher. Initially it was believed that the partially buried concrete and timber structure would prove similar to the adjacent exposed 1943 crusher structure to the south. Waste rock removal revealed a multi-level L-plan concrete structure with an apparent aperture in its east elevation. After WR was removed down to original soil to the extent possible given the steep slope, the operator moved the excavator to the top of the structure and carefully passed the smooth edged cleanout bucket blade over the ore bin floor, exposing, and then removing, its double plank floor and timber floorbeams. Unexpectedly, the space below was not a void for gravity ore passage to a crusher; instead the area between the bin concrete support walls was filled with WR. WR removal behind (west) and north of the crusher exposed a timber retaining wall, square concrete ore car trestle footings, and several east-west oriented heavy timbers. The exposed concrete ore bin foundation was dissimilar to the 1943 crusher, and the actual crusher footings were not located as WR removal progressed deeper to the east and north. An inclined 6" diameter steel pipe was encountered north of the foundation and may have served the fire hydrant to the east or the ore processing buildings below.

Two intact mine rail features were uncovered north of the foundation. One consisted of two parallel north-south oriented narrow gauge rails connected with bolted joint bars supported by at least five timber ties. The rails were broken off north of the E-W ore bin support wall, suggesting they served an earlier operation, possibly the 1910s Hecksher smelter on the hillside to the north. Higher and to the north two short sections of apparently in situ rails arranged next to each other and bent in dissimilar radii were found next to an ore trestle support pier; it is unclear if these rails were for transportation or structural support.

The PAL CRM left the site at 4:30 p.m.

Index to Photos:

1. Concentration Mill ore silo base, looking N

	<ol style="list-style-type: none"> 2. Tyson ore roast bed soil, Garage location, looking E 3. Tyson ore roast bed soil, S of Thickener Building, looking N 4. Tyson ore roast bed soil, N of Thickener Building, looking W 5. Thickener Building E wall before removal, looking N 6. Thickener Building foundations, looking E 7. Lower Tier foundations, looking SE 8. Thickener Building, Oliver pump, looking SW 9. Thickener Building, Fairbanks scale, looking E 10. Concentration Mill foundation, looking SW 11. 1942 Crusher, looking NW 12. 1943 Crusher S retaining wall, looking SW 13. 1943 Crusher N retaining wall, looking NW 14. 1949 Crusher excavation, looking N 15. 1949 Crusher ore bin floor planks, looking SE 16. 1949 Crusher ore bin floor beams 17. 1949 Crusher, water pipe 18. 1949 Crusher, possible WWI-era Hecksher mine rail and ties, looking W 19. Detail of rail and joint bars 20. Concentration Mill ore crusher ball storage bin, looking SW
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DAILY SURVEY LOG

Out of Scope Work:	None

DATE: 12/6/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	50 degrees and showers
Hours worked:	9.5 hours on site
Progress:	n/a
% Complete:	n/a
Findings:	<p>PAL Cultural Resources Monitor (CRM) Matt Kierstead arrived at the mine site at 6:30 a.m. to continue monitoring waste rock (WR) removal in the lower tier WWII ore processing buildings. Removal commenced at the 1943 crusher foundation. The backhoe operator removed the mound of decayed ore from the floor of the collapsed ore bin, then the plank deck floor and its supporting floor beams. Kierstead photographed the removal process and the top of the crusher once the WR was removed from around it.</p> <p>WR removal then resumed at the 1949 crusher. A concrete feature was encountered immediately south of the ore bin support wall. Kierstead instructed the operator to pursue revealing the feature, which resulted in partial uncovering of a cluster of rectangular concrete pads and piers presumably where the jaw crusher originally sat. A section of mine rail of the same gauge encountered Monday was observed in the soil south of the ore bin. Clearing WR on the east side of the bin foundation indicated</p>

DAILY SURVEY LOG

that there is no open space inside the lower level.

WR removal also began in the grubbed area south of the 1943 crusher. The operator removed the collapsed timber ball mill grinding ball bin structure and the WR from around the east, north and west sides of its concrete foundation. The operator removed and set aside a hydrant from the WWII fire fighting system.

Kierstead and Ed Benton (Weston Solutions) discussed the disposition of the above three concrete foundations, part or all of which may be reburied because of their proximity to steep slopes. Benton agreed that their corners should be documented using an onsite GPS unit. Kierstead and Benton will gather that data before the end of the week. Additional monitoring may include demolition of the 1949 ore silo at the SW corner of the Flotation Mill.

Kierstead and Benton visited the South Mine site to investigate the proximity of WR and test pits to the known historic shaft location in case WR removal is needed around the shaft. They also confirmed that planned South Open Cut WR removal east of Copperas Road will not take place near the recorded large stone foundation in the vicinity.

The PAL CRM departed the site at 4:00 p.m.

Index to Photos:

1. 1943 Crusher ore bin floor timbers, looking E
2. 1943 Ore bin chute floor
3. 1943 Ore bin concrete pad, looking NE
4. 1943 Ore Crusher footings, looking SW
5. 1943 Ore Crusher footings, looking E
6. 1943 Crusher S retaining wall and ore car trestle footings,

DAILY SURVEY LOG

	<p>looking SW</p> <p>7. 1943 Ore Crusher, trestle footings, looking NE</p> <p>8. 1949 Crusher excavation, looking NW</p> <p>9. Ore Concentration Mill foundations, looking NE</p> <p>10. Ore Concentration Mill foundations, looking NE</p> <p>11. Ore Concentration Mill foundations, looking SE</p> <p>12. Thickener Building foundations, looking NE</p> <p>13. Thickener Building thickener tanks motor support beam piers, looking NE</p> <p>14. Thickener Building thickener tank motor support beam pier, looking NE</p> <p>15. 1943 Crusher gyratory crusher base, looking W</p>
<p>Out of Scope Work:</p>	<p>None</p>

DATE: 12/6/11

Field Survey	
Project Number:	2673
Project Name:	Elizabeth Mine-WWII Buildings
Location:	South Strafford, VT
Crew Members:	MK – PAL monitor
Weather Conditions:	50 degrees and showers
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3. 1943 Ore bin concrete pad, looking NE
4. 1943 Ore Crusher footings, looking SW
5. 1943 Ore Crusher footings, looking E
6. 1943 Crusher S retaining wall and ore car trestle footings,

DAILY SURVEY LOG

	<p>looking SW</p> <p>7. 1943 Ore Crusher, trestle footings, looking NE</p> <p>8. 1949 Crusher excavation, looking NW</p> <p>9. Ore Concentration Mill foundations, looking NE</p> <p>10. Ore Concentration Mill foundations, looking NE</p> <p>11. Ore Concentration Mill foundations, looking SE</p> <p>12. Thickener Building foundations, looking NE</p> <p>13. Thickener Building thickener tanks motor support beam piers, looking NE</p> <p>14. Thickener Building thickener tank motor support beam pier, looking NE</p> <p>15. 1943 Crusher gyratory crusher base, looking W</p>
Out of Scope Work:	None

APPENDIX G

Digital Site Documentation Photographs and Historic Mine Maps CD



















































































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