Environmental
Transportation
Land Development
Services

VHB PIONEER

7056 US Route 7
Post Office Box 120
North Ferrisburgh, Vermont 05473
802.425-7788
Fax 802.425.7799

Memorandum

To: White & Burke - Moran Plant Project File

Date: February 1, 2010

Project No.: 57372.00

From: Daniel J. Prasch

Re: Moran Plant – Historical Aerial Photograph Review and Wetland Documentation

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This memorandum has been prepared, in order to provide a summary description of the extent of anthropogenic activities that have occurred at the proposed Moran Plant (Project) redevelopment site in Burlington, Vermont. VHB Pioneer (VHBP) has reviewed available historical photography and corresponding hydrologic data spanning sixty-seven years covering changes in land use, land cover, lake levels, and development around the site. VHBP has subsequently utilized the historical aerial review in conducting wetland delineations for the Project. The discussion below presents the chronological development at the proposed Project site and provides an analysis of these documents to support the position that the wetland feature identified within the site is man-induced and currently serving to isolate historic petroleum-based contaminants from nearby waters, namely Lake Champlain.

Site Description and Location

The Project is located within the mostly historic and commercial land use matrix of Burlington, Vermont. Currently, the dominant land cover on the site is secondary succession woodland, with small open areas, and one isolation berm that has developed wetland vegetation during the years since removal in 1992 of an above-ground petroleum storage tank (Tank 109) associated with the Astroline Site (Heindel & Noyes, 1997). The Project site is located on the edge of Lake Champlain, which, although not fully contained within the borders of Vermont, is considered the largest fresh water body in the region (see Site Location Maps on pages 1 and 2 of Attachment 1). The Project site has a long history of commercial and industrial uses dating back to the Linsley Lumber Mill that was constructed on filled lands within the Burlington Harbor that occurred between the years of 1860-1862 (UVM CAP, 2009; see Attachment 2). The Linsley Mill was partially destroyed by fire in 1906 and the Project site remained partially vacant during the period between the years 1906 and 1912 with a small house and remaining structures associated with the lumber mill being finally and completely razed between the years of 1912 and 1938. The footprint of the former Linsley Mill is located at the approximate location

of the isolation berm on lands filled by the Vermont & Canada Railroad between 1860 and 1862 (UVM CAP, 2009). Aerial photography for the years following begins in 1937 and shows that the Linsley Mill was indeed removed by August of 1937. The details of the aerial photograph review and discussion of the wetland delineation results is provided below.

Aerial Photographs 1937-2004

Historical aerial photography from 1937, 1962 and 1974 was accessed by VHBP from the University of Vermont (UVM), Bailey/Howe Map Library (see pages 3 through 6 of Attachment 1). The 1972, 1986, 1988, and 1992 aerial photographs were all obtained from the United States Geologic Survey (USGS) Earth Explorer website by VHBP (see pages 6 through 9 of Attachment 1). The Vermont Center for Geographic Information (VCGI) (formerly available through the Vermont Mapping Program) provided the 2000 panchromatic aerial (page 10 of Attachment 1). The United States Department of Agriculture – National Agricultural Imagery Program (NAIP) was the source for the 2003 color imagery (page 11 of Attachment 1). These data were downloaded from the VCGI website. The Chittenden County Metropolitan Planning Organization (CCMPO) provided the 2004 color aerial photography of the site provided on page 12 of Attachment 1.

A total of ten historic aerial photographs were scanned and geo-referenced by VHBP to correspond to the datum and projected coordinate system of the most recent aerial photograph. See Table 1 below. Accurate digital registration of historical panchromatic aerial photography within ArcGIS® environment is critical for overlay and spatial analysis of repeat photography. Delineated wetland boundaries, the top of bank of Lake Champlain, and the locations of the berms on-site were incorporated to correlate land cover changes within the site to known reference landmarks that are present throughout the sequence of available aerial photography for the proposed redeveloped Moran Plant site. Additionally, USGS gage readings for Lake Champlain water levels were compared to photograph dates to better understand site hydrology in context of aerial signatures. Historic lake level data for Lake Champlain was obtained by VHBP using the USGS website. Daily lake level data for USGS gage number 04294500 (Burlington Waterfront) were used (Latitude 44°28'34", Longitude 73°13'19"). This station is currently operated in cooperation with the Vermont Department of Environmental Conservation (VTDEC) and the Leahy Center for Lake Champlain.

Results

The following brief narratives describe the land covers and land uses in context of the Project site and isolation berm as they were visible on the historic aerial photographs.

1937 Photography
Panchromatic aerial taken on August 18, 1937 showing the open, sandy lot left vacant following removal of the Linsley Mill structures. USGS water level for Lake Champlain was reported to be 94.94 feet above sea level at the date of photography. The Vermont & Canada Railroad lines are visible to the east of the investigation area (see page 2 of Attachment). There is an active petroleum storage area to the north and a building associated with the American Oil Company located along the southern boundary of the investigation area. The shoreline of Lake Champlain is located to the west and the general configuration is consistent with what is depicted on the Fire Insurance Mapping for Burlington prepared by Sanborn Mapping and Publishing Company. As petroleum storage activities had not yet begun at the Project site, the isolation berm is not present in this aerial photograph.

1962 Photography
Panchromatic aerial taken on May 9, 1962 showing that additional harbor fills had occurred since the 1937 aerial bringing the shoreline configuration of Lake Champlain at the project site to its current configuration. The isolation berm and a petroleum storage tank are now located at the location of the former Linsley Mill. Entire area south of the isolation berm and the Moran Plant is composed of coal stockpile area. Infrastructure connecting tank 109 to the storage tank site to the north is visible in the aerial. Lake Champlain water level was 98.63 feet above sea level at the date of photography. Based on elevation data derived from CCMPO digital data, the shoreline cribbing is approximately 102 feet above sea level with the remainder of the site at approximately 100 feet above sea level. The Project site does not appear to be flooded or inundated by Lake Champlain on this day when the lake level was above OHW, which is 98.00 feet above sea level.

1972 Photography
Color aerial photograph taken on September 15, 1972 with Lake Champlain water surface elevation at 95.97 feet above sea level. The coal stockpiling area for the Moran Plant still appears to be active and the area within the isolation berm does not appear to be flooded or inundated. The tank storage area to the north of the Project site is quite active with active petroleum transfer captured in the photograph. Petroleum infrastructure connecting Tank 109 to the facility to the north is clearly visible in this photograph.

1974 Photography
Panchromatic aerial photograph taken on April 27, 1974 with Lake Champlain water level at 99.73 feet above sea level. The majority of the Project site does not appear flooded or inundated, but the eastern edge of the isolation berm does appear to show a wetness signature. Based on my personal observations, this area of the isolation berm has a slight depression in comparison to the remaining berm surface elevation.

1986 Photography
A poor quality color aerial photograph from May 9, 1985 correlated to a surface water elevation of 97.59 feet above sea level. Although not clearly visible, there is differentiation between what appears to be additional fill material within the isolation berm along the southeast corner and extending north through the middle of the berm. This additional fill material and grading represents the current configuration of the berm within the investigation area. These activities are likely associated with early parts of the decommission process for the Astroline Site which began during the 1980's (Heindel and Noyes, 1997).

1988 Photography
A good quality panchromatic aerial photograph taken on April 12, 1988 with a lake water elevation of 97.35 feet above sea level. The isolation berm has now been filled and graded along the western extent to its current surface elevation of approximately 100.00-102.00 feet above sea level. The isolation berm has been reduced to the current configuration with Tank 109 still present. The Project site does not appear to be flooded or ponded at the time of the photograph. The coal stock pile for the Moran Plant has been reduced since the 1974 photograph.

1992 Photography
A poor quality color aerial photograph taken on April, 27, 1992 with lake water elevation at 98.92 feet above sea level. The Project site does not appear flooded or inundated at the date of photography. The coal stock pile area has been removed and the southern portion of the site graded to its current elevation. Although still shown in the photograph, a City of Burlington Zoning Department application was filed for removal of Tank 109 and approved by the City in August of 1992 when the tank was subsequently removed (Heindel and Noyes, 1997).

2000 Photography
A good quality panchromatic aerial photograph that was taken on June 1, 2000 with a lake water elevation of 99.77 feet above sea level. Tank 109 has now been removed from within the isolation berm. The Project site does not appear to be flooded or inundated and very little woody growth is present. Several of the white pines present on the site today are evident in the northeast corner of the investigation area.

2003 Photography
CCMPO color aerial photograph was taken in August 15, 2003, with corresponding lake level of 96.57 feet above sea level. The Project site does not appear to be flooded or inundated though extensive shrubby and woody vegetation has developed since the 2000 photograph. There appears to be some correlation with the vegetation line shown in the photograph in context of the progression of prior harbor fills.

2004 Photography
This spring panchromatic aerial photograph was taken on April 27, 2004 with a lake level elevation of 98.27 feet above sea level. Although lake levels are above OHW, the Project site does not exhibit signs of flooding or inundation. Leaf-out has yet to occur at the time the photograph was taken and it does not appear that wetland characteristics have developed within the isolation berm area. The footprint of the former concrete pad associated with Tank 109 is still visible in this photograph.

Current Extent and Distribution of Wetlands and Surface Waters

Daniel Prasch, Senior Wetland Scientist, of VHBP conducted the natural resources assessment on September 3, 2009 and September 14, 2009 within an approximately 5.3 acre investigation area. This portion of the investigation area (eastern edge) was previously delineated by Daniel Prasch on July 2, 2008 as part of a separate Section 248 filing with the Vermont Public Services Board. Precipitation conditions were near normal for the month of September based on review of United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Wetness Evaluation Tables (WETS) for Station: BURLINGTON WSO AP, VT1081. Actual precipitation recorded for Burlington, Vermont for the month of September 2009 was 3.67 inches in comparison to the 30-year average of 3.83 (NOAA, 2010). Weather conditions were warm and sunny during both days of delineation and a thorough evaluation of soils, hydrology, and vegetation was conducted.

Wetland delineations followed methodology outlined in the *Corps of Engineers Wetland Delineation Manual (*1987 Manual). The 1987 Manual utilizes a three parameter approach to wetland delineation, including hydric soils, dominant hydrophytic vegetation and wetland hydrology. Wetlands were identified in the field with pink "Wetland Delineation" flagging labeled with the year, wetland ID, and flag number (e.g., 2009-1 #1). Flag locations were located in the field using a Trimble® GPS unit capable of sub-meter accuracy.

As outlined in the 1987 Manual, when any one or more of the delineation parameters is not met due to some physical alteration whether it is man-made or naturally induced, Section F Subsection 4 would be implemented in making a wetland determination. In evaluating whether Normal Circumstances exist within the investigation area, one needs to consider the relative extent and permanence of the physical alteration to the wetland parameter being considered under Section F. In the context of the isolation berm at the Project site, the physical alterations to the soil/substrate that has occurred historically through incremental harbor fills and subsequent grading have occurred so recently that hydric soil conditions have not yet developed and in fact, many of the soil profiles conducted during VHBP delineation efforts, as well as during a site visit with the United States Army Corps of Engineers in November 2009, revealed strata of coal debris, gravel, and other unconsolidated fill material as the primary

composition of the soils within the Project site. The progression of harbor fills is evidenced the historic USGS topographic quadrangles, aerial photographs, and soil mapping by NRCS, which shows the soils within the Project site mapped as fill material. The Wetland Delineation and Soils Map on Page 13 of Attachment 1 depicts the most recent aerial photography for the site and extent of VHBP-delineated wetlands. Wetland Delineation Data Forms provided on pages 14 through 21 of Attachment 1 present the results of transects conducted to delineate the extent of wetlands within the Project site.

Discussion

Based on the chronological review of aerial photography presented above and giving due consideration to previous studies conducted for the Project site, including the *Wetlands Report* prepared by Heindel and Noyes dated January 31, 2006, VHBP has conducted a wetland functions and values assessment pursuant to the methodology described in *The Highway Methodology Workbook Supplement* (USACE, 1993). The functions and values form generated as part of this effort is located on page 22 of Attachment 1. In making a determination of a wetland's functions and values, one must also consider the proximity of adjacent development and associated interrelationships, as well as the historical context of land use associated with a resource area. Given the history of the Project site as presented above, and following the functions and values assessment VHBP has determined that the delineated wetland does not perform at a principal level any of the 13 functions or values considered by the USACE Regulatory Branch for Section 404 permit requirements. Due to past industrial/commercial uses for the Project site, including the construction of the petroleum isolation berm associated with the Astroline site, the subsequently developed wetland habitat within the berm may be suitable for sediment/toxicant retention and nutrient removal/retention function, although existing levels of toxicants/pollutants within the berm area are negligible (WEM, 2010).

Conclusion

VHBP conducted wetland delineations within an approximately 5.3 acres investigation area associated with the Project site during the growing season of 2009 and delineated a wetland using the guidelines under Section F of the *1987 Manual.* Total surface area of the delineated wetland is approximately 1.11 acre. A portion of this wetland was previously delineated by VHBP in 2008 for a separate effort associated with a Vermont Public Service Board filing. A site visit was conducted with Vermont Agency of Natural Resources during fall of 2008 to review and confirm that the delineated wetland is Class III under the Vermont Wetland Rules. Additionally, a site visit was conducted with the USACE on November 3, 2009 to conduct additional soil samples and review the VHBP delineation effort. No revisions to the wetland delineation were requested by USACE during the site visit. The subsequent review of aerial photography and functions and values assessment indicate that while the feature meets the

criteria of the *1987 Manual* under Section F the wetland in question does not function at a significant level for any of the functions and values identified by the *The Highway Methodology Workbook Supplement.*

REFERENCES

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitat of the United States. U.S. Fish and Wildlife Service. FWS/OBD-79/31. 103pp.

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U.S. Army Corps of Engineers (USACE). 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiments Station.

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Waite Environmental Management 2010. *Phase II Environmental Site Assessment Report, Moran Generating Plant*, January 20, 2010.

ATTACHMENT 1

Legend

VHBP Investigation Area

Former Moran Plant
Burlington, Vermont
Site Location Map

February 1, 2010

400 200 0 400 Feet

Sources: CCMPO Ortho (2004); Investigation area prepared by VHBP (2009).

VHB PIONEER
7056 US Route 7, PO Box 120
North Ferrisburgh, VT 05473
T.802 425.7788 F.802-425.7799
www.vhb.com

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Legend

VHBP Investigation Area

Prepared by: JAT

Former Moran Plant
Burlington, Vermont
Site Location Map

December 15, 2009

2,000 1,000 0 2,000 Feet

Sources: Background: USGS Topographic Quads (1983); Investigation area prepared by VHBP (2009).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

VHB PIONEER
7056 US Route 7, PO Box 120
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T.802.425.7788 F.802-425.7799
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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

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T.802.425.7788 F.802-425.7799
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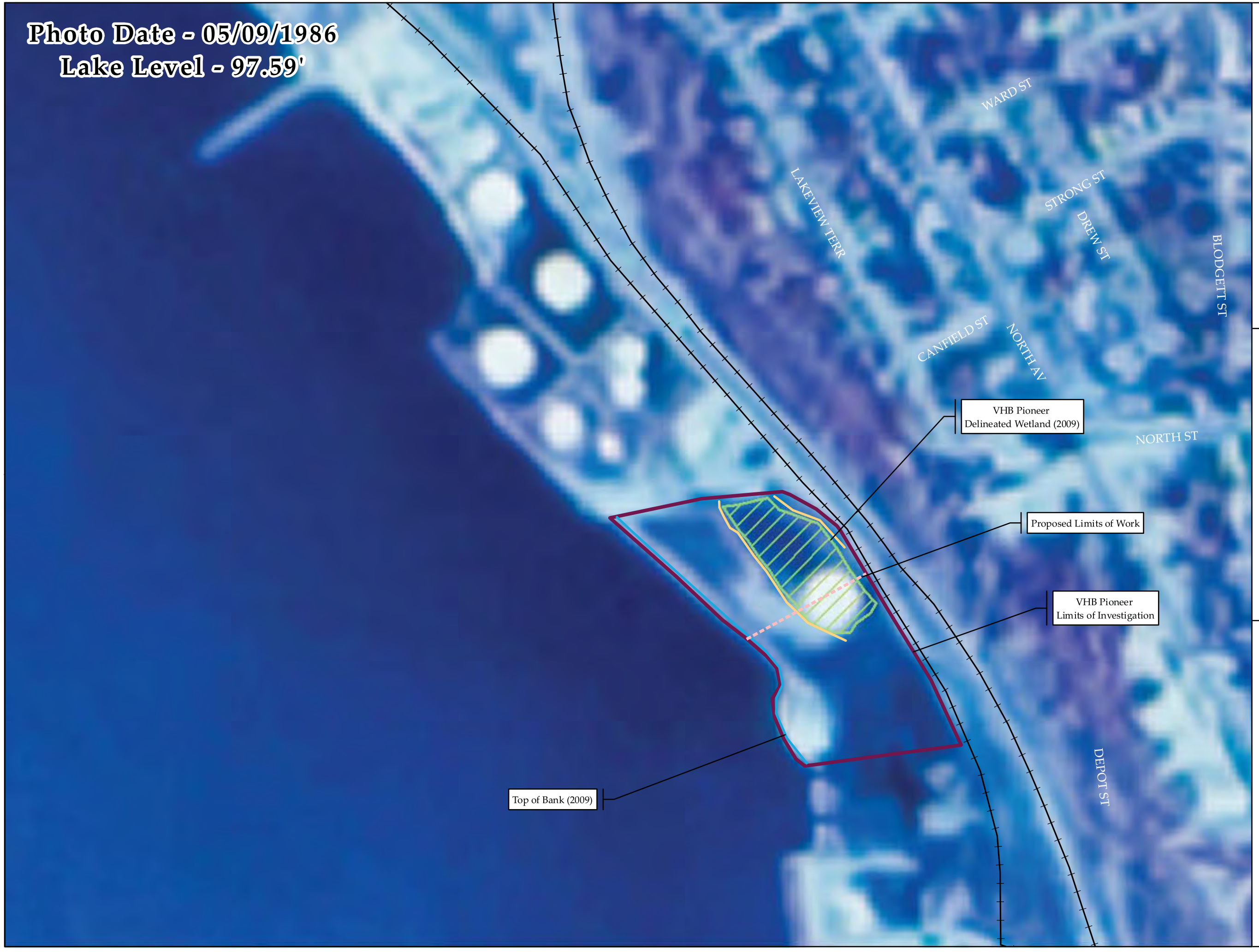

Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Berm
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Berm
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Berm
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo aligned by VHBP (2009).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Berm
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo obtained from the former Vermont Mapping Program (2000).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0 Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Berm
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Aerial photo obtained from the USDA (2003).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation - Aerial Photograph Historical Comparison

January 5, 2010

200 100 0
Feet

N

- VHBP Wetland (2009)
- Top of Bank (2009)
- Berm
- Proposed Limit of Work
- VHBP Limits of Investigation
- Railroad

Sources: Wetlands and Top-of-Bank delineated by VHB Pioneer (2009); Road Data provided by VCGI (2008); Orthophotography provided by the Chittenden County Metropolitan Planning Organization (CCMPO) (2004).

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Former Moran Plant
City of Burlington, VT
Wetland Delineation and Soil Map

February 1, 2010

Legend

- VHBP Wetland (2009)
- VHBP Limits of Investigation
- Top of Bank
- NRCS Soil Boundary
- Berm
- Railroad
- 2 ft. Contour
- 10 ft. Contour
- Approximate Transect Location

100 50 0 Feet

N

Sources: Background: CCMPO Orthophoto (2004); Wetland and Top of Bank features delineated and captured by VHB Pioneer using Trimble GPS (2009); Roads data downloaded from VCGI (2008); Soils data downloaded from VCGI (2008); Contours generated using Lidar DEM by VHB Pioneer (2009).

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T.802.425.7788 F.802-425.7799
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Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **1**

Project/Site: **Moran Plant**
Applicant/Owner: **City of Burlington**
Investigator: **Daniel Prasch, CWS**

Date: **September 03, 2009**
County: **Chittenden**
State: **VT**

[**True**] Do normal circumstances exist on the site?
[**True**] Is the site significantly disturbed (Atypical Situation)?
[**True**] Is the area a potential problem area?

Community ID: **Upland**
Station ID: **1**
Plot ID: **A**

Vegetation

Dominant	Species	Common Name / CofC	% Cover	Indicator
Herbaceous				
	Toxicodendron radicans	Ivy,Poison	5	FAC
	Celastrus scandens	Bitter-Sweet,American	5	FACU-
X	*Rhamnus cathartica*	Buckthorn,Common	10	UPL
X	*Equisetum hyemale*	Horsetail,Rough	20	FACW
X	*Equisetum arvense*	Horsetail,Field	10	FAC
Shrub				
X	*Populus tremula*	Aspen,Quaking	40	FACU
X	*Abies balsamea*	Fir,Balsam	20	FAC
X	*Rhamnus cathartica*	Buckthorn,Common	20	UPL
Tree				
X	*Populus tremula*	Aspen,Quaking	60	FACU
X	*Populus deltoides*	Cotton-Wood,Eastern	30	FAC

% Species that are OBL, FACW, or FAC (except FAC-): **50** Cowardin Classification:

Remarks

Hydrology

[**X**] Recorded Data (describe in remarks)
- [**X**] Stream, Lake, or Tide Gage
- [**X**] Aerial Photograph
- [ ] Other (describe in remarks)

Field Observations:
- Depth of Surface Water(in.): **0**
- Depth to Free Water in Pit(in.): **>24**
- Depth to Saturated Soils(in.): **>24**

Primary Wetland Hydrology Indicators
- [ ] Inundated
- [ ] Saturated in upper 12 inches
- [ ] Water marks
- [ ] Drift lines
- [ ] Sediment deposits
- [ ] Drainage patterns in wetlands

Secondary Hydrology Indicators
- [ ] Oxidized root channels
- [ ] Water-stained leaves
- [ ] Local soil survey data
- [ ] FAC-Neutral test
- [ ] Other (explain in remarks)

Remarks
Dry-no oxidized Root channels in upper 12"

Soils

Depth (in.)	Hor.	Matrix Color	Mottle / 2nd Mottle Color	Abundance	Contrast	Texture, Structure, etc.
0-2		10YR 2/1				Fine Sandy Loam
2-20		7.5YR 4/3				Fine Sand

Hydric Soils Indicators
- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Probable Aquatic Moist Regime
- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic % in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (explain in remarks)

Unit Name: **Fill Land**
Drainage Class:

Taxonomy:
[ ] Field Observations match map

Remarks
Review of NRCS Soils and Aerial Photography indicates that this data point is located on historically filled lands.

Wetland Determination

[**False**] Hydrophytic Vegetation Present
[**False**] Hydric Soils Present
[**False**] Wetland Hydrology Present

[**False**] This Data Point is a Wetland

Remarks
Section F of the 1987 Manual was applied in making the wetlands determination on-site.

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **2**

Project/Site: **Moran Plant**
Applicant/Owner: **City of Burlington**
Investigator: **Daniel Prasch, CWS**

Date: **September 03, 2009**
County: **Chittenden**
State: **VT**

[**True**] Do normal circumstances exist on the site?
[**True**] Is the site significantly disturbed (Atypical Situation)?
[**True**] Is the area a potential problem area?

Community ID: **PEM**
Station ID: **1**
Plot ID: **B**

Vegetation

Dominant	Species	Common Name / CofC	% Cover	Indicator
Herbaceous				
	Solidago gigantea	Golden-Rod,Giant	5	FACW
	Equisetum palustre	Horsetail,Marsh	5	FACW
X	*Onoclea sensibilis*	Fern,Sensitive	15	FACW
X	*Carex stricta*	Sedge,Uptight	15	OBL
Shrub				
	Salix bebbiana	Willow,Bebb	10	FACW
X	*Salix exigua*	Willow,Sandbar	75	OBL
X	*Cornus stolonifera*	Dogwood,Red-Osier	25	FACW+
Vine				
X	*Vitis riparia*	Grape,River-Bank	40	FACW

% Species that are OBL, FACW, or FAC (except FAC-): **100** Cowardin Classification:

Remarks

Willows exhibit morphological adaptations to saturated soil/inudated conditions: adventitious roots.

Hydrology

[**X**] Recorded Data (describe in remarks)
- [**X**] Stream, Lake, or Tide Gage
- [**X**] Aerial Photograph
- [ ] Other (describe in remarks)

Field Observations:
- Depth of Surface Water(in.): **0**
- Depth to Free Water in Pit(in.): **14**
- Depth to Saturated Soils(in.): **10**

Primary Wetland Hydrology Indicators
- [ ] Inundated
- [**X**] Saturated in upper 12 inches
- [ ] Water marks
- [ ] Drift lines
- [ ] Sediment deposits
- [ ] Drainage patterns in wetlands

Secondary Hydrology Indicators
- [**X**] Oxidized root channels
- [ ] Water-stained leaves
- [ ] Local soil survey data
- [ ] FAC-Neutral test
- [ ] Other (explain in remarks)

Remarks

Soils

Depth (in.)	Hor.	Matrix Color	Mottle / 2nd Mottle Color	Abundance	Contrast	Texture, Structure, etc.
0-2		10YR 2/1				Loamy Sand
2-24		5Y 4/3	2.5YR 5/6	many	prominent	Sand

Hydric Soils Indicators
- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Probable Aquatic Moist Regime
- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic % in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (explain in remarks)

Unit Name: **Filled Land**
Drainage Class:

Taxonomy:
[ ] Field Observations match map

Remarks

Review of NRCS Soils and Aerial Photography indicates that this data point is located on historically filled lands. Soils within the isolation berm do not exhibit hydric soil conditions as required by New England Technical Committee for Hydric Soils.

Wetland Determination

[**True**] Hydrophytic Vegetation Present
[**False**] Hydric Soils Present
[**True**] Wetland Hydrology Present

[**True**] This Data Point is a Wetland

Remarks

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **2**

Pursuant to Section F of the 1987 Federal Manual, on sites where changes in soil characteristics can be documented and hydrology and hydrophytic vegetation present, delineate the data plot as wetland and refer to current CE policy regarding man-induced wetlands. Aerial photographs reveal that this data plot is located within an isolation berm historically constructed on filled lands.

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **3**

Project/Site: **Moran Plant**
Applicant/Owner: **City of Burlington**
Investigator: **Daniel Prasch, CWS**

Date: **September 14, 2009**
County: **Chittenden**
State: **VT**

[**True**] Do normal circumstances exist on the site?
[**True**] Is the site significantly disturbed (Atypical Situation)?
[**True**] Is the area a potential problem area?

Community ID: **Upland**
Station ID: **2**
Plot ID: **A**

Vegetation

Dominant	Species	Common Name / CofC	% Cover	Indicator
Herbaceous				
	Solidago nuttallii	Golden-Rod,Nuttall	5	FACU+
	Vaccinium angustifolium	Blueberry,Lowbush	5	FACU-
	Lythrum salicaria	Loosestrife,Purple	5	FACW+
	Phragmites australis	Reed,Common	5	FACW
	Equisetum pratense	Horsetail,Meadow	5	FACW
	Poa pratensis	Bluegrass,Kentucky	5	FACU
X	*Toxicodendron radicans*	Ivy,Poison	15	FAC
X	*Onoclea sensibilis*	Fern,Sensitive	15	FACW
X	*Phleum pratense*	Timothy	15	FACU
Shrub				
	Lonicera x bella	Honeysuckle	5	FACU-
	Rhus Hirta	Staghorn Sumac	15	NI
	Fraxinus pennsylvanica	Ash,Green	5	FACW
	Cornus stolonifera	Dogwood,Red-Osier	5	FACW+
X	*Populus tremula*	Aspen,Quaking	15	FACU
X	*Salix bebbiana*	Willow,Bebb	15	FACW
Tree				
X	*Populus tremula*	Aspen,Quaking	75	FACU

% Species that are OBL, FACW, or FAC (except FAC-): **50** Cowardin Classification:

Remarks

Hydrology

[**X**] Recorded Data (describe in remarks)
- [**X**] Stream, Lake, or Tide Gage
- [**X**] Aerial Photograph
- [ ] Other (describe in remarks)

Field Observations:
- Depth of Surface Water(in.): **0**
- Depth to Free Water in Pit(in.): **>20**
- Depth to Saturated Soils(in.): **>20**

Primary Wetland Hydrology Indicators
- [ ] Inundated
- [ ] Saturated in upper 12 inches
- [ ] Water marks
- [ ] Drift lines
- [ ] Sediment deposits
- [ ] Drainage patterns in wetlands

Secondary Hydrology Indicators
- [ ] Oxidized root channels
- [ ] Water-stained leaves
- [ ] Local soil survey data
- [ ] FAC-Neutral test
- [ ] Other (explain in remarks)

Remarks
Dry, no oxidized root channels in upper 12"

Soils

Depth (in.)	Hor.	Matrix Color	Mottle / 2nd Mottle Color	Abundance	Contrast	Texture, Structure, etc.
0-4		10YR 2/1				Silt Loam
4-20		5Y 5/3	10YR 5/6	few	distinct	

Hydric Soils Indicators
- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Probable Aquatic Moist Regime
- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic % in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (explain in remarks)

Unit Name: **Filled land**
Drainage Class:

Taxonomy:
[ ] Field Observations match map

Remarks
Review of NRCS Soils and Aerial Photography indicates that this data point is located on historically filled lands. Soil pit revealed buried fill material including pieces of coal, gravel, and course woody debris. Refusal >20 inches.

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **3**

Wetland Determination

[**False**] Hydrophytic Vegetation Present
[**False**] Hydric Soils Present
[**False**] Wetland Hydrology Present
[**False**] This Data Point is a Wetland

Remarks

Section F of the 1987 Manual was applied in making the wetlands determination on-site.

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **4**

Project/Site: **Moran Plant**
Applicant/Owner: **City of Burlington**
Investigator: **Daniel Prasch, CWS**

Date: **September 14, 2009**
County: **Chittenden**
State: **VT**

[**True**] Do normal circumstances exist on the site?
[**True**] Is the site significantly disturbed (Atypical Situation)?
[**True**] Is the area a potential problem area?

Community ID: **PEM**
Station ID: **2**
Plot ID: **B**

Vegetation

Dominant	Species	Common Name / CofC	% Cover	Indicator
Herbaceous				
X	*Phragmites australis*	Reed,Common	100	FACW
Shrub				
X	*Salix bebbiana*	Willow,Bebb	15	FACW

% Species that are OBL, FACW, or FAC (except FAC-): **100**

Cowardin Classification:

Remarks

Hydrology

[**X**] Recorded Data (describe in remarks)
- [**X**] Stream, Lake, or Tide Gage
- [**X**] Aerial Photograph
- [ ] Other (describe in remarks)

Field Observations:
- Depth of Surface Water(in.): **0**
- Depth to Free Water in Pit(in.): **14**
- Depth to Saturated Soils(in.): **10**

Primary Wetland Hydrology Indicators
- [ ] Inundated
- [**X**] Saturated in upper 12 inches
- [ ] Water marks
- [ ] Drift lines
- [ ] Sediment deposits
- [ ] Drainage patterns in wetlands

Secondary Hydrology Indicators
- [**X**] Oxidized root channels
- [**X**] Water-stained leaves
- [ ] Local soil survey data
- [ ] FAC-Neutral test
- [ ] Other (explain in remarks)

Remarks

Soils

Depth (in.)	Hor.	Matrix Color	Mottle / 2nd Mottle Color	Abundance	Contrast	Texture, Structure, etc.
0-2		10YR 2/1				Loamy Sand roots
2-24		5Y 5/3	2.5YR 4/6	many	prominent	Sand

Hydric Soils Indicators
- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Probable Aquatic Moist Regime
- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic % in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (explain in remarks)

Unit Name: **Filled Land**
Drainage Class:

Taxonomy:
[ ] Field Observations match map

Remarks

Review of NRCS Soils and Aerial Photography indicates that this data point is located on historically filled lands. Soils within the isolation berm do not exhibit hydric soil conditions as required by New England Technical Committee for Hydric Soils.

Wetland Determination

[**True**] Hydrophytic Vegetation Present
[**False**] Hydric Soils Present
[**True**] Wetland Hydrology Present

[**True**] This Data Point is a Wetland

Remarks

Pursuant to Section F of the 1987 Federal Manual, on sites where changes in soil characteristics can be documented and hydrology and hydrophytic vegetation present, delineate the data plot as wetland and refer to current CE policy regarding man-induced wetlands. Aerial photographs reveal that this data plot is located within an isolation berm historically constructed on filled lands.

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **5**

Project/Site: **Moran Plant**
Applicant/Owner: **City of Burlington**
Investigator: **Daniel Prasch, CWS**

Date: **December 18, 2009**
County: **Chittenden**
State: **VT**

[**True**] Do normal circumstances exist on the site?
[**True**] Is the site significantly disturbed (Atypical Situation)?
[**True**] Is the area a potential problem area?

Community ID: **Upland**
Station ID: **3**
Plot ID: **A**

Vegetation

Dominant	Species	Common Name / CofC	% Cover	Indicator
Herbaceous				
	Solidago nuttallii	Golden-Rod,Nuttall	5	FACU+
	Lythrum salicaria	Loosestrife,Purple	5	FACW+
	Onoclea sensibilis	Fern,Sensitive	15	FACW
	Toxicodendron radicans	Ivy,Poison	5	FAC
X	*Equisetum hyemale*	Horsetail,Rough	60	FACW
Shrub				
X	*Prunus virginiana*	Cherry,Choke	20	FACU
X	*Rhus Hirta*	Staghorn Sumac	15	NI
X	*Rhamnus cathartica*	Buckthorn,Common	15	UPL
X	*Cornus stolonifera*	Dogwood,Red-Osier	15	FACW+
Tree				
X	*Pinus strobus*	Pine,Eastern White	40	FACU
X	*Betula papyrifera*	Birch,Paper	20	FACU

% Species that are OBL, FACW, or FAC (except FAC-): **33**
Cowardin Classification:

Remarks

Hydrology

[**X**] Recorded Data (describe in remarks)
- [**X**] Stream, Lake, or Tide Gage
- [**X**] Aerial Photograph
- [ ] Other (describe in remarks)

Field Observations:
- Depth of Surface Water(in.): **0**
- Depth to Free Water in Pit(in.): **>20**
- Depth to Saturated Soils(in.): **>20**

Primary Wetland Hydrology Indicators
- [ ] Inundated
- [ ] Saturated in upper 12 inches
- [ ] Water marks
- [ ] Drift lines
- [ ] Sediment deposits
- [ ] Drainage patterns in wetlands

Secondary Hydrology Indicators
- [ ] Oxidized root channels
- [ ] Water-stained leaves
- [ ] Local soil survey data
- [ ] FAC-Neutral test
- [ ] Other (explain in remarks)

Remarks
Dry, no oxidized root channels in upper 12"

Soils

Depth (in.)	Hor.	Matrix Color	Mottle / 2nd Mottle Color	Abundance	Contrast	Texture, Structure, etc.
0-4		5YR 2/1				Coarse Sandy Loam
4-10		2.5Y 5/3				Loamy Sand
10-20		5Y 4/3	10YR 4/6	few	faint	

Hydric Soils Indicators
- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Probable Aquatic Moist Regime
- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic % in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (explain in remarks)

Unit Name: **Filled Land**
Drainage Class:

Taxonomy:
[ ] Field Observations match map

Remarks
Review of NRCS Soils and Aerial Photography indicates that this data point is located on historically filled lands.

Wetland Determination

[**False**] Hydrophytic Vegetation Present
[**False**] Hydric Soils Present
[**False**] Wetland Hydrology Present

[**False**] This Data Point is a Wetland

Remarks
Section F of the 1987 Manual was applied in making the wetlands determination on-site.

Data Form
Routine Wetland Determination

Job Number: **57372**
Town/Village/City: **Burlington**
Wetland Data Point: **6**

Project/Site: **Moran Plant**
Applicant/Owner: **City of Burlington**
Investigator: **Daniel Prasch, CWS**

Date: **December 18, 2009**
County: **Chittenden**
State: **VT**

[**True**] Do normal circumstances exist on the site?
[**True**] Is the site significantly disturbed (Atypical Situation)?
[**True**] Is the area a potential problem area?

Community ID: **PEM**
Station ID: **3**
Plot ID: **B**

Vegetation

Dominant	Species	Common Name / CofC	% Cover	Indicator
Herbaceous				
X	*Phragmites australis*	Reed,Common	60	FACW
X	*Equisetum hyemale*	Horsetail,Rough	30	FACW
Shrub				
X	*Salix bebbiana*	Willow,Bebb	40	FACW

% Species that are OBL, FACW, or FAC (except FAC-): **100** Cowardin Classification:

Remarks

Hydrology

[**X**] Recorded Data (describe in remarks)
- [**X**] Stream, Lake, or Tide Gage
- [**X**] Aerial Photograph
- [ ] Other (describe in remarks)

Field Observations:
- Depth of Surface Water(in.): **0**
- Depth to Free Water in Pit(in.): **16**
- Depth to Saturated Soils(in.): **12**

Primary Wetland Hydrology Indicators
- [ ] Inundated
- [**X**] Saturated in upper 12 inches
- [**X**] Water marks
- [ ] Drift lines
- [ ] Sediment deposits
- [ ] Drainage patterns in wetlands

Secondary Hydrology Indicators
- [**X**] Oxidized root channels
- [**X**] Water-stained leaves
- [ ] Local soil survey data
- [ ] FAC-Neutral test
- [ ] Other (explain in remarks)

Remarks

Soils

Depth (in.)	Hor.	Matrix Color	Mottle / 2nd Mottle Color	Abundance	Contrast	Texture, Structure, etc.
0-4		2.5YR 2/2				Sandy Loam
4-20		2.5Y 4/3	10YR 4/6	common	distinct	Loamy Coarse Sand

Hydric Soils Indicators
- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Probable Aquatic Moist Regime
- [ ] Reducing Conditions
- [ ] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic % in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (explain in remarks)

Unit Name: **Filled Land**
Drainage Class:

Taxonomy:
[ ] Field Observations match map

Remarks
Review of NRCS Soils and Aerial Photography indicates that this data point is located on historically filled lands. Soils within the isolation berm do not exhibit hydric soil conditions as required by New England Technical Committee for Hydric Soils.

Wetland Determination

[**True**] Hydrophytic Vegetation Present
[**False**] Hydric Soils Present
[**True**] Wetland Hydrology Present

[**True**] This Data Point is a Wetland

Remarks
Pursuant to Section F of the 1987 Federal Manual, on sites where changes in soil characteristics can be documented and hydrology and hydrophytic vegetation present, delineate the data plot as wetland and refer to current CE policy regarding man-induced wetlands. Aerial photographs reveal that this data plot is located within an isolation berm historically constructed on filled lands.

US Army Corps of Engineers
New England District

VHB PIONEER Environmental Transportation Land Development Services

Wetland Function-Value Evaluation Form

Total area of wetland 43,385 SF Human made? X Is wetland part of a wildlife corridor?_____ or a "habitat island"? X

Adjacent land use industrial, residential, commercial Distance to nearest roadway or other development Adjacent

Dominant wetland systems present palustrine, emergent Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? X If not, where does the wetland lie in the drainage basin?_____

How many tributaries contribute to the wetland? N/A Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. 2009-001

Latitude_____ Longitude_____

Prepared by:_____ Date_____

Wetland Impact:

Type_____ Area_____

Evaluation based on:

Office ✓ Field ✓

Corps manual wetland delineation completed? Y ✓ N_____

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge		✓	4,5,15		No springs or seeps present. Upgradient watershed is very limited for hydrologic input into wetland. Municipal stormwater management associated with upgradient hydrology.
Floodflow Alteration		✓	3,4,6,18		Wetland is isolated from Lake Champlain. Wetland size is limited and storage capacity is minimal in comparison to lake basin watershed. Wetland is contained within isolation berm.
Fish and Shellfish Habitat		✓	None applicable		No habitat present for fish or shellfish. Seasonally inundated.
Sediment/Toxicant Retention	✓		1,2,5,9,		Wetland has developed hydrophytic vegetation over the last 18 years within a former petroleum isolation berm.
Nutrient Removal	✓		3,4,5,8		Isolation berm wetland with minimal nutrient input and minimal opportunity to transform nutrients to other trophic levels.
Production Export		✓	4,7		This wetland is not effective in producing food or usable products. Dominated by invasive species, debris, and detritus from vagrant camps.
Sediment/Shoreline Stabilization		✓	6		Wetland is located within a berm and is isolated from the shore of Lake Champlain.
Wildlife Habitat		✓	13,17		Wetland is degraded by historic land use and current prevalence of debris and vagrant activity. Dominated by invasive species.
Recreation		✓	12		Extensive vagrant encampments and debris strewn about within the berm wetlands and on adjacent lands.
Educational/Scientific Value		✓	1		S1 species, Spiked Grass (*Aristida longespica)* known to occur within the Project site. Plant not identified as part of VHBP delineation. Plant not protected under 10 V.S.A. Chapter 123.
Uniqueness/Heritage		✓	1,14		No archeology sites present. No remaining historic structures. Man-induced berm wetland.
Visual Quality/Aesthetics		✓	None applicable		Man-induced wetland dominated by invasive species and detritus associated with vagrant camps.
ES Endangered Species Habitat		✓	1		S1 species, Spiked Grass (*Aristida longespica)* known to occur within the Project site. Plant not identified as part of VHBP delineation. Plant not protected under 10 V.S.A. Chapter 123.
Other					

Notes: Man-induced berm wetland delineated under Section F of the 1987 Federal Manual.

* Refer to backup list of numbered considerations.

Adapted from: U.S.Army Corps of Engineers - New England District. 1999. The Highway Methodology Workbook: Supplement: Wetland Functions and Values - A Descriptive Approach. NAEEP-360-1-30a.

ATTACHMENT 2

Archaeological Resources Assessment
Moran Center at Waterfront Park
City of Burlington, Chittenden County, Vermont

Submitted to:
Alan R. Liptak
KAS, Inc.
368 Avenue D, Suite 15
P.O. Box 787
Williston, Vermont 05495

Submitted by:
University of Vermont
Consulting Archaeology Program
111 Delehanty Hall, 180 Colchester Ave
Burlington, Vermont 05405
Report No. 557
August, 2009

Introduction

This Archaeological Resources Assessment (ARA) was prepared by the University of Vermont Consulting Archaeology Program (UVM CAP) as part of the Section 106 cultural resources review process of the National Historic Preservation Act (1966), as amended, for the first phase of development at the Moran Center at Waterfront Park in the City of Burlington, Chittenden County, Vermont. The project area is located along the eastern shore of Lake Champlain immediately north and east of the old Moran generating plant (Figures 1 and 2). The proposed project includes the construction of stormwater retention ponds, reconfiguring parking areas, the installation of new underground service lines, and general landscaping. The ARA was prepared under contract with KAS, Inc. in advance of environmental testing within the project area.

The goal of this ARA is to identify potential archaeological resources within the project's Area of Potential Effect (APE) at a general level. The principal sources used in compiling this report included historic maps, photographs, town reports, census reports, newspaper articles, and published histories. Additionally, a review of the Vermont Archaeological Inventory (VAI), which is maintained by the Vermont Division of Historic Preservation (VDHP), was undertaken to locate previously identified precontact Native American and historic Euro-American sites in the general vicinity of the current study area.

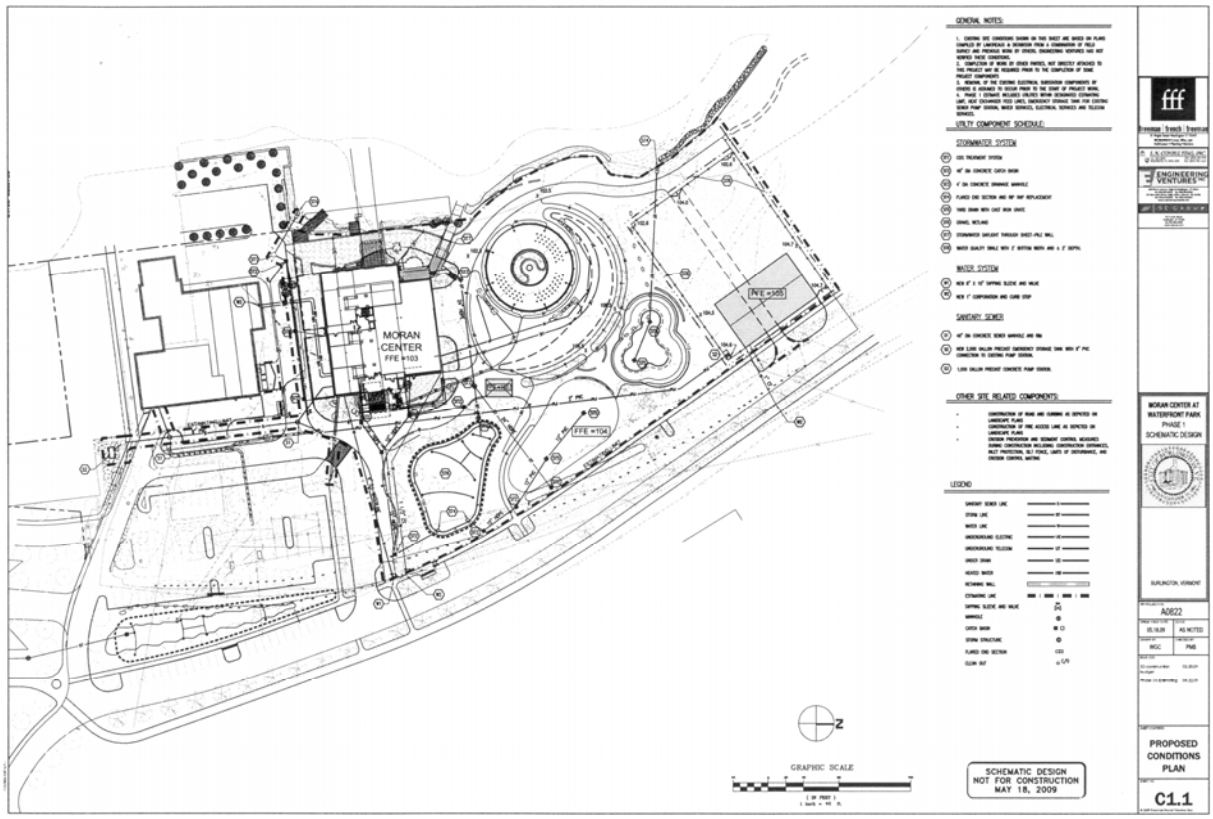

Figure 1. Current Phase 1 Project Plans for the Moran Center at Waterfront Park, City of Burlington, Chittenden County, Vermont.

Figure 2. Location of the proposed Moran Center at Waterfront Park and known archaeological sites nearby in the City of Burlington, Chittenden County, Vermont.

Precontact Native American Sites

Burlington's precontact lakefront landscape in the vicinity of the current project area consisted of a high dry sandy bluff overlooking the beach and bay (Visser et al. 1990:11). Some precontact Native American sites have already been identified on the higher elevations overlooking Lake Champlain including a Terminal Archaic (1300-900 B.C.) period site (VT-CH-847) at the extreme northern end of North Avenue and an incidental discovery of three chert flakes (byproducts of stone tool production) on top of the bluff near the intersection of North Avenue and North Street within the boundaries of the War of 1812 cantonment and military burial ground site (VT-CH-961). In addition to the high ground, the shoreline itself "with its abundant supply of fresh water and aquatic flora and fauna would have been an ideal location for prehistoric settlement and/or activity" (Visser et al. 1990:11). Some of these latter sites, if present, may have become partially or wholly submerged as the mean water level of Lake Champlain has risen about 6.1 m (20 ft) over the past 8000 years effectively moving the shoreline east approximately 381-457.2 m (1250-1500 ft) (McLaughlin 2000; Visser et al. 1990:11).

Known precontact Native American sites along or adjacent to Burlington's lakeshore include VT-CH-81 and VT-CH-161. The site VT-CH-81 is located along the shoreline in the southern portion of the city between the old Queen City Mills and Cliffside Park. It "was identified in the early twentieth century by a local resident who collected artifacts along the shoreline and underwater in the lake" (Corey and Petersen 1998:13). This site yielded "artifacts attributable to the Late Archaic period, specifically Brewerton points, dated ca. 2700-2500 B.C., and the Middle-Late Woodland periods, specifically Levanna points dated ca. A.D. 800-1600" (Corey and Petersen 1998:13). The other site, VT-CH-161, is located at the northeast corner of Main and Battery Streets, close to the original shoreline. This site was identified during construction activity near the historic Holloway Block. Here, a number of stone flakes were observed in an undisturbed context under three feet of historic fill (Visser et al. 1990:11). Unfortunately, "because the site was partially destroyed and not subject to professional analysis, no positive date could be assigned to the remains" (Visser et al. 1990:11).

Table 1. List of known archaeological sites indicated on Figure 2.

Site#	Type	Sub-Type	Time Period	Description
VT-CH-161	Precontact Historic	Unknown Unknown	Unknown 19th century	Lithic debitage Domestic and architectural material
VT-CH-661	Historic	Residential/Commercial	Early 19th century	House and store foundations
VT-CH-732	Historic	Industrial	ca. 1870-1938	Lumber and coal sheds
VT-CH-733	Historic	Industrial	ca. 1870-1938	Lumber shed
VT-CH-734	Historic	Residential	ca. 1885-1912	House
VT-CH-735	Historic	Industrial	ca. 1870-1938+	Lumber shed
VT-CH-736	Historic	Transportation	ca. 1849-1912	Railroad round house and turntable

Historic Background

Burlington's waterfront played a vital role in the city's early economic life and commercial development. Not only was the waterfront home to many industries over the years (i.e. lumber processing, stone carving, and iron working), but it was also an important transportation hub for travelers and bulk goods (i.e. lumber, coal, stone, apples, oil & etc.).

When Euro-American settlers arrived in Burlington the eastern margin of Lake Champlain was sandy crescent beach lying at the foot of a bluff (Figure 3). The bluff ranged from about 30.5 m (100 ft) high at the site of present day Battery Park but moderated to a low gentle slope near the foot of Maple Street. In several places, the steep bank ran directly to the waterline (Rann 1886:404). In other places, the water lay an estimated 50.3 m (165 ft) west of Battery Street (Rann 1886:404). The waterfront remained largely unmodified until ca. 1810 when Curtis Holgate built a wharf at the foot of Maple Street (Rann 1886:405). While this was a start, little else changed in regard to the shoreline over the next two decades (Young 1830).

Figure 3. Early depiction of Burlington's shoreline (Burlington Image File, Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont).

Shoreline development, especially the creation of filled land, began in earnest in the 1830s with additional wharf construction that was encouraged by the growing regional population and increased water traffic following the opening of the Champlain Canal in 1823. Development accelerated in extent and scale between ca. 1846-1853 with the arrival of the railroads, which required the creation of large areas of artificial land along the waterfront in order to connect their lines to the lake traffic and waterfront industry (Figure 4). In the late 1840s and early 1850s "filling was going on . . . as fast as

they would crib and then fill in up to the crib making a bulkhead" (Horton 1912). The creation of new land continued at intervals with the establishment and expansion of various waterfront industries from the 1850s through the 1890s (Beers 1869; Hopkins 1890; Meilbeck 1877; Presdee & Edwards 1853). The transformation of the landscape in this part of Burlington was so striking that in 1872 a local newspaper commented:

> "probably few of our own citizens even, have any adequate idea of the amount of business done in the portion of our city lying north and west of the Pioneer Shops. A resident of fifteen or twenty years ago, who has not seen or kept informed of the changes in that quarter, would say that there must be a very good reason why there should not be much business done there, in the fact that the area in question consisted either of a nearly perpendicular bank a hundred feet high, or of water. But the fifteen years or more past have wrought great changes there. The bank has been shoveled down into the lake by many thousands of cubic yards, and to-day where many of those who still call themselves young men used to go in swimming, extend miles of planked streets and lanes between the piles of lumber, covering many acres of made land" (*Burlington Free Press* February 24, 1872).

Alterations to the shoreline continued to be made into the 1960s. During this whole process, the shallow lake bottom and beach of Burlington was progressively covered and filled to make anywhere from 30.5 to 182.9 m (100 to 600 ft) of additional useable land west of the original shoreline (Horton 1912).

The creation of new land was accomplished in a variety of ways but principally by cribbing or by the construction of bulkheads. Cribbing involved the construction of a series of large squared timber and/or log chambers held together by iron rods or wooden dowel fasteners, which were built or maneuvered into place and filled with stone or sand (Crock 2001; Horton 1912; Visser et al. 1990:18). Bulkheads were linear retaining walls, which had perpendicular "dead man" anchors or ties extending into the fill (Crock 2001; Horton 1912; Visser et al. 1990:18). These were most likely used in wetland areas. However, in some places, "when they wanted to make a new pier they . . . sank a barge and filled it with stone" (Visser et al. 1990:20). In still other areas, such as in natural low lying areas or small ponds, fill such as sawdust, wood shavings, ashes/cinder, or sand was simply dumped (Crock 2001; Horton 1912). In the 20th century, rock riprap was placed along the waterfront, especially near oil tank sites, or steel sheets were driven near the 20th century buildings (Geotechnics & Resources Inc. 1962).

The whole current project area sits on manmade land, which was created in the mid-to late 19th century (Horton 1912; Visser et. al. 1990). The Moran Generating Plant stands on land that dates to ca. 1860-1862 (Beers 1869; Wainwright 1862; Walling 1857). This fill abuts land to the east that was created by railroad companies ca. 1847-1850 (Figure 5).

In the late 1850s, complaints concerning the bridges and street crossings associated with the Vermont Central/Vermont & Canada line which ran through the city and the lack of a physical connection between the Rutland & Burlington Railroad and the Central Railroad forced the Central Vermont to take on the task of creating a new route

along the lakeshore, through the high bluff, skirting the Intervale, and crossing the bridge to Winooski (Horton 1912). To create this new route, the railroad company bought much of the bluff that the Lakeview Terrace neighborhood now stands upon and by the latter part of February 1860 it was reported "three gangs of men are now at work on the line of the new connection of the Vt. & Canada with the Rutland & Burlington Railroads in pursuance of the provisions of the Act of the last session of the Legislature. The workmen are engaged on the heavy cuts and embankments on the farm of J.N. Pomeroy, Esq., north of the village" (Blow 2003:68; *The Daily Times* February 29, 1860).

While H. R. Campbell was the contractor for the technically challenging 300 ft long horseshoe-shaped brick lined tunnel, the chief engineer for the rest of the project, with its extensive embankments, cuts, and wharfing, was D.C. Linsley (*Burlington Free Press* March 2, 1860; *The Daily Times* February 29, 1860). In March of 1860, one local newspaper observed, "work upon the new route through 'the sand bank' north of the village is in active progress. We understand that the grade of the new track will be a descending one of 40 feet to the mile from the bridge over the Winooski to the interval, across which it will pass on a level, then descending again through the sand bank to the lake shore. The contractors for the principal portion of the excavation are Messrs. Charles Linsley & Co. As their contract includes the digging out of a cut some 1500 feet long by 75 to 80 feet deep, it is plain that they have some work before them" (*Burlington Free Press* March 2, 1860). Work reportedly continued both day and night (*The Daily Times* March 2, 1860). The massive amount of sand removed from the long approach to the tunnel as well as the tunnel itself probably provided much of the fill for the area within the current project area (Figures 6 and 7).

The filled land north of this (and just north of the current project area) was created primarily by the Vermont Central Railroad ca. 1868-1872, which later leased the new grounds to various lumber companies for storage. In July of 1868 the *Burlington Free Press* detailed the work being done to fill in the waterfront in this vicinity:

> "we came to the fill of some eight or nine acres now making by the Vermont Central Railroad Company for the increasing business of the Hunterstown Lumber Company, in connection with Messrs Flint and Hall. The western side of this extensive fill is formed by a pier commencing at the northerly side of the railroad company's wharf, and extending into the lake in a north westerly direction 600 ft, thence northerly for the same distance, thence 200 feet towards shore, when it turns northerly again parallel with the beach 400 feet, or nearly to the company's recent purchase of Mr. Howard, where it connects with the shore. This pier will be about 10 feet higher than low water mark. Under the efficient superintendance of Messrs. J. Bigelow and Wm. Smith, foremen of Mr. Whitney, the contractor, but two feet more of the required height is yet to be built of the main portion. A multitude of men and carts are busily dumping into the fill the earth taken from the adjacent sand bank, and a track has just been laid so that dirt carts can be used to hasten the work hereafter" (*Burlington Free Press* July 20, 1868).

In August of the same year, the paper added:

> "tracks are now laid from the sand bank north of the fill, so that dirt cars are constantly running besides horse carts. The work is being very materially advanced by an ingenious and simple but successful arrangement for securing the assistance of water power. A 2 ½ inch pipe connected with the aqueduct main near the pump, is laid part way up the sand where the excavation is being made and there empties itself into a wooden trough 1 ½ feet square, which leads to the fill. The force of this water washes down the dirt to the fill as rapidly as ten laborers can shovel it into the trough, thereby doing away with all necessity of handling the earth more than once" (*Burlington Free Press* August 17, 1868).

In the 1870s, the Vermont Central Railroad continued to build land to the north. For example, in 1872 it was reported that the Blodgett Company was to lease "six acres of the new Vt. Central fill, putting in the crib-work themselves, while the railroad company does the filling, which will be completed as soon as possible in the spring" (*Burlington Free Press* February 24, 1872).

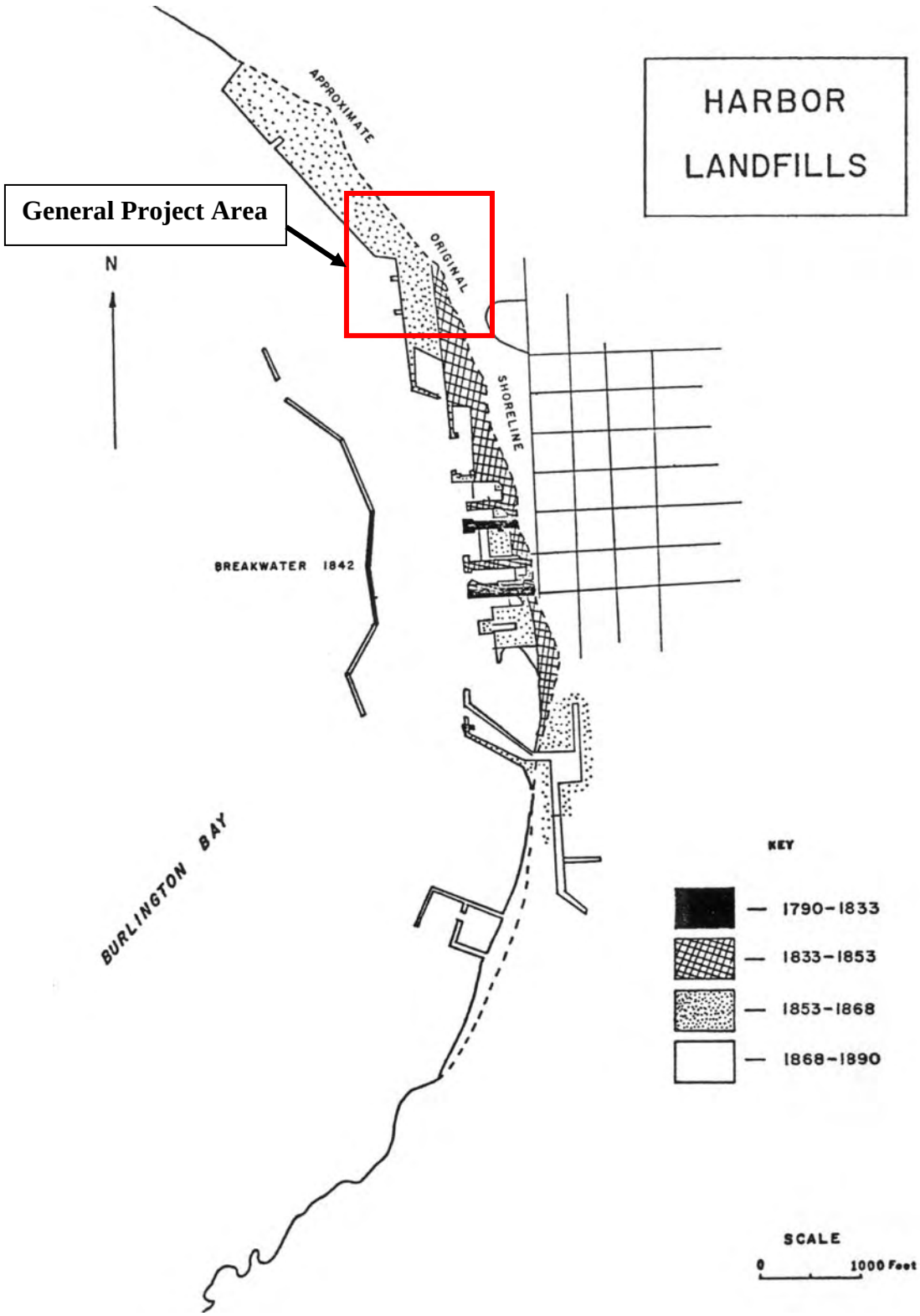

Figure 4. General progression of the Burlington harbor landfills (from Orr 1972:Figure 18).

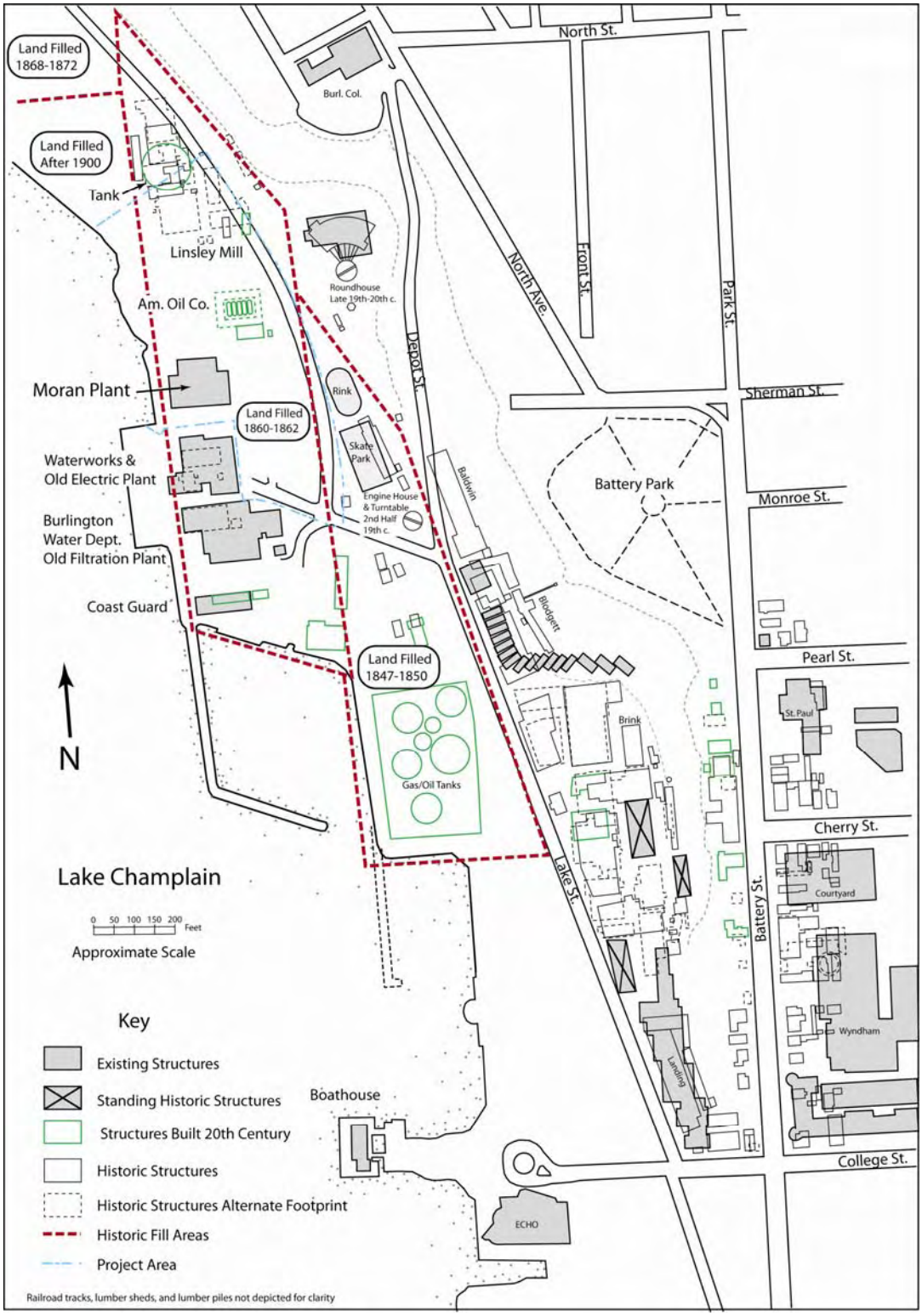

Figure 5. Schematic Map of the general project area integrating information from the Fire Insurance Maps produced by the Sanborn Mapping & Publishing Company 1869, 1885, 1889, 1894, 1900, 1906, 1912, 1919, 1926, 1938, 1942, and 1978 as well as the Presdee & Edwards map of 1853.

Figure 6. Burlington waterfront looking south; taken ca. 1866-1867, featuring the land built by the railroad ca. 1860-1862 (Burlington Photo File 1-22.43, Wilbur Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont).

Figure 7. View of the cut leading to the railroad tunnel under North Avenue, looking southwesterly, taken after ca. 1868 (Burlington Photo File 2-6.1, Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont). This image shows the filling of the area west of the bend in the tracks that is in the foreground of Figure 6. The built land in this image was created ca. 1868-1872.

The Linsley Mill

On the northern part of the land created by the Vt. & Canada Railroad in the early 1860s, S.S. Churchill & Co. built the steam powered lumber processing mill, commonly known as the Linsley Mill, in 1865-1866 (Figures 8-12) (*Burlington Free Press* February 8, 1866 and February 24, 1872). Originally, this mill specialized in processing dimension building and bridge lumber from logs brought in rafts from Ottawa, Canada (*Burlington Free Press* February 6, 1869). The 1870 Industrial Census indicates that the mill was powered by a 250 hp steam engine, which ran six saws and eighteen planes. The company kept 50 men employed year round processing $200,000 of logs into $300,000 of lumber. Beginning ca. 1871-1872, the firm of W. & D. G. Crane leased this mill to house their box factory (*Burlington Free Press* February 24, 1872; Sanborn Mapping & Publishing Company 1889). Later, in the 1890s, much of the complex was leased to the Vermont Shade Roller Company (Sanborn Mapping & Publishing Company 1869, 1889, 1894, and 1900). This mill was saved from the massive lumberyard fire of December 14, 1894 (*Burlington Free Press* December 25, 1894).

However, the southernmost section of the Linsley Mill complex (lying just within the northern part of the current project area) that was built in the 1860s and enlarged in the 1890s was destroyed by fire between 1900 and 1906 (Sanborn Mapping & Publishing Company 1869, 1894, 1900, and 1906). A small two story office and garage was built on the vacated land between 1906 and 1912, but this was removed between 1926 and 1938; probably when the rest of the Linsley Mill complex (located just north of current project area) was razed (Sanborn Mapping & Publishing Company 1900, 1906, 1926, and 1938). Subsequently, between 1926 and 1938, the area within the northern portion of the current study area became the site of five aboveground gasoline storage tanks (surrounded by a 4 ft high earthen dyke) belonging to the American Oil Company (Sanborn Mapping & Publishing Company 1926 and 1938). This company also built an office and garage just south of the tanks (see Figure 14) (Sanborn Mapping & Publishing Company 1926 and 1938). By 1962, however, the whole area was occupied by the massive coal pile for the Moran Generating Plant as well as one large bulk storage tank (see Figure 17) (Geotechnics & Resources Inc., 1962).

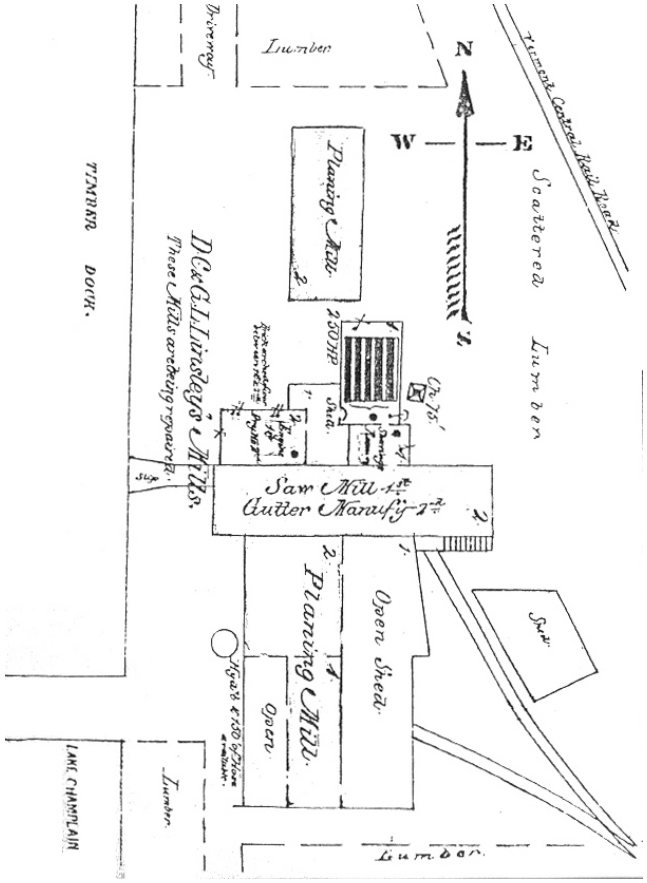

Figure 8. Early layout of the Linsley Mill (Sanborn 1869). This mill would undergo several significant changes before being removed in the early-to-mid 20th century.

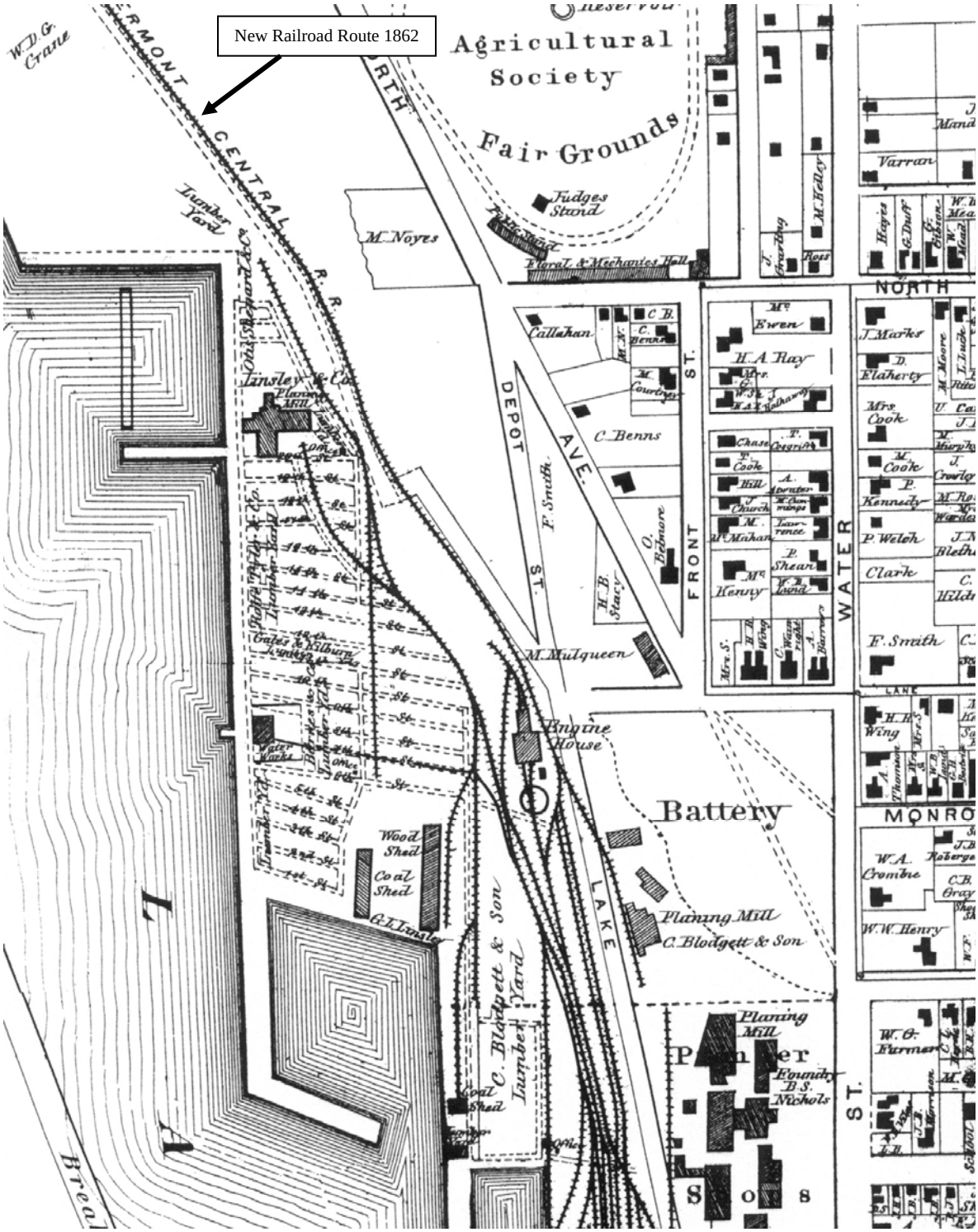

Figure 9. Detail of the 'Plan of the City of Burlington,' in F.W. Beers' *Atlas Chittenden County, Vermont* (1869).

Figure 10. View of the Linsley Mill. This mill stood upon land built ca. 1860-1862. The lumber piles in the background sit on land built ca. 1868-1872. The site of the Moran plant is to the left, out of frame of this image. The basin in front of the mill was largely filled in the 20th century. Note the large area of un-vegetated sand in foreground. Much of the fill used to build the northern end of Burlington's waterfront was sand removed from the shoreline bluffs.

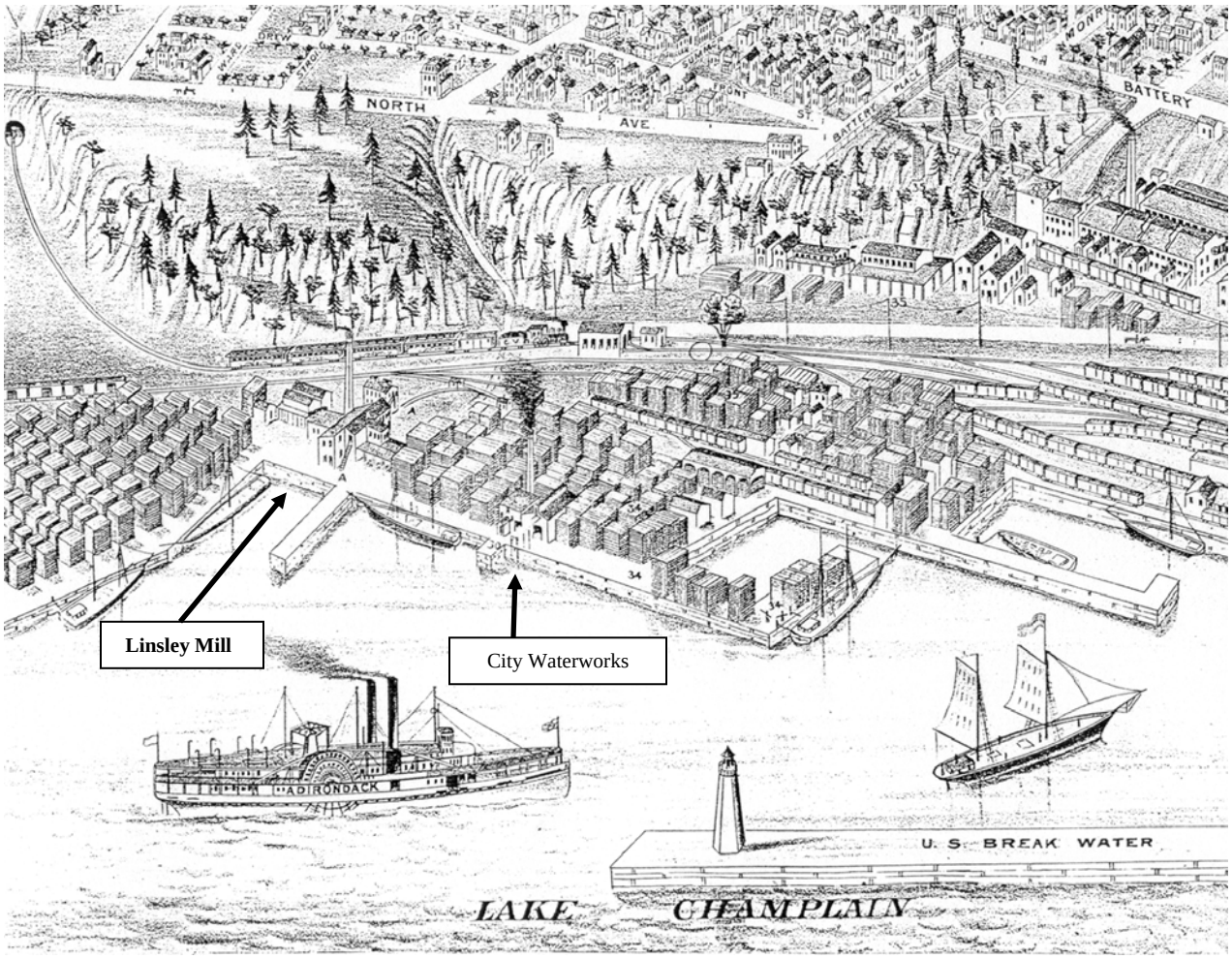

Figure 11. Detail of Meilbek's 1877 Birds-eye View of Burlington (Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont). The Moran plant was built on the site of the lumber piles located between the city waterworks and the Linsley Mill in this illustration.

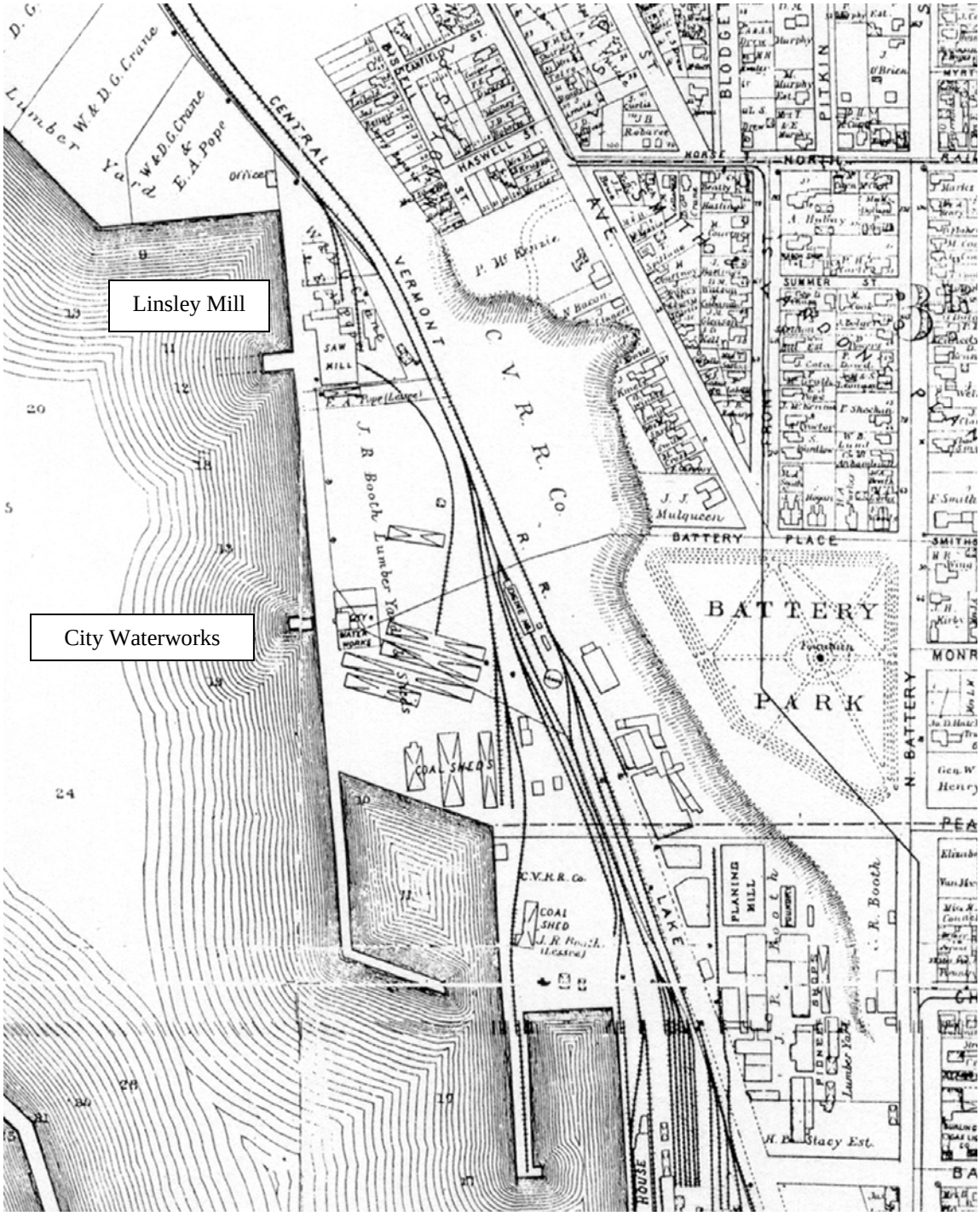

Figure 12. Detail of G.M. Hopkins' *Map of the City of Burlington, Vermont* (1890).

Municipal Waterworks

Also on part of the filled land created ca. 1860-1862 the City of Burlington built its first municipal waterworks in 1867 (Figure 13). Previous to this time, the residents of Burlington obtained their water from a variety of sources. Part of the city was supplied by the Burlington Aqueduct Company (est. 1849), which maintained a reservoir on Pearl Street (Rann 1886:442). Other households relied on springs, wells, cisterns, and even water deliveries from the Lake (Thayer 1866). The switch to city water was, in part, prompted by growing the concern that private wells could be easily contaminated by seepage from the numerous privies required by an expanding population. Outbreaks of cholera in the 1830s and 1840s that ravaged parts of the United States (although not Burlington) convinced many in more urban areas to make the investment in public water systems (Thayer 1866). On October 21, 1867, the *Burlington Free Press* noted, "the construction of the city water-works [by Spear & Thayer] continues in active progress, and the heaviest portions of the work approach completion" (*Burlington Free Press* October 21, 1867). The pump house on the lakeshore had a 80-85 foot chimney stack and was equipped with an Worthington engine capable of pumping 300,000 gallons up to the large reservoir on Main Street near the University of Vermont in ten hours (*Burlington Free Press* October 21, 1867; Sanborn Mapping & Publishing Company 1869). This facility began operation on December 25, 1867 (*Burlington Free Press* December 26, 1867).

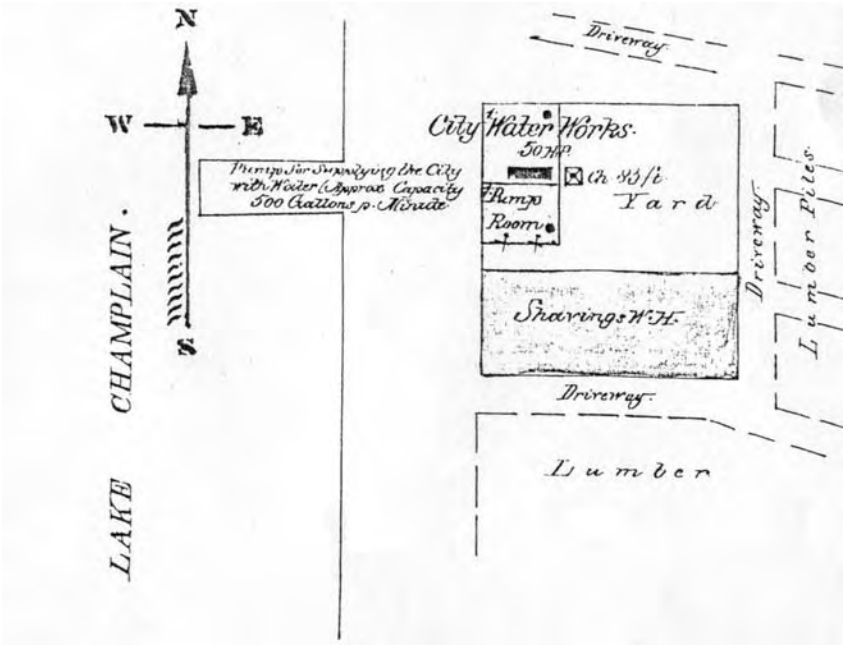

Figure 13. The original City Waterworks (Sanborn Mapping & Publishing Company 1869). This building had iron shutters, iron doors, and a tin roof (*Burlington Free Press* December 25, 1894).

The water system was not an immediate success. Many of Burlington's residents were convinced that the persistence of typhoid fever and intestinal disorders in the city

were the result of the close proximity of the plant's water intake pipe to the city's sewage discharge pipe (Perkins 1906:278-280). The problem was not satisfactorily resolved until ca.1894-1895, when an extension of the intake pipe three miles out into the lake to Appletree Point reef put "the purity of [the] water supply . . . beyond question" (*Burlington Free Press* April 2, 1895; Perkins 1906:278-280).

On a very windy Christmas Eve 1894, a fire began "in the old railroad woodshed directly west of the foot of Pearl Street," which was then being used "by the Vermont Shade Roller Company as a storehouse for stock, which was dry and of a size that burned readily" (*Burlington Free Press* December 25, 1894). The fire soon spread to the extensive lumberyard of J.R. Booth. The ensuing firestorm could be seen in Plattsburg and illuminated the night sky in Essex to the degree (it was said) that a newspaper could be read at Fort Ethan Allen (*Burlington Free Press* December 25, 1894 and December 26, 1894). By the time it was over, more than 15 acres of lumber piles, several woodsheds, two unoccupied offices, and a number of freight cars (some loaded with coal others with barrels of oil) were destroyed and the engine house belonging to the Central Vermont Railroad was slightly damaged (*Burlington Free Press* December 25, 1894 and December 26, 1894). The fire so completely consumed the stacks of lumber that "the strong winds from the south during the fire and from the northwest during the day had scattered the ashes so that the ground was as clean as an open field" (*Burlington Free Press* December 26, 1894).

Despite the fact that it was surrounded on three sides by burning stacks of lumber, the city's pumping station not only survived, but through the efforts of the city engineer, Joel W. Thomas, and his assistant, kept operating (*Burlington Free Press* December 25, 1894 and December 26, 1894). The heat "there was so intense as to crack and splinter the granite coping on top of the well" and warped the iron girders of the adjoining brick fuel shed (*Burlington Free Press* December 25, 1894 and December 26, 1894). "The wooden building over the pump well was destroyed, its tin roof and cinders falling into the well" and the cornice of the waterworks were slightly singed (*Burlington Free Press* December 25, 1894 and December 26, 1894). Following the fire, an agreement was made with the Central Vermont Railroad Company "for the lease of additional ground about the pumping station, which would keep all other buildings or any piles of lumber a sufficient distance [away] to make the pumping station safe in case of another fire" (*Burlington Free Press* December 25, 1894 and April 2, 1895).

Municipal Electric Plant / Moran Plant

After two major fires in the lumber stacks on the waterfront near the current project area in 1894 and 1895, there was "a substantial decline" in Burlington's lumber industry due to western competition and to the dwindling lumber imports from Canada caused by the Dingley Tariff of 1897 (Corey and Petersen 1998:22). In the 20th century portions of the once bustling lumberyards were converted to new uses; specifically electric power generation and the storage of petroleum products.

In the fall of 1904, the City of Burlington began construction of a municipal electrical light plant immediately east of the waterworks (Figure 14) (City of Burlington 1906:53; Sanborn Mapping & Publishing Company 1900 and 1906). This building was ready for the installation of its steam and electrical equipment in January of 1905 (City of Burlington 1906:53). On April 29, 1905 the Burlington Electric Department began service when current flowed to two circuits of streetlights (City of Burlington 1906:53).

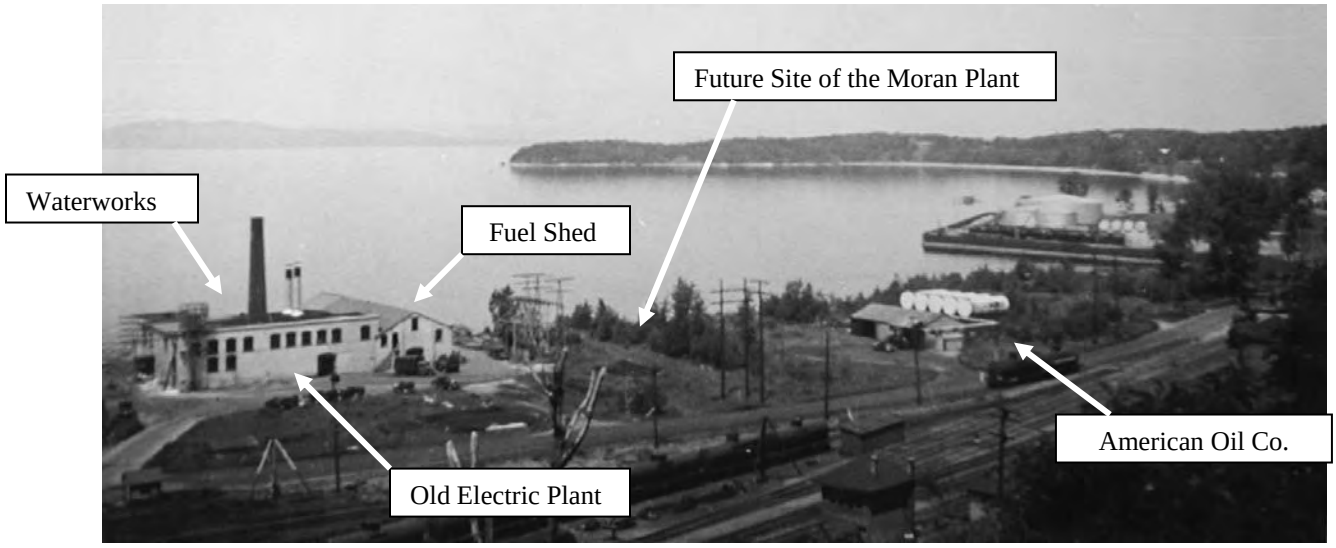

Figure 14. Burlington's first municipal electric plant built 1904-1905 (Burlington Photo File, Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont). The fuel shed of the city waterworks was originally located on its south side. The present brick building was constructed between 1877 and 1889 (Meilbek 1877; Sanborn Mapping & Publishing Company 1889).

The old municipal electrical plant, described above, continued in service until the 1950s. However, occasional power shortages in the years after World War II highlighted the need for a new facility. The coal fired J. Edward Moran Generating Plant was built in 1952-1954 immediately north of the city waterworks and old electric plant (Figures 15-17) (Blow 2003:69). Unfortunately, placing such a large coal burning plant up wind of the city proved to be problematical. The Lakeview Terrace neighborhood, which began to develop in the late 1880s on the top of the bluff to the east suffered acutely. The plant "regularly spewed out fly-ash and soot that proved difficult to clean up. A large cloud of black smoke hung over the entire neighborhood. Women who hung their clothes outside often found it covered with black fly-ash cinders and soot" (Blow 2003:69). After being cited in 1975 for violating EPA emission limits, the city attempted to convert the Moran plant to a wood burning facility. In 1977, the Moran Plant began burning wood chips as part of an experiment, which eventually led the city to build the McNeil Generating Plant on the intervale north of the city in the early 1980s (Blow 2003:69, 83). The Moran Plant was shut down in June of 1986 and has stood vacant since (Blow 2003:69).

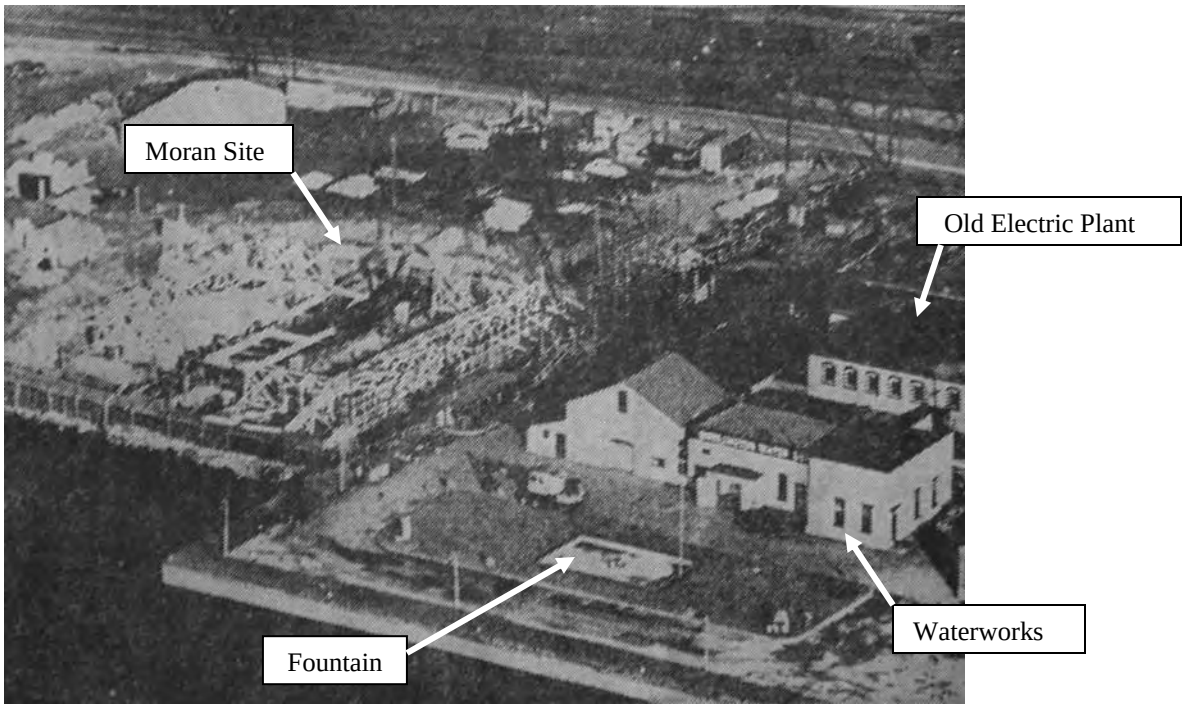

Figure 15. Aerial view of the Moran Generating Plant construction site in January of 1953 (Newspaper Clipping Collection: Burlington. Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont).

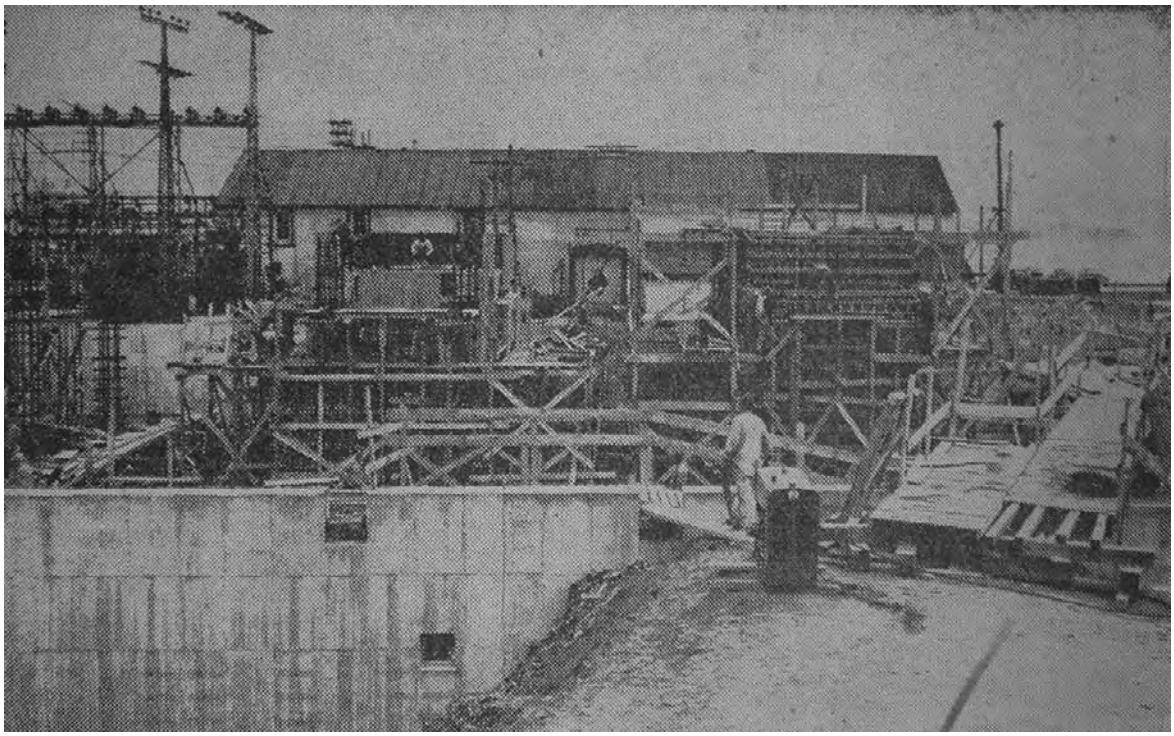
Figure 16. Construction of the Moran Generating Plant, looking south. The north wall and roof of the waterworks/electrical plant's fuel shed can be seen in the background (Newspaper Clipping Collection: Burlington. Special Collections, Bailey-Howe Library, University of Vermont, Burlington, Vermont).

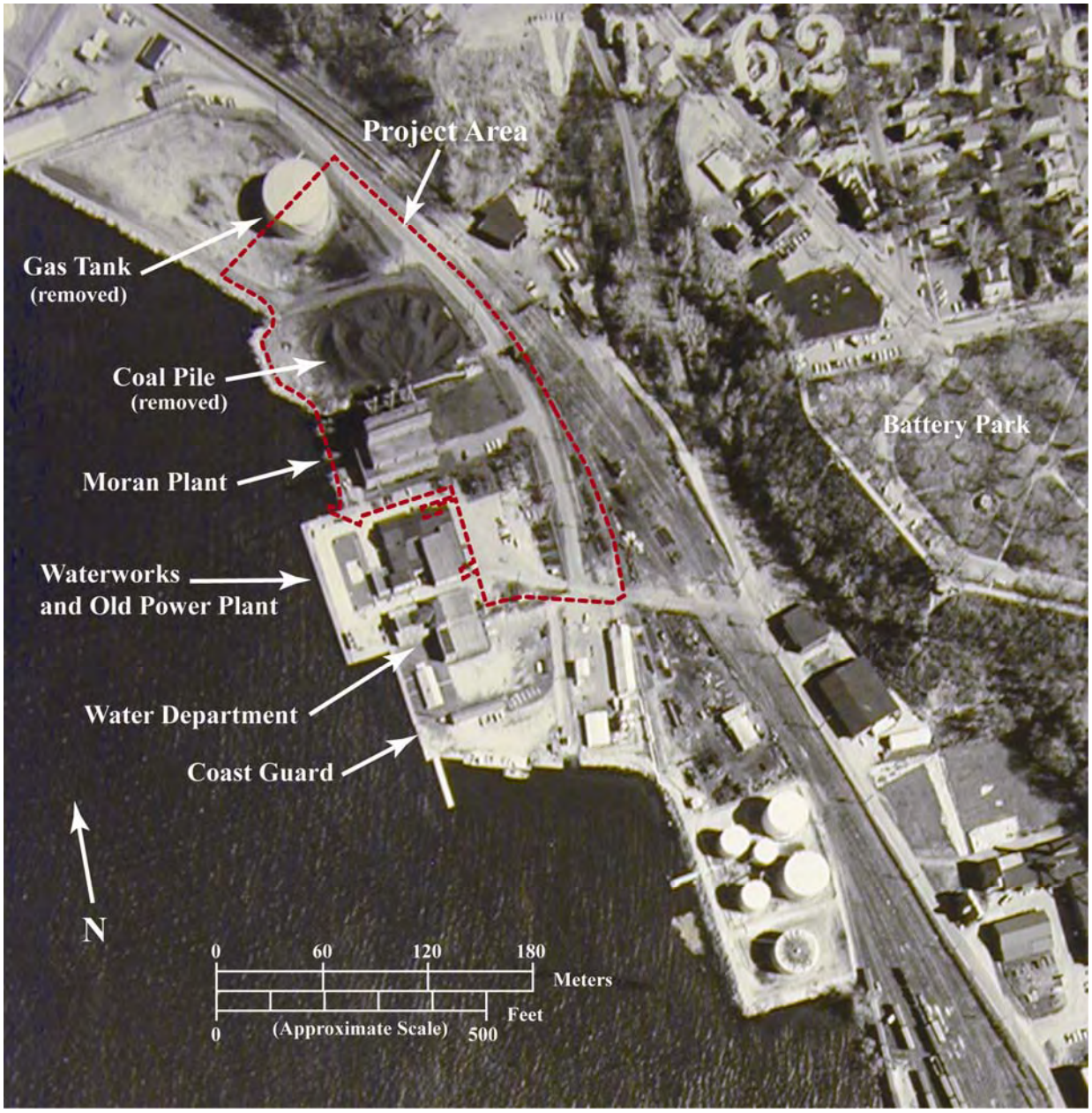

Figure 17. Detail of a 1962 aerial photograph showing general study area (Geotechnics & Resources Inc. 1962).

Conclusions and Recommendations

The land within the current project area is all manmade, created after the mid-1800s. Therefore, no precontact Native American sites are expected in this area. Historically, most of this land was used for railroad tracks, lumber piles, storage sheds, shaving sheds, lumber sheds, coal storage, and gas/oil tanks. Some historic features that may remain within the project area include traces of water tanks (for fire suppression), footings for sheds, railroad track beds, foundations for lumber or petroleum company field offices / garages (possibly concrete pads), and old waterlines. These are not

considered archaeologically significant. However, the northernmost portion of the project area reaches into the southernmost part of the mid-19th to mid-20th century Linsley Mill complex. While some subsurface physical remains of this complex may exist within the current project area, the extensive documentary sources available (especially the fire insurance maps, newspaper articles, and census records) combined with the probable ground disturbances in the area (i.e. site clearing after the early 20th century fire, the construction of the large storage tank in the mid-20th century and/or the building of the road/bike path), it is considered unlikely that further work would produce new information about the layout, fixtures/equipment, and/or use of this site. Finally, although the old bulkheads that once ran north-to-south just west of the Linsley Mill complex probably still survive within the current project area, these features are not considered archaeologically significant and the fills near them are most likely saturated and unstable at depth. Therefore, no further archaeological work is necessary prior to the proposed environmental testing or any future redevelopment of the broad Moran Center project area. We recommend that the proposed environmental testing and the redevelopment of the Moran Center receive a determination of No Historic Properties Affected.

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