Highlands Center

Cape Cod National Seashore
North Truro, Massachusetts

BUILDING CONDITION ASSESSMENT
Title I Facilities Planning
Task Order 13

November 1, 2000

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I. General Overview

Executive Summary

We were retained by the National Park Service, Boston Support Office (NPS-BSO) and Cape Cod National Seashore (CACO) to provide a comprehensive condition assessment for a representative sampling of buildings at the former North Truro Air Force Station, now part of Cape Cod National Seashore. The proposed use for the buildings surveyed is an education, research and conference facility to be known as the Highlands Center for the Arts and Environment. This study reports on our inspection and evaluation of the buildings designated by NPS and references applicable building code requirements and upgrades that will be necessary for the buildings to be rehabilitated for this use. Prepared in a building-by-building worksheet format, the assessment includes detailed backup materials.

The report contains detailed recommendations and summary conclusions regarding building upgrade and reuse. Geared toward a successful Highlands Center reuse scenario intended to be both realistic and open-minded, our findings envision retention of all of the study buildings.

Approach and Procedure

Our approach entailed a comprehensive existing building condition analysis and hazardous building materials analysis and an assessment and evaluation of building upgrade needs. Assumptions made with regard to the new uses of the buildings and applicable code requirements are discussed in both the architectural and M/E/P components of this report. While a reasonably strict interpretation of the Massachusetts State Building Code – together with such industry standards as National Fire Protection Association (NFPA) certification and Underwriters Laboratories (UL) listing – dictates removal and replacement of many components affecting the comfort and safety of occupants, our recommendations for retention and repair of certain existing building materials, fixtures and systems are mindful of provisions of the Massachusetts State Building Code, 780CMR Chapter 34 (which allows for retention of existing building systems, under certain conditions) and of NPS sustainability practices; refer to the sustainability analysis and recommendations.

Base building data, including approximate construction dates, was compiled from previous reports supplied by NPS. The Park Service had previously determined that none of the structures included in the study have historical significance.

The building condition analysis looks at existing exterior roof, wall, trim, and foundation conditions, as well as interior ceiling, wall, trim, and floor conditions. Foundation structure and floor, wall and roof framing systems were also documented in plan drawings and evaluated, and existing windows and doors were visually inspected. Life safety code applicability was considered and recommendations were made to bring each building up to code, according to the proposed use or uses. All buildings of public accommodation will require alterations to achieve universal accessibility; in addition, full accessibility is proposed for one of the existing single-family houses.

Most buildings evidence minor structural damage at best and require more or less cosmetic exterior envelope repairs, although most doors and windows are damaged or deteriorated beyond repair. Cracks in concrete block wall infill panels were determined to be repairable at reasonable cost. Required structural repair or alteration, building envelope repair or renewal and code-related upgrades were considered.

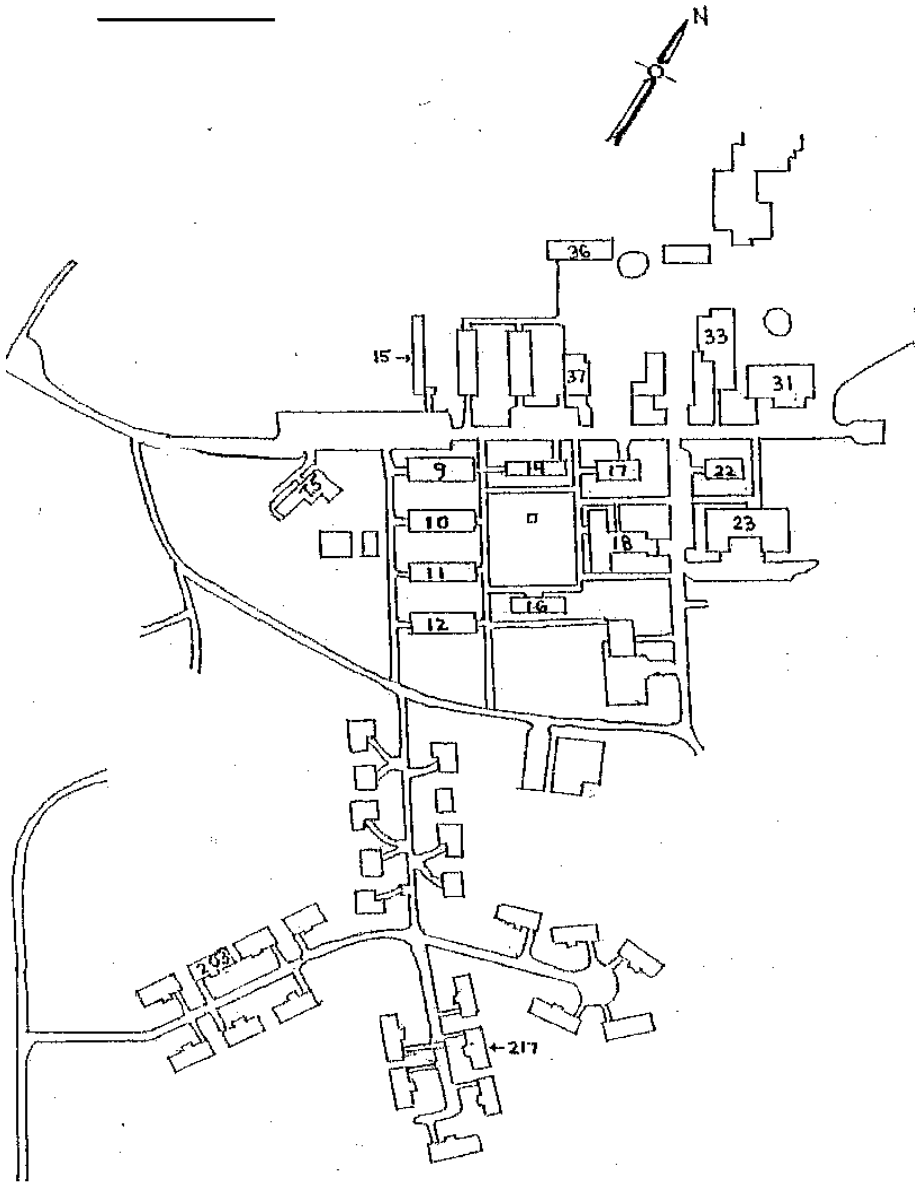
The Mechanical/Electrical/Plumbing section of the report describes all mechanical, electrical, plumbing and fire protection systems and identifies components that are reusable. While lavatories, janitor's sinks and some kitchen equipment remain candidates for refurbishing, all piping, faucets and valves are considered to be past their useful service life; most of these systems are too deteriorated to provide reliable and safe service. In addition, "low-flow" and other requirements dictate replacement of water closets, showers, etc. Recommendations for new systems are included.

The hazardous materials inspection involved on-site visual observation, limited destructive testing and collection of samples for laboratory testing. Results are included in the report, together with abatement recommendations and cost estimates. The inspection and analysis covers asbestos-containing materials, lead-based paint, oil and containers of other potentially hazardous materials.

Finally, the report contains detailed recommendations geared toward building upgrade reuse. We have concluded that all buildings included in the analysis are feasible candidates for reuse, with the understanding that extensive replacement of piping, wiring and other mechanical systems and equipment is required to bring them up to current code and life safety requirements and reasonable human comfort standards. Rehabilitation costs are likely to be high because most of the individual buildings are small; significant economies of scale would result from cooperative construction management and/or shared resources.

While one building (T5) has extensive foundation problems in one section only (and requires typical envelope and building systems upgrades), we believe that reconstruction of this section to accommodate the NPS anticipated uses could be seen as an opportunity for a prominent new "gateway" structure bringing together faculty, staff and students and inviting visitors into the Highlands Center.

Site Plan



List of Buildings Surveyed

Building #T5-Building Non-Commissioned Officers' Club
Building #9- Dormitory
Building #14-Library
Building #15-Bowling Alley
Building #16-Multi-purpose / Recreation
Building# 17-Post Exchange
Building# 18-Dining Hall
Building #22-Theater
Building#23-Bachelor Officer's Quarters
Building # 31 -Electrical Power Plant
Building # 33 -Recreation
Building #36-Maintenance Shop
Building #37-Vehicle Maintenance Facility
Building # 203 -Residence
Building #217- Residence

II. Architectural Overview

Architectural Overview

Introduction

The architectural and structural observation and assessment of the subject Highlands Center buildings followed review of materials provided to the A/E by the National Park Service (NPS) and coincided roughly with the hazardous materials ("hazmat") and MEP systems reviews. Using a custom-designed worksheet format created prior to the fieldwork, team members proceeded to investigate the structures, verifying or correcting data transcribed from earlier reports wherever possible.

Measured, diagrammatic floor and roof plans were provided to illustrate construction techniques and locate problem areas, and are included.

Assumptions

1. Construction dates for existing Highlands Center buildings are as listed in earlier reports provided by NPS; no historical research was undertaken as part of the Building Condition Assessment work.

2. Observing and entering building interiors and crawl spaces and accessing roofs where possible, the architectural and structural review teams relied mostly on visual inspections. Estimated quantities related to required repair and replacement assume a certain extent of concealed conditions based on prior experience.

3. Although exposed architectural elements potentially containing hazardous materials were observed in the course of the architectural review, no hazmat assessments were performed by the architectural/structural teams; refer to environmental assessments and estimates.

4. Assumption is made that the subject buildings will be upgraded to meet the provisions for new construction of Massachusetts State Building Code, 6th Edition, 780 CMR, except in those instances discussed in the Code Analysis section where Article 34 provides relief.

Typical Architectural/Structural Items

1. Regarding wood-shingled buildings, it was observed that weathering and deterioration differ markedly depending upon exposure to prevailing winds and weather. Shingle replacement work includes patching on some elevations and total replacement on others. Repair and patching of soffits and trim are included where required.

2. Field investigations included accessible building attics and crawl space; framing systems are noted on dimensioned plan diagrams. Existing roofs of unusually low pitch were singled out for comment because they will require additional maintenance and are more susceptible to leakage. Area estimates for repair and replacement of concealed framing and sheathing are approximate and based on the condition of the adjacent interior and exterior finish materials.

3. Areas of specific water damage (e.g., foundations at Building T5 and portions of Building 23) are noted in the building survey reports.

4. Cracks observed in sections of concrete masonry unit (CMU) walls appear to result from thermal expansion/contraction and weathering rather than from settlement of foundations. Indeed, buildings with observed cracks and damage have steel or concrete frames with CMU infill; repair and repointing are called for.

5. Other than isolated areas of rotted trim, no insect infestation was observed. Overall, structural framing was observed to be in good-to-excellent condition – owing, probably, to adequate natural ventilation and sandy soil conditions.

6. Proposed architectural upgrades include installation of blown cellulose or batt insulation.

7. Architectural work items include cutting and patching allowances, as well as general interior cleanout and mildew treatments.

8. New floor, wall and ceiling finishes throughout are assumed, as are repair and/or replacement and painting of all interior doors and trim.

9. Basic accessibility improvements (regraded walkways, wheelchair ramps) are included.

10. Exit doors in buildings used for assembly purposes must be fitted with panic hardware; elsewhere, new and refurbished doors shall have accessible lever hardware.

III. Building Code Review

Applicable Building Code Analysis

General

The relevant building codes for alterations and repairs of the various buildings comprising the proposed Highlands Center at Cape Cod National Seashore include the Uniform Building Code (UBC); the Life Safety Code, National Fire Protection Association 101 (NFPA) 1999; Alternative Approaches to Life Safety, NFPA 101 M; and the Massachusetts State Building Code (780 CMR), 6th Edition. Since the buildings are not considered historic, the Uniform Code for Building Conservation (UCBC) would not apply.

In general, the National Park Service promotes meeting the most stringent applicable code requirements.

UBC versus Massachusetts State Code

The UBC is the applicable building code for federal properties. The purpose of the code is to "provide minimum standards to safeguard life or limb, health, property, and public welfare..." (Section 101.2). The scope of this code applies to alteration, repair and maintenance of any building within its jurisdiction (Section 101.3). However, because anticipated renovations and additions executed for the Highlands Center will be undertaken by tenants pursuant to long-term leases, rather than by the National Park Service itself, the State Building Code (the "State Code") is the most appropriate reference. In any case, UBC and State Code occupancy provisions are very similar.

Various use, occupancy and egress provisions of the State Code apply to the range of proposed uses at Highlands Center, together with the individual chapters dealing with fireresistance of materials, automatic fire detection and suppression systems, plumbing, electrical work and energy conservation. Refer to the Building Code Use Assumptions and code analysis text below.

Building Classification

The State Code requires all structures to be classified with respect to occupancy in one or more of the use groups defined by 780 CMR 302.0. Specific occupancy areas which are incidental to the main use group(s) shall be separated and protected (per Table 302.1.1); separation/protection requirements may vary, depending upon whether specific occupancy areas are required to be protected with an automatic fire protection system. Use groups and construction types largely determine the limits and restrictions in applicable State Code sections.

Means of Egress

A reasonably safe means of egress from all structures must be provided. Every floor area shall be provided with the minimum number of approved exits. Per 1009.3, where exits serve more than one floor, only the occupant load of each floor considered individually shall be used in computing the required capacity of the exits at that floor, provided that the exit capacity shall not decrease in the direction of travel.

Where a building is occupied by two or more occupancies, the means of egress requirements shall apply to each portion of the building based on the occupancy of space (1004.3).

Per 1001.2, where strict compliance with the State Code provisions is not practical, the code official shall approve alternative means of egress which will accomplish the same purpose.

Chapter 34

Unique to Massachusetts, the provisions of Chapter 34, Repair, Alteration, Addition, and Change of Use of Existing Buildings (780 CMR 34) are intended to maintain or increase public safety, health and general welfare in existing buildings by permitting repair, alteration, addition and/or change of use without requiring full compliance with the State Code for new construction. Where compliance with the provisions of the

State Code for new construction are impractical *because of construction difficulties or regulatory conflicts*, compliance alternatives (as described in 780 CMR 3406.0) may be accepted by the building official.

Building Systems: Building systems are defined in 3401.0 as "any mechanical, structural, egress, electrical, plumbing, building enclosure and/or fire protection system, or fire resistive construction system, or portion thereof." Per 3404.3, any new building system must conform to new construction provisions of the State Code to the fullest extent practical. However, individual components of an existing building system may be repaired or replaced without requiring that system to comply fully with the code for new construction (unless specifically cited in 3408, and subject to the following Hazard Index restrictions).

Hazard Index: The provisions of Chapter 34 applying to repair, alteration, addition or change in use of existing buildings depend upon the proposed change in use group and, in particular, the resulting amount of change in *Hazard Index* (as determined by 780 CMR 3403). Proposed continuation of the same use group, or proposed change in use group resulting in a change of Hazard Index of one or less shall comply with Chapter 34. However, a change in use group with Hazard Index of two or more greater than the Hazard Index of the existing use must generally comply with the requirements of the State Code for new construction (except that structural systems determined by inspection/analysis to be adequate – or properly strengthened and/or supplemented -- may be retained, per 3408.0). Refer to the Mass. Code Assumptions chart for Highlands Center study buildings affected by this provision.

Hazard Index Modifier: When a building is classified in construction type 2C or 5B, it is necessary to add one to the Hazard Index (identified in Table 3403) for the applicable proposed new use group. This provision affects most of the Highlands Center buildings, which are unprotected frame structures.

Assembly and Residential Use Group Exceptions: The following exceptions to provisions of Chapter 34 (3400.3) apply to the proposed Highlands Center: A change from any other use group to an assembly use group (A) or any alteration or change in occupancy within an assembly use group shall comply with the requirements of the State Code for new construction. Similarly, a change from any other use group to a residential use group (R) or any alteration or change in occupancy within a residential use group shall comply with the requirements of the State Code for new construction (except earthquake requirements need only comply with 3408.0).

Special Provisions for Means of Egress: Existing, non-conforming means of egress (including less than the required number of means of egress, and/or insufficient width and unsafe arrangement of egress) is treated as a violation. Although Chapter 34 does not provide specific relief from means of egress requirements of the State Code for new construction, certain compliance alternatives may be accepted by the building official.

It should be noted for comparison that UBC Appendix Chapter 34, Existing Structures, is similarly intended to allow alterations that do not conform with the minimum requirements of the code for new construction but which provide a reasonable degree of safety to persons occupying existing buildings, for most occupancies. Regarding number of means of egress, UBC allows an exterior fire escape complying with Section 3407.4 to qualify as one of the two required means of egress from a second floor. Per 3407.2, UBC stair dimensional requirements (9" max. tread; 8" max. riser) and stair widths (30" min.) offer an extra degree flexibility, relative to the Mass. Code.

Compliance Alternatives: Appendix F of the State Code exists to assist building officials in judging the acceptability of compliance alternatives to specific provisions otherwise required. Appendix F-201.0 contains generally acceptable compliance alternatives and illustrative examples. Regarding number of exits (F-202.1), general compliance alternatives may include providing alternate egress facilities

(e.g., windows), a fire escape or fire-rated areas of refuge. Regarding enclosure of exitways (F-202.3), compliance alternatives may include improvements to existing enclosures, introduction of a partial fire suppression systems or addition of a detection system. Compliance alternatives for fire separation and partitions (F-203.1) include improving fire separation or adding fire suppression and/or detection systems.

Ordinary Repairs: Ordinary repairs (conforming to 780 CMR 110.3 (4), 780 CMR 2 and 780 CMR 902) may be performed without a building permit. Although the proposed changes in use and the scope of rehabilitation work required for the Highlands Center transformation preclude its applicability, this provision may apply to future, minor work.

Accessibility

Accessibility provisions of the Americans with Disabilities Act (ADA) should apply to all Highlands Center facilities open to the public and/or used by employees, including offices, laboratories and dormitories. As federally-owned property, the Uniform Federal Accessibility Standards (UFAS) currently applies; however, if the subject buildings are offered to private redevelopers subject to local codes, the provisions of Massachusetts Access Board Regulations (MAAB) should take precedence. MAAB Regulations are similar to UFAS and ADA Standards, with minor differences in interpretation and detail.

In the context of Highlands Center building rehabilitation, MAAB and UFAS regulations address exterior and interior accessible routes, including walkways, ramps, entrances, doors and doorways, in addition to stairs and elevators. Kitchens and toilet rooms are covered, as well as dwelling units. Areas of nonconformance are easily correctible in most instances and relate to architectural barriers such as steps and door thresholds. In some buildings, corridors and vestibules are too narrow and may need to be enlarged as part of an adaptive use renovation; however, no major accessibility work of this type is envisioned except for the proposed remodeling of Building 217 into an accessible residence.

All new toilet rooms and kitchens proposed in this Report are intended to meet applicable MAAB and UFAS standards and to conform to the intent of the ADA. In some instances, existing bathrooms will require reconfiguration or relocation; cost estimates include allowances for new partitions.

Most of the existing buildings proposed for Highlands Center upgrade and reuse have one, two or three concrete steps at doorways and are, therefore, not fully accessible to persons with physical disabilities. Where landscape areas surrounding the subject buildings appear suitable for regrading, allowances are included in the cost estimates for walkway accessibility improvements; otherwise simple wheelchair ramps at primary entrances are envisioned.

While the existing single-family residences intended for occupancy by persons with disabilities will require extensive remodeling, the thorniest accessibility improvements challenge relates to conversion of Building 23 into new upstairs dormitories; here, existing unit layouts defy accessibility requirements regarding thresholds, corridor widths and wheelchair approach and turning requirements. More obvious accessibility requirements here and at other multi-story buildings include the addition of limited-use/limited applicability (LULA) elevators.

Several ADA provisions (e.g., appropriate ambient lighting levels, fire detection and alarm device locations, faucet and knob hardware) relate more to tenant rehab and fit-out and were not addressed in this feasibility study. Where sinks or other fixtures are determined reusable, it is assumed that they will be relocated (in conjunction with required re-piping work) and refitted with appropriate new accessible hardware.

PRELIM. BLDG. DISPOSITION AND MASS. CODE USE ASSUMPTIONS FOR BUILDING CONDITION ASSESSMENT

Former North Truro Air Force Station **(Based on materials received from Cape Cod NS, November 1999)**

NO	BUILDING	AREA (SF)	POSSIBLE USE(S)	EXISTING MA. CODE OCCUPANCY (ASSUMED)	PROPOSED MA. CODE OCCUPANCY	CHANGE IN HAZARD INDEX[3]	ASSUMED MA. CODE OCCUPANCY (MOST RESTRICTIVE INTERPRETATION)
T5	NCO Club/Mess	3,625	Social center with meeting, gallery space and several offices	A-2	A-3; B as accessory use	-1	318 ("concentrated" assembly w/ chairs only in 2,225 sf) + 14 (at 100 sf/occupant) = 332
9	Administration/ Dormitory	5,780	Dorm, studio space or office space	B; R-2	R-2 and/or B[2]	+1	32 (Dorm - actual); 58 (Shop); 58 (Office)
14	Library	1,742	Meeting, office or studio space[1]	A-3	A-3 (if meeting space >50 occupants), B[2]	+1 (OR –1 if B use)	116 ("unconcentrated" assembly w/ tables & chairs); 18 (Shop); 18 (Office)
15	Bowling Alley	1,987	Studio space[1] or bowling	A-3	B[2] (if <50 occupants)	-3	20 (Shop); 10 (2 Bowling Alleys)
16	Recreation/ Multi-Purpose	1,960	Meeting, office or studio space[1]	A-3	A-3 (if meeting space >50 occupants), B[2]	+1 (OR –1 if B use)	131("unconcentrated" assembly w/ tables & chairs); 20 (Office); 20 (Shop)
17	Exchange Sales Store; Base Supply	1,650	Meeting, office or studio space[1]	M	A-3 (if meeting space >50 occupants), B[2]	+2	110 ("unconcentrated" assembly w/ tables & chairs); 17 (Office); 17 (Shop)
18	Dining Hall	4,680	Dining facility/community center	A-3	A-3	+1	185 ("unconcentrated" assembly w/ tables & chairs in 2,775 sf) + 20 (at 100 sf/occ.) = 205
22	Theater/HQ	1,340	Meeting area with offices or smaller meeting rooms	B	B (if meeting spaces w/ <50 occ.)	+1 (if B use)	40 (actual fixed seats + wheelchair spaces) + 6 small mtg spaces. in 550 sf) = 46
23	Dormitory/ BOQ	11,240	Conference center with meeting space, offices, and overnight accommodations; laboratory facilities with same	R-2	R-2 (dorm) with accessory OR separated B[2] (if mtg. spaces, labs <50 occ.)	+1	28 (2nd Flr. Dorm - actual) + 1st Flr.: 57 (Lab) OR 57 (meeting spaces < 50 occupants in 5,620 sf) = 85
31	Power Plant	6,564	Shop or studio space[1], theatre	F-1	F-1 or F-2; A-3 (if theater >50 occupants)	+1; +3	66 (Shop); 398 (turbines removed; "concentrated" assembly w/ chairs only in 2,785 sf;) + 38 (at 100 sf/occ.) = 436

No	Building	Area (SF)	Possible Use(s)	Existing Ma. Code Occupancy (assumed)	Proposed Ma. Code Occupancy	Change in Hazard Index[3]	Assumed Ma. Code Occupancy (most restrictive interpretation)
33	Multi-Purpose/ Recreation Building	5,460	Theater	A-3	A-3	0	226 ("concentrated" assembly w/ chairs only in 1,580 sf) + 67 ("unconcentrated" assembly w/ tables & chairs in 1,000 sf) + 29 (at 100 sf/occ.) = 322
36	Maintenance Shop	2,470	Maintenance shop with offices	S-1	S-1 with accessory B (no open flame/welding)	0	4 (garage) + 15 (at 100 sf/occupant) = 19
37	Auto Maint. Shop	2,200	Shop or studio space[1]	S-1	B[2]	0	22 (Shop)
203	Family Housing	1,648	Residence	R-4	R-4[4]	+1	6 (actual)
217	Family Housing	1,815	Accessible residence (with potential work space)	R-4	R-4[4]	+1	6 (actual)

Notes:

[1] **Studios may be shop space for performing or visual arts or environmental research.** Regarding MA. Code occupancy provisions, Highlands Center studios are assumed to be vocational shops used for business training, rather than factory/industrial facilities used for production. However, Power Plant 31 may be designated moderate- or low-hazard factory/industrial occupancies F-1 or F-2 to accommodate woodworking, steel, ceramic or glass products or foundries. All studio facilities assumed to have state-of-the-art tel./data connections; some laboratory or studio uses will have specialized technology needs and possibly greater need for water or other infrastructure.

[2] 780 CMR Code 305.2 **Business or vocational training** requires that structures occupied for business training be classified in the same use group as the business or vocation taught.

[3] When a building is classified in construction Type 2C or 5B, it is required to add one to Table 3403 Hazard Index for applicable proposed new use group only.

[4] Use group R-4 structures includes all detached one-family dwellings not more than three stories in height, and the accessory structures. All such structures shall be designed in accordance with 780 CMR 36 or in accordance with the requirements of 780 CMR applicable to Use Group R-3 (310.6).

Other assumptions: Sustainable, life-cycle approach to utilities; energy and water conservation; lighting fixtures; materials selection (consider potential toxicity or other hazards of PVC, portland cement, treated wood, carpets, and VOC levels of paints, adhesives, and finishes). Consider solar (photovoltaics and passive solar building design for heating/ventilation/day lighting) and wind energy technologies. Natural gas lines do not extend to Truro at this time. Consider building material waste management and recycling during rehab efforts.

PRELIM. BLDG. DISPOSITION AND UBC USE ASSUMPTIONS FOR BUILDING CONDITION ASSESSMENT

Former North Truro Air Force Station **(Based on materials received from Cape Cod NS, November 1999)**

NO	BUILDING	AREA (SF)	POSSIBLE USE(S)	ASSUMED UBC OCCUPANCY GROUP/DIVISION	ASSUMED UBC OCCUPANCY (MOST RESTRICTIVE INTERPRETATION)
T5	NCO Club/Mess	3,625	Social center with meeting, gallery space and several offices	A-3; B as accessory use	318 (concentrated use w/o fixed seats in 2,225 sf) + 14 = 332
9	Administration/ Dormitory	5,780	Dorm, studio space or office space	R-1 and/or B	32 (Dorm - actual); 116 (Shop); 58 (Office)
14	Library	1,742	Meeting, office or studio space **	A-3 (if meeting space >50 occupants), B	116 (Assembly); 36 (Shop); 18 (Office)
15	Bowling Alley	1,987	Studio space ** or bowling	B (if <50 occupants)	40 (Shop); 10 (2 Bowling Alleys)
16	Recreation/ Multi-Purpose	1,960	Meeting, office or studio space **	A-3 (if meeting space >50 occupants), B	131 (Assembly); 20 (Office); 40 (Shop)
17	Exchange Sales Store; Base Supply	1,650	Meeting, office or studio space **	A-3 (if meeting space >50 occupants), B	110 (Assembly); 17 (Office); 34 (Shop)
18	Dining Hall	4,680	Dining facility/community center	A-3	185 (Assembly in 2,775 sf) + 20 = 205
22	Theater/HQ	1,340	Meeting area with offices or smaller meeting rooms	A-3 or B	40 (Assembly – actual fixed seats + wheelchair spaces) + 6 = 46
23	Dormitory/BOQ	11,240	Conference center with meeting space, offices, and overnight accommodations; laboratory facilities with same	R-1 (dorm) with accessory OR separated B (if mtg. spaces or labs <50 occupants)	28 (2nd Flr. Dorm - actual) + 1st Flr.: 57 (Lab) OR 57 (Assembly <50 occ.) = 85
31	Power Plant	6,564	Shop or studio space **, theatre	F-1 or F-2; A-3 (if theater >50 occupants)	132 (Shop); 398 (Assembly w/o fixed seats in 2,785 sf) + 38 = 436
33	Multi-Purpose/ Recreation Building	5,460	Theater (UBC "concentrated use")	A-3	226 (concentrated use w/o fixed seats in 1,580 sf) + 67 (unconcentrated Assembly in 1,000 sf) + 29 ("Other Uses") = 322
36	Maintenance Shop	2,470	Maintenance shop with offices	S-3 with accessory B (assumes no H-4 open flame, welding)	25 ("Other Uses")

No	Building	Area (SF)	Possible Use(s)	Assumed UBC Occupancy Group/Division	Assumed UBC Occupancy (Most Restrictive Interpretation)
37	Auto Maintenance Shop	2,200	Shop or studio space**	B	44 (Shop)
203	Family Housing	1,648	Residence	R-3	6 (actual)
217	Family Housing	1,815	Accessible Residence (with potential work space)	R-3	6 (actual)

**Studios may be shop space for performing or visual arts or environmental research. Regarding UBC occupancy, studios are assumed to be vocational shops used for educational purposes, rather than factory/industrial facilities used for production; however, Power Plant 31 may be designated moderate- or low-hazard factory or industrial occupancies F-1 or F-2 to accommodate woodworking, steel, ceramic or glass products or foundries. All studio facilities will require state-of-the-art data and communications connections; some laboratory or studio uses will have specialized technology needs and possibly greater need for water or other infrastructure.

Other assumptions: Sustainable, life-cycle approach to utilities; energy and water conservation; lighting fixtures; materials selection (consider potential toxicity or other hazards of PVC, portland cement, treated wood, carpets, and VOC levels of paints, adhesives, and finishes). Consider solar (photovoltaics and passive solar building design for heating/ventilation/day lighting) and wind energy technologies. Natural gas lines do not extend to Truro at this time. Consider building material waste management and recycling during rehab efforts.

IV. M/E/P/FP Overview

I MECHANICAL, ELECTRICAL, FIRE PROTECTION AND PLUMBING INTRODUCTION

A. The Mechanical, Electrical and Plumbing/Fire Protection systems site review of the Highlands Center was completed between November 2 and November 4, 1999. The following Mechanical, Electrical and Plumbing/Fire Protection Assumptions and Typical Items sections are provided to establish limits of scope and reduce redundant text. The individual Mechanical, Electrical and Plumbing/Fire Protection building evaluations are divided into two sections: Existing Conditions and Recommendations (which are based on proposed building uses provided by National Park Service).

B. The sustainability supplement is attached at the end of this section. This supplement lists potential measures incorporating "green" practices into the operations of the Highland Center. "Green" practices include:

- Energy efficiency options for the recommendations outlined in the Mechanical, Electrical and Plumbing/Fire Protection site review.
- Renewable energy sources for the designated buildings as well as the entire site.
- Improved water and waste management practices for the designated buildings and/or recommendation(s) outlined in the Mechanical, Electrical and Plumbing/Fire Protection site review.

The supplement incorporates those "green" practices mentioned and coordinated in individual Mechanical, Electrical and Plumbing/Fire Protection building evaluations, and refers to the report in the measure's conclusion section.

II MECHANICAL, ELECTRICAL, FIRE PROTECTION AND PLUMBING ASSUMPTIONS

A. GENERAL

1. No hazardous materials were reviewed or included in the Mechanical, Electrical, Fire Protection and Plumbing Evaluations; refer to environmental assessments.

2. The evaluations and recommendations are based on a 20-year lifespan.

3. The recommendations for Mechanical, Electrical, Fire Protection and Plumbing systems are based on the proposed uses provided by National Park Service. National Park Service must adjust estimates if building uses vary from those provided.

4. Requirements for seismic restraint of equipment or piping systems are not included in the Mechanical, Electrical, Fire Protection and Plumbing evaluations.

5. Unless noted, all cutting and patching required for Mechanical, Electrical, Fire Protection and Plumbing work is to be completed by the General Contractor.

B. HEATING, VENTILATING AND AIR CONDITIONING

1. All motors shall conform to NEMA Standards Performance Data for energy efficient motors.

2. Assumption is made that the buildings will be upgraded to Massachusetts State Building Code, 6th Edition, 780 CMR Article 15 (Energy Conservation).

3. A cursory comparison of oil and propane as a heating media showed oil to be 50% to 200% higher in cost than propane. The percentage depends on the size and location of the oil storage tank (outside, inside or below grade). Power to operate the oil burning equipment is also slightly higher. In keeping with the direction to be "green," this report includes outside individual point-of-use propane tanks. Refer to plumbing section and sustainability section for other viable options.

4. Cooling media, where noted, shall be direct expansion with cooled condensing units located outside of the building or air-cooled water chiller.

5. See sustainability section for solar, etcetera.

6. Due to the age and present condition of the remaining steam piping and air handling systems, the building's systems shall be removed in its entirety from the site.

7. No museum type environmental conditions design will be provided. If required, the tenant shall provide point-of-use.

8. Provisions <u>have not</u> been made for laboratory facilities, fume hood, exhaust, air systems, make-up air systems, kiln exhaust, woodworking dust collection, welding exhaust, garage automobile exhaust air systems, et cetera Special systems will be provided by the tenant on point-of-use. See Building Number 31 recommendation for industrial occupancies.

9. Equipment associated with make-up air systems for kitchen hood exhaust cooking systems within the community center has not been provided.

C. PLUMBING

1. Water conservation is included in the individual building sections and sustainability section. Solar heating of domestic water, sanitary waste reclamation and bulk propane site distribution are included in the individual building sections and Sustainability Supplement attached at the end of the Mechanical, Electrical, Fire Protection and Plumbing evaluations.

2. Individual point-of-use propane bottles at each building (where noted) shall be the primary fuel for domestic hot water, building heating, commercial kitchen equipment and labs. Natural gas service is not readily available at this site.
3. Fuel oil is not considered "green" and, therefore, not included in the recommendations. Where noted, point-of-use electric water heating is considered only where the domestic hot water load is less than the output of the smallest propane fired water heater. The proposed small electric storage water heaters could be exchanged for instantaneous electric heaters as addressed in Sustainability Supplement.

4. The propane storage bottles (bulk or point of use) will be supplied and installed by an outside service company.

5. Due to the age and present condition of the existing plumbing piping systems, it is assumed that all existing sanitary (except residential houses), vent, domestic water (except residential houses), and (where noted) storm piping shall be removed entirely from the site.

6. Except for various noted lavatories, tubs and sinks, all existing plumbing fixtures, faucets, water supplies, drains and related trim shall be removed entirely from the site. This assumption is due to the age and present condition of the fixtures. The faucets and trim are beyond their service life, have inoperable valves and water closets (tank and flush valve) are not code compliant low-flow 1.6 gallons per flush. Many fixtures are damaged and parts for refurbishing are not readily available.

7. The fixture counts that will be required for the proposed building uses will be as required by the Massachusetts Plumbing Code. The occupancies provided in the use group/occupancy section of the report will be divided equally between male and female.

8. The plumbing existing conditions and recommendations start at each of the building foundations. It is assumed that adequate water flow, pressure (50 pounds per square inch gauge minimum. – 75 pounds per square inch gauge maximum. for domestic water service) and service pipe size will be provided to each of the buildings to meet the proposed plumbing and fire protection demands of all the proposed building uses. Also assumed is an adequate sanitary service will be provided to each if the buildings. All work outside the building foundation is not included in the recommendations. Where noted, storm systems will also be limited to within the building foundation. Refer to the 5/7/99 Evaluation of the Existing Waste Water, Water and Fire Suppression Systems Report.

D. FIRE PROTECTION

1. Except where noted, fire suppression systems will be recommended only where required by the Massachusetts Building Code based on proposed use groups.

2. Extinguishers existing or proposed are not included in Mechanical, Electrical, Fire Protection and Plumbing evaluations.

E. ELECTRICAL

1. Demolition scope will be to remove all electrical equipment, wiring, boxes, and devices. It is assumed the Electrical Contractor will not be required for demolition and all electrical equipment will be removed by the General Contractor. Almost all buildings have been without power or heat for 15 years. The integrity of the electrical equipment cannot be verified or expected. Conduits and outlets have been infested with insects. It could pose a health problem if all existing boxes, conduits, et cetera were not completely removed or cleaned and abandoned.

2. The scope of new work will include base building electrical service equipment, normal and emergency indoor and outdoor (building entry) lighting fixtures, convenience receptacles, power for Heating, Ventilating and Air Conditioning, plumbing, fire protection, fire alarm and security base building systems, conduit systems for telephone/data and cable television only (wiring and equipment by tenant television/data installer), and provisions

for future fit-up systems and equipment for type of use to which the existing building is being converted. Also, lightning protection will be provided for each building. The level of lightning protection required will be based on building location, height, and use.

3. Site power, cable television, telephone/data, site lighting, and all other site distribution systems will not be addressed in this report. Refer to "Electrical Utility Study," dated April 28, 1999, for electrical services which will be provided to the buildings.

4. All lighting fixtures will be supplied with energy saving electronic ballasts with T8 type octic fluorescent lamps.

5. The following power allowances will be assumed: (VA = Volt-Amps)

   a. Heating, Ventilating and Air Conditioning equipment: 5 VA per SF
   (assumes air conditioning via central unit or single window units installed in the future).
   b. Miscellaneous equipment: 2 VA per SF
   c. Receptacle: 1 VA per SF
   d. Lighting: 2 VA per SF
   e. Tenant power allowance (for future fitup):
      1) Social center 1.5 VA per SF
      2) Meeting Space 1.5 VA per SF
      3) Gallery Space 0.5 VA per SF
      4) Offices 2.5 VA per SF
      5) Dorm Space 0.5 VA per SF
      6) Studio Space 0.5 VA per SF
      7) Bowling Alley 2 VA per SF
      8) Dining Facility 5.0 VA per SF
      (assuming gas kitchen equipment)
      9) Community Center 1.5 VA per SF
      10) Conference Center 1.5 VA per SF
      11) Overnight Accommodations 0.5 VA per SF
      12) Laboratory Facilities 10.0 VA per SF
      13) Shop Space 5.0 VA per SF
      14) Theater Space 0.5 VA per SF
      15) Maintenance Shop 5.0 VA per SF
      16) Residence 0.5 VA per SF
      17) Accessible Residence 1.5 VA per SF
      (with potential work space)

III TYPICAL MECHANICAL, ELECTRICAL, FIRE PROTECTION AND PLUMBING ITEMS

A. HEATING, VENTILATING AND AIR CONDITIONING

1. Heating media to be separate propane tanks. The tanks shall be located outside of the building with associated gas piping to individual hot water boilers.

2. Cooling media for Buildings T-5, 18 and 13 scheduled for air conditioning is outside air-cooled water chillers with associated chilled water pumps and piping systems within the building.

3. Estimated heating load for Building 18, kitchen hood make-up air systems associated with kitchen hood exhaust fans have been included.

B. PLUMBING

1. All water closets in residential houses will be new 1.6 gallons per flush tank-type, floor mounted white fixtures. All other building water closets will be new wall hung commercial grade fixtures with 1.6 gallons per flush, flush valves.

2. All counter lavatories in residential houses will remain as is. Americans with Disabilities Act modification is noted in Miscellaneous Section where necessary. All other building lavatories will be new wall hung fixtures with new faucets (0.5 gallons per minute), drains and water supplies.

3. All tubs in residential houses will remain as-is. Americans with Disabilities Act modification is noted in Miscellaneous Section where necessary. All other building showers will be new, including enclosures, shower valves (2.7 gallons per minute), drains and water supplies.

4. All stainless steel kitchen sinks in residential houses will remain as-is. Americans with Disabilities Act modification is noted in Miscellaneous Section where necessary. All existing disposers will be removed from the site entirely. All other building sinks will be removed entirely.

5. All Proposed drinking fountains are Americans with Disabilities Act compliant, wall hung without chillers.

6. All Proposed showers include stall, drain and shower valve (2.7 gallons per minute).

7. All floor drains are 4 inch for simplicity. Shower rooms will most likely be 2-inch to 3-inch.

8. All proposed janitor's sinks are wall hung, with 3-inch trap and faucet (1.5 gallons per minute) with integral vacuum breaker.

9. All proposed exterior wall hydrants are freezeproof, surface mounted, with integral vacuum breaker and loose key handles.

10. Noted in Plumbing Assumptions is an expected 50-75 pounds per square inch gauge water pressure at the building. However, to further reduce water consumption, after the individual buildings are developed, install a pressure reducing valve on every water service. Then reduce pressure to least possible required pressure at an estimated maximum flow.

11. The proposed fixture counts for the various building uses are the minimum total required by code. Handicapped fixtures may be substituted where required under the Architectural Section.

12. No water meters were found in any of the surveyed buildings and are not included in proposal work.

13. No existing pipe insulation was found. All proposed hot and cold water piping will be insulated.

14. All proposed sanitary piping will run by gravity. Sewage ejectors are not required within any of the buildings at this time.

15. Existing copper domestic water soldered joints were not evaluated (including residential houses). Lead solder may be present due to the age of installation.

16. Unless otherwise noted, all new proposed domestic water piping is copper tubing with wrought copper (or brass) sweat fittings. All sanitary waste and vent piping is cast iron with hub and no-hub fittings. All new proposed gas piping will be schedule 40 steel with malleable cast iron screwed fittings. All proposed water piping in crawlspaces, attics and unheated areas will be protected with electric freeze protection cable.

17. Storm systems will only be proposed new where flat roofs presently exist. (As noted in various buildings.)

18. The bulk or point-of-use propane storage cylinders, pads, and regulators are provided by an outside service contractor.

19. All future studio tenants must provide proper interceptors on all waste piping systems leaving the building as well as point-of-use traps at all fixtures. These devices are required to trap items such as sand, clay, paint, et cetera from entering the sanitary system and on-site treatment facility.

20. All future studio tenants must provide proper cross connection devices (reduced pressure backflow preventers, vacuum breakers, etc.) within their space per the plumbing code. These devices are required to prevent cross-connection between the potable water supply within the building and non-potable studio equipment connections.

C. FIRE PROTECTION

1. All existing buildings (except kitchen hoods in Building 18) on this site presently do not have any automatic fire suppression.

D. ELECTRICAL

1. The electrical distribution systems, for each building, are typically grounded at the main service entrance, but the grounding system is not carried through to other sub-panels or to loads.

2. The fire alarm systems are obsolete. They are not up to present industry standards. They are also not compliant with present day codes or with the Americans with Disabilities Act.

3. Main electric services, telephone, fire alarm system, central station notification, and cable television services have all been disconnected.

4. There is no lightning protection for any of the buildings on the site.

5. All electrical work shall conform to requirements and regulations of the National Electrical Code and Local Codes and authorities.

6. The following is a description of the basic new systems recommended. Each description of systems will be typical for all buildings, unless otherwise qualified in the description and will included base building systems only. Provisions will be made to provide sufficient spare capacity for tenant fit-up in the future. See "II. Mechanical, Electrical, Fire Protection and Plumbing Assumptions, Paragraph E., 5." for tenant fit-up power allowances assumed for various building uses:

   a. Building Electric Service:
      1) Power distribution system shall include feeders, panelboards, and connections to motors and equipment for a complete system for base building services only, with a sufficient spare capacity for tenant fit-up. 120/208 volt, 3-phase, 4-wire service (120/240 volts, 1 phase, 3-wire for residences) shall be provided for receptacles and base building service equipment as required. All fixtures, neutral conductors, metal conduits, supports, panelboards,

motor frames, starters, safety switches and all other metal parts shall be grounded. A complete green ground wire system shall be installed with all phase conductors in addition to neutral conductor. Panelboards for lighting, power and distribution shall be safety dead front style, with NEMA I enclosure surface or flush mounted. Circuit breakers shall be molded case thermal magnetic type with bolted connections to the bus. All wiring shall be 98% conductivity copper with 75 degrees C insulation, minimum size #12 AWG.

b. Fire Alarm System:
   1) Fire alarm system shall be complete television addressable, zoned, closed circuit, electrically supervised of the automatic and manual type with signal via telephone line to the local Fire Department or monitoring company as required. The equipment and complete installation shall be in compliance with Local and National Codes, authorities having jurisdiction and in accordance with applicable Section of the latest edition of NFPA 72B for fire alarm systems. All equipment shall be listed by Underwriters Laboratories, Incorporated. Manual pull stations shall be located at all exits from all floors within 5 feet of door on corridor side. Smoke detectors will be located in all corridors, storage rooms, and sleeping rooms. Waterflow and tamper switches will be provided for all sprinkler zones. Sufficient spare capacity shall be allowed for tenant fit-up.

c. Lighting:
   1) Lighting, in general, shall utilize 2' X 4' parabolic fluorescent fixtures for Offices, Dining / Kitchen (gasketed), Laboratories, Bowling Alleys, and Meeting / Conference / Social Areas, industrial fluorescent fixtures for Studio, Storage, Shop, Maintenance and Support Areas, and wall bracket fluorescent fixtures for toilets.
   2) Gallery lighting shall utilize directional track lighting.
   3) Residential, Dormitory, and other Living Space lighting, in general, shall utilize switched receptacles in sleeping areas for table lamps. Other areas will have ceiling mounted fluorescent or incandescent fixtures.

d. Emergency Lighting:
   1) Battery operated remote lighting heads and exit signs shall be provided for all means of egress from the building.

e. Exterior Lighting:
   1) Exterior lighting shall be provided near entries of buildings via wall mounted lighting fixtures with metal halide lamps with photocell and time clock control.
   2) Exterior residential lighting shall be via compact fluorescent fixtures at front and rear entries with switch control.

f. Wiring Devices:
   1) General-purpose, grounding type, convenience outlets shall be provided as required by code and per building proposed use requirements.

g. Telephone System:
   1) A telephone raceway system shall be provided. Backboards, telephone outlets, and empty conduit system with pullcords shall be provided as required for final installation of cable, devices, and equipment by the tenant's telephone company.

h. Cable Television System:
   1) A cable television raceway system will be provided. Backboards, cable television outlets and empty conduit system with pullcords shall be provided as required for final installation of cable and devices by the tenant's cable television company.

i. Lightning Protection System:
   1) All building services shall be protected by a service entrance surge protector.
   2) All buildings of 2 stories in height or in open areas prone to lightning strikes shall be provided with a complete lightning protection system in accordance with NFPA 780 for a UL Master Label and LPI certification.

j. Security Systems:

1) Security control panel shall be fully addressable and provide for a building perimeter monitoring and motion detection system with signal via telephone line to the local police or the tenant's security company. Motion detectors shall be provided in all corridors and in all first floor rooms with windows. Door monitoring switches shall be installed on all exterior doors. A system keypad shall be located at the main entrance for arming and disarming the system. Keypad shall include a system led annunciator. Sufficient spare capacity shall be allowed for tenant fit-up.

Sustainability Supplement

Introduction.

The following sustainability measures are listed under one of the following sections: HVAC, Electrical, Plumbing, or Interactive.
The Interactive section lists those measures that provide more than one "green" practice. For example, recycling hot water, which saves both energy and improves water management.
In each of these sections the measures are listed under one of the following categories,
Energy Efficiency
Renewable Energy Sources
Water and Waste Management
In each category the listed measures include a brief description, pertinent assumptions, sample benefits, sample installation costs and a conclusion. The conclusion uses the sample benefits and costs as a basis for implementation recommendations.

Summary.

In general the conclusions drawn on the following energy measures are based on the same preliminary building dispositions used for the MEP Report. Hours of operation and building load profiles were estimated based on past experience with similar type projects. Other overall assumptions include:

- Blended electric energy rate of about $0.10 / kWh
- Average propane cost of about $ 0.80 / gallon
- Existing utilities in place, (i.e. electric and water) per 4/28/99 Electrical Utility Study and 5/7/99 Evaluation of the Existing Waste Water , Water and Fire Suppression Systems Report.
- Probable costs do not include development costs, third party financing costs, design engineering, or construction management.
- Buildings are in compliance with appropriate local, state and federal codes, thus installation costs do not include code-related upgrades.
- Overall site equipment life cycle of 20 years.
- Natural gas not available. Fuel oils are not a preferred option (in regards "green" practices).
- Conclusions based on this preliminary feasibility assessment. Further engineering and/ or study is recommended prior to implementation of most of these measures.

Note that the listed conclusions and sample benefits do not take into account any rebates or other funding that may be available from state, federal and/or utility sources. These types of funding sources are typically available for "green" type practices including renewable energy and waste management projects. Shooshanian Engineering is available to provide a comprehensive energy study, which would identify such projects and then provide project design and management services to implement those projects selected for implementation.

I. HVAC

A. (HVAC) Energy Efficiency

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Outdoor air economizer for a/c units	Building T5 used as an example. Design cooling load is about 46 tons. Existing A/C unit is air cooled, DX type.	Economizer results in decreased hours of operation for the A/C compressor. A conservative savings estimate of about 10 % yields about $2000 per year cost savings.	A typical retrofit of a DX unit with minimum outdoor air intake would cost about $8,000, installed.	Outdoor Air units already specified in MEP report. Thus sample benefits apply with substantially less costs.
Use sprinkler system for space heating by running hot water through exposed piping.	Building 18 used as sample. Design heat load is 700 Mbh.	Use proposed heating unit to heat sprinkler water, supplementing building heat. Estimated propane savings of about $1,000 per year	Assume sprinkler system in place would require study to determine code compliance and hot water temperature settings. Estimate all-in costs of about $46,000.	Cost savings do not justify installation costs, i.e. financial return longer than equipment life cycle. Note use of sprinkler system also reduces first time heating system costs.
Use ground source heat pumps for a/c and space heating	Building 18 used as sample. Design heat load is 700 Mbh. Design cooling load is 35 tons.	Install ground source heat pump in lieu of standard DX air-cooled unit. Heat pump is more energy efficient because of decreased condensing temperature and use of heat from ground source. Estimate propane and electric savings of about $2,500 per year.	Heat pump provides heating and cooling in one unit, eliminating separate A/C and heating units, thus decreasing first time installation costs. Total incremental costs increase of about $50,000.	Cost savings do not justify installation costs, i.e. financial return longer than equipment life cycle.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Use air source heat pumps for a/c and space heating	Same as above	There are fewer savings because of less heat available and a reduced decrease in condensing temperatures.	Less incremental costs.	Same conclusion.
Install setback thermostat controls for heating and a/c	Same as above	Cooling and heating savings occur as the space temperature set point is changed according to building occupancy. Estimate annual cost savings of about: $ 2,500 in electric and propane costs.	Estimate includes two programmable thermostats with all-in costs of about, $3,000.	Automatic temperature controls are already specified in MEP report.
Install a central plant thermal storage system to reduce on peak a/c electric costs	Total site-cooling load of about 141 tons.	Cooling savings result from increased efficiency of larger equipment. Also thermal storage allows compressors to operate during off-peak rate hours, thus reducing electric costs. Estimate electric cost savings of over $12,000 per year.	Total installed costs of over $300,000. Including central plant, piping, pumps, etc	Cost savings do not justify installation costs, i.e. financial return longer than equipment life cycle. Also electric rate is unknown and may not include on-peak demand charges.
Install more efficient central a/c plant	Total site-cooling load of about 141 tons.	Cooling savings result from increased efficiency of larger equipment. Estimate electric cost savings of about $12,000 per year.	Total installed costs of over $275,000. Including central plant, piping, pumps, etc.	Cost savings do not justify installation costs, i.e. financial return longer than equipment life cycle

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install more efficient central heating plant	Total site heating load of about 13,610 Mbh	Heating savings result from increased efficiency of larger equipment. Estimate propane cost savings of about $20,000 per year.	Total installed costs of over $475,000. Including central plant (>450 hp), piping, pumps, etc.	Cost savings do not justify installation costs, i.e. financial return longer than equipment life cycle
Install 2-speed fans on ventilation systems to reduce fan power during unoccupied/low use periods	Building 31 used as sample. 10 hp fan motor used as example.	Electric energy savings result from reducing the fan motor speed during unoccupied/low use periods. Estimate annual cost savings of about $ 400.	Total installation costs include 2-speed motor and controls and total about $ 3,000.	Recommend further analysis at time of construction. The payback is relatively long and dependent on final electric rates and occupancy schedules.
Install water cooled air conditioning units	Building T5 used as an example. Design cooling load is about 46 tons. Existing A/C unit is air cooled, DX type.	Electric energy savings result from increased efficiency due to decreased condensing temperatures. Estimate annual cost savings of about $ 2,000.	Total incremental cost of about $ 30,000. Costs include cooling water system including pumps, etc.	Recommend further analysis at time of construction. The payback is relatively long and dependent on final electric rates.

B. (HVAC) Renewable energy source

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install solar hot water collectors for supplemental and/or total space heating	Building 33 used as an example. Design heating load is about 8,000 Mbh. The hot water is provided via a multiple source hot water tank as specified in the MEP report.	Hot water produced by solar panels will displace heat from installed propane fired heater. Estimate annual savings of over $40,000 per year.	Based on preliminary assumptions estimate over 13,000-sq. ft of panels for design load. This results in installed costs over $ 840,000.	Recommend installing traditional heating system due to relatively long paybacks. However, if a showcase system is desired recommend further study for a smaller part-load system in building with consistent heat load.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install CPC (compound parabolic concentrator) solar collectors to produce steam for absorption type a/c system	Building 33 used as an example. Design heating load is about 8,000 Mbh. Design cooling load is about 60 tons.	Install solar panels design to produce high temperature hot water, which can then be used for heating and for powering an absorption type a/c system. Estimate electric cost savings of over $ 4,700 per year.	Based on preliminary assumptions estimate over 1,200-sq. ft of panels for design cooling load. This results in installed costs over $ 110,000 for cooling system alone.	Combined cooling and heating solar system cost savings do not justify the installation costs, as the financial return is longer than equipment life cycles.
Install skylights for passive solar heating	No existing skylights in the designated buildings.		Based on past project experiences, paybacks associated with skylight installations range from 15 to 25 years.	The installed costs for skylights cannot be economically justified based on heating savings.
Geo-thermal heating sources				No geothermal sources available.

C. (HVAC) Water and Waste management

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
None.				No existing or proposed HVAC water consuming systems.

I. Plumbing / Fire Protection

A. (Plumbing / Fire Protection) Energy Efficiency

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install instantaneous water heaters		Instantaneous heaters reduce amount of hot water storage, thus reducing radiation and convection losses.		These types of electric water heaters increase electric demand (kW). Further study is required to quantify and compare additional demand costs versus decreased heat losses.
Install high efficiency water heaters including insulation.	Building 18 used as an example. Domestic hot water load of 925 Mbh based on occupancy of 185 people.	Insulated water heaters have reduced radiant and convection skin losses resulting in reduced fuel (propane) consumption. Estimate annual cost savings of about $ 660.	All-in installation of insulation estimated at about $ 1,500	Typically high efficiency water heaters are specified, and include insulation.

B. (Plumbing / Fire Protection) Renewable energy source

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install solar hot water collectors for domestic water heating	Building 18 used as an example. Domestic hot water load of 925 Mbh based on occupancy of 185 people. The hot water is provided via a multiple source hot water storage tank as specified in the MEP report.	Hot water produced by solar panels will displace heat provided by propane fired water heater. Estimate annual savings of over $5,700 per year.	Based on preliminary assumptions estimate over 1,500-sq. ft of panels for design load. This results in installed costs over $ 97,000.	Recommend installing traditional water heating system due to relatively long paybacks. However, if a showcase system is desired recommend further study for more detailed system sizing, siting, etc.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install multiple source water heating coils within one hot water storage tank.		Hot water would be produced by solar, building heating, and propane, pending the season, efficiency, and energy costs.		This would be most likely a showcase system due to high up-front costs for multiple coils, pipe configurations, valving and controls.
Install methane recovery from the treatment plant and use methane as a fuel source.		Methane from wastewater treatment system would replace propone as fuel source.		Apparently, from site loads and condition of existing systems, there is not enough existing system capacity to justify installation costs.

C. (Plumbing / Fire Protection) Water and Waste management

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Reduce water use through low-flow fixtures, i.e. faucets, shower heads, urinals, toilets, etc.	Existing fixtures pre 1970. Toilets 5-7 gal/flush Faucets 3-5 gpm showerheads 3-7 gpm	New low flow types: Toilets 1.6 gpf (save 5,500 gal/ person/yr.) Faucets 1.5 gpm Showerheads 2.7 gpm.	New toilets typical paybacks < 4 years. New faucets and showerheads shorter paybacks.	New fixtures are already specified in the MEP Report (to meet 1994 Fed code). Note the MEP also specifies PRV valves to reduce supply water flow.
Recycle gray water for uses such as irrigation, cooling water, water closets, urinals, etc..	Existing treatment plant to be reused.	Combined recycle treatment plant reduces water use and sludge output.	Typical costs range from: $ 70,000 for 100 person capacity to $ 450,000 for 2,500 person capacity units.	Relatively high paybacks require more study be done to determine feasibility once size and type of treatment plant is determined. Possible point of use reclaim systems could reviewed for a showcase system.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install alternative biological waste water treatment plant				Once size and type of treatment plant is determined, this option should be further analyzed. Drawbacks are size, exposure to endangered birds, etc.
Install Bulk Storage Propane Tanks.		Bulk storage propane tanks reduce the number of underground tanks thus reducing installation costs and the potential for spills/leaks.		The MEP report already discusses alternate bulk storage propane tanks.
Implement landscaping techniques to reduce water use, i.e. mulching, reduce lawn areas, etc.				Once size and type of site landscaping determined, implement Xeriscaping techniques. (as listed). Further study is required to quantify savings and costs.

II. Electrical

A. (Electrical) Energy Efficiency

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Specify premium efficiency electric motors for all applications		Premium efficiency motors are typically 2 % to 4 % more efficient than standard efficiency motors in the 5 to 75 hp ranges. Depending on the hours of operation and the electric rate, annual cost savings of up to 5% are possible.	Premium efficiency motors are typically more expensive and if retrofitted require new sheaves and base mountings. As such, paybacks ranging from 5 to 8 years are typical.	Premium efficiency motors are specified in the MEP report. For existing motors it is recommended premium efficiency motors be installed to replace the existing motors as they fail.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Specify more efficient T8 lamps and low output electronic ballasts.		High efficiency electronic ballast and T8 octic lamps produce required lighting level with less electric energy input.	T8 lamps and electronic ballast are more expensive. However besides energy cost savings there are additional maintenance cost savings due to longer life which requires less replacement and decreased waste disposal costs.	T8 lamps and electronic ballast are specified in the MEP report.
Install daylight dimming controls on ballast		Reduces lighting energy by using ambient space outdoor light.		Best application is for areas with ample background Daylighting. Typically areas with large windows and/or skylights. There does not appear to be any such sites in the designated buildings.
Install occupancy sensor lighting controls		Automatically shuts off lighting when area unoccupied. Best applications in areas with intermittent occupancy i.e. restrooms, conference rooms, etc. Not recommended for equipment rooms, entryways, etc. Savings are dependent on occupancy rates.	Installed in lieu of traditional switches. Placement depends on size of area and number of lights to be controlled. Wall mounted sensors are typical for smaller applications, ceiling mounted sensors for larger applications.	As mentioned placement of sensors should be analyzed prior to installation. Factors affecting feasibility include number of lights controlled, size of lit area, frequency of occupancy, etc. Recommend further analysis prior to implementation.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install photo cell controls on outdoor lighting		Photocell sensors automatically shut off outdoor lighting when ambient light levels fall below predetermined settings. Savings dependent on light size, type, etc.	Typical paybacks to retrofit existing fixtures range from 0.5 to 2 years depending on electric rates, lamp size, lamp type etc.	No applicable fixtures in designated buildings.
Install variable frequency drives controls (VFDs) on appropriate electric powered motors.		VFDs reduce electric motor input energy by reducing motor speed to meet required motor loads.	Typical paybacks on VFD retrofits range from 2 to 8 years depending on operating hours, motor size, system requirements and electric rates.	There do not appear to be any applications in the designated buildings. However, if candidates are found, then further analysis is required to determine feasibility.
Install high efficiency transformers where appropriate.		Decreased temperature rise i.e. 80 deg C vs. 150 deg C in dry type transformer could yield savings of 0.5 to 2 percent of the full-load rating.		Recommend high efficiency transformers be specified if/when new distribution system is installed. Typically high efficiency transformers are specified for individual buildings.
Install energy efficient dishwashers, washing machines and clothes dryers.		More efficient washing machines, clothes dryers and dishwashers are available. These items reduce input energy by reclaiming exhaust heat, recycling warm water, reducing idling time, etc.	Typical paybacks on an incremental basis for more efficient models range from 4 to 9 years depending on equipment size, utility rates, hours of operation, etc.	There is no existing applicable equipment for basebuilding systems. For tenant fitup, new equipment installations, high efficiency models should be specified, where appropriate

B. (Electrical) Renewable energy source

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install photovoltaic panels for individual buildings.	Building 23 used as an example. Connected load of 20 kVA. Occupancy/load factor of 50%	Install photovoltaic panels to produce electric power. This power would displace electric power purchased from the utility. Implementation results in estimated annual avoided utility charges of about $4,400.	Installed panels, back up batteries, and auto switchgear to the site electric grid total about $ 60,000 in installed costs. Note there will also be a relatively small annual maintenance charge.	Recommend using site electric system due to relatively long paybacks. However, if a showcase system is desired recommend further study to determine exact costs, and savings based on actual loads and operations.
Install photovoltaic panel central power for entire site.	Total site connected load is not presently known. For information purposes a total site load of 33.4 kVA was assumed. Occupancy/load factor of 50%	Install photovoltaic panels to produce electric power. This power would displace electric power purchased from the utility. Implementation results in estimated annual avoided utility charges of about $ 59,000.	Installed panels, auto switchgear to the site electric grid and new site-wide distribution system total about $ 661,000 in installed costs. Note there will also be a relatively small annual maintenance charge.	Recommend using site electric system due to relatively long paybacks. However, if a showcase system is desired recommend further study for a smaller system, which would determine exact costs and savings based on actual loads and operations.
Install wind turbines for individual buildings	Building 23 used as an example. Connected load of 20 kVA. Occupancy/load factor of 50% No conflicts with endangered bird species (site requires review for approval)	Install wind driven turbine-generators to produce electric power. This power would displace electric power purchased from the utility. Implementation results in estimated annual avoided utility charges of about $ 7,200.	Installed wind turbines, back up batteries, and auto switchgear to the site electric grid total about $ 82,500 in installed costs. Note there will also be a relatively small annual maintenance charge.	Recommend using site electric system due to relatively long paybacks. However, if a showcase system is desired recommend further studies to determine exact costs, and savings based on actual loads and operations.

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install wind turbine driven central power plant for entire site.	As previously explained, used an assumed total site connected load of 33.4 kVA. Occupancy/load factor of 50%. No conflicts with endangered bird species (site requires review for approval).	Install wind driven turbine generators to produce electric power. This power would displace electric power purchased from the utility. Implementation results in estimated annual avoided utility charges of about $ 59,000.	Installed wind turbines, auto switchgear to the site electric grid and new site-wide distribution system total about $ 661,000 in installed costs. Note there will also be a relatively small annual maintenance charge.	Recommend using site electric system due to relatively long paybacks. However, if a showcase system is desired recommend further study for a smaller system, which would determine exact costs and savings based on actual loads and operations.
Install Tidal Hydro power				Not applicable due to beach erosion, endangered species habitat, etc.
Install Fuel Cell(s)				Not Applicable because of fuel restrictions and development issues.
Install combined source power plant, i.e. wind turbines with back up engine driven generators equipped with heat recovery to supply hot water and/or steam.		Would not require any connections to electric utility.	Relatively high installation costs plus a long list of development issues including: emission permitting, noise ordinances, and fuel storage and back up power rates, etc.	Not applicable for reasons stated in sample costs. Engine driven generators do not appear to be practical at this site.

C. (Electrical) Water and Waste management

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Install desalination plant to provide water source				Not practical. Extremely high operating costs, and many development issues including brine discharge permitting, emission permitting, beach access, etc.

IV. Interactive

Description	Assumptions	Sample Benefits	Sample costs	Conclusion
Preheat domestic hot water using a/c condenser air/water		Decreases hot water energy input and reduces load on cooling water tower(s).	Installed costs would include heat exchanger, controls, pumps, etc.	Not enough available information to quantify available savings. Does not appear to be practical given the grade of heat available from the condensers.
Cogeneration installations include electric generation with heat recovery.				Not practical because of fuel restrictions and development issues.
Cogeneration combined with renewable energy source(s).				Same.
Control nitrification to reduce aeration energy and water use.	Reduce nitrogen load on wastewater treatment plant via new toilets:Clivius composting and Incinerator type. Also use additional filters-Waterloo Biofilter, Bioclere, and Recirculating Sand Filter types.	Reduced nitrogen load reduces wastewater stream, thus reducing energy used by treatment plant. Also, removes all human waste from site.	High installation costs (underground tanks, etc). High maintenance costs, not amenable for residential use.	Not recommended because of high maintenance costs and accessibility issues.
Restrict vehicles to electric powered models. Install on-site programmable trick charge batteries to recharge vehicles.				Does not appear to be practical due to high capital costs of electric vehicles and restrictions to traffic flow onto public property.

V. Environmental Pre-Demolition Audit Overview

December 10, 1999

Ref: 06780

Mr. Jack Glassman, AIA
Bargmann Hendrie + Archetype
Boston, Massachusetts
02210-1710

Re: Pre-Demolition Audits
ACM, LBP, and OHM
15 Buildings
North Truro Air Force Station
Truro, MA

Dear Mr. Glassman:

In accordance with our letter proposal dated September 26, 1999, Vanasse Hangen Brustlin, Inc. (VHB) and Smith & Wessel Associates, Inc. (S&W), conducted pre-demolition building audits at 15 vacant buildings located at the former North Truro Air Force Station (AFS) to identify the following:

- Asbestos-containing materials (ACM);
- Building materials coated with Lead-Based Paint (LBP);
- Items which contain Polychlorinated Biphenyls (PCBs);
- Mercury-containing lamps/tubes/thermostats;
- Appliances and refrigeration equipment which contain chlorofluorocarbons (CFCs); and
- Miscellaneous containers of oil and other hazardous materials (OHM).

This report is subject to the terms and conditions of the agreement between VHB and Bargmann Hendrie + Archetype (BH+A) and the attached Limitations (Attachment A).

Mr. Tim Downey of VHB, Mr. Glenn Nelson and Mr. Dan Smith of S&W performed the survey on November 2-4, 1999. Mr. Nelson and Mr. Smith are certified by the Commonwealth of Massachusetts Department of Labor and Workforce Development as an Asbestos Inspector and Management Planner (Certifications #AI30052, #AP30053 and #AI30136 and #AP30117). Because no buildings are occupied dwellings with a child under the age of 6 years or a day care facility, the Commonwealth of Massachusetts Department of Public Health requires no

accreditation to perform a survey for surfaces coated with LBP. No accreditations are required in the Commonwealth of Massachusetts to perform inspections for PCBs or mercury-containing lamps/tubes or appliances equipment containing CFCs.
The survey was limited to fifteen (15) buildings at the Site. In addition, the garage areas of Buildings #203 and #217 were visually accessible only. No visual evidence of ACM, LBP or OHM was observed from the windows of the overhead doors. The following 15 buildings were included in the scope of work for this survey:

- Building #9 - Dormitory
- Building #14 - Library
- Building #15- Bowling Alley
- Building #16 - Recreation
- Building #17 - Post Exchange
- Building #18 - Dining Hall
- Building #22 - Theatre
- Building #23 - Bachelor Officer's Quarters
- Building #31 - Electrical Power Supply
- Building #33 - Gym/Theatre/Classroom
- Building #36 - Maintenance Shop
- Building #37 - Vehicle Maintenance Facility
- Building #203 - Residence
- Building #217 - Residence
- Building #T-5 - Non-Commissioned Officers Club

ASBESTOS-CONTAINING MATERIALS (ACM)

The inspection for suspect asbestos-containing materials (ACM) was conducted by Smith & Wessel Associates, Inc. in general accordance with guidelines published by the Environmental Protection Agency (EPA) Title 40 CFR, Part 763, Subpart E (AHERA) and 40 CFR Part 61, Subpart M (NESHAPS). Sampling procedures included the collection of at least one sample of all identified suspect homogeneous friable (easily crumbled or crushed to powder by hand pressure) and non-friable materials from each building surveyed. The survey for suspect ACM consisted of visual inspection, sampling and laboratory analyses. Destructive sampling and investigation activities, including roof sampling, were performed as part of the survey, as agreed by the NPS to gain a more comprehensive sampling.

Sample analyses were performed at the SciLab Boston, Inc. laboratory located in Weymouth, Massachusetts. Bulk sample analysis was performed using Polarized Light Microscopy with Dispersion Staining (PLM/DS) in accordance with EPA protocol (Title 40 CFR, Part "Interim Method for the Determination of Asbestos in Bulk Insulation Samples", October, 1987).

A total of 283 samples of suspect ACM were collected and submitted for laboratory analyses from the 15 buildings surveyed. Samples were collected from the following materials:

- Cementitious exterior siding shingles (transite);
- Wall and ceiling plasters;
- Sheet rock wall boards and associated joint compounds;
- Linoleums;
- Floor tiles and associated mastic adhesives;
- Asphalt-based roof shingles, tar paper, felts, and cement flashings;
- Ceiling tiles and associated glue;
- Window glazings and caulkings;
- Pipe insulations;
- Textured ceiling paints;
- Tar paper exterior vapor barrier behind shingles;
- Paper vapor barrier beneath floors;
- Cementitious panels (transite);
- Asphaltic roof flashing;
- Expansion joint caulking;
- Vibration damper cloth;
- Asphaltic roofing material;
- Wood panel mastic;
- Carpet mastic;
- Pipe fitting insulation; and
- Baseboards and associated mastics;

The results of the ACM survey indicated the following types of materials were ACM:

- Floor tiles and associated mastic adhesives;
- Cement board (transite);
- Ceiling tile glue;
- Asphalt roof flashing;
- Window caulking;
- Joint compound and associated sheet rock;
- Asphalt roll roofing;

- Pipe insulation;
- Asphalt roof shingles;
- Sink mastic;
- Baseboard mastic;
- Air vent caulking; and
- Linoleum flooring;

Refer to the attached Smith & Wessel (Appendix B) report for detailed analytical results, an inventory of all suspect and identified ACM and an estimate of probable abatement costs. Because of the uncertainty of future building rehabilitation, Smith & Wessel have provided unit cost breakdowns per material type to assist in estimating future cost implications for asbestos abatement.

Prior to renovation/demolition activities that will disturb ACM, the ACM must be removed by a licensed Asbestos Abatement Contractor in accordance with all federal, state and local regulations governing asbestos abatement work. Following removal of ACM from each work zone, a third party independent industrial hygiene firm must conduct clearance air monitoring in accordance with Massachusetts Department of Labor and Workforce Development regulations at 453 CMR, 6.14.

The Massachusetts Department of Environmental Protection allows building demolition with asbestos-containing asphaltic roofing materials and vinyl floor tiles, provided that the material is nonfriable and in good condition. All demolition debris generated must be disposed of at a construction debris landfill that will accept asbestos-containing asphaltic roofing materials/floor tiles commingled with demolition debris. In VHB's opinion, the asphalt-based roofing and flooring materials are not in good condition and must be removed prior to renovations to the roofing systems or demolition of the buildings.

Lead-Based Taint (LBP)

The lead inspection was performed in general accordance with a Massachusetts Department of Public Health regulations (MADPH 105 CMR, Part 460.000). The surface of each different painted building component from each of the 15 buildings was tested for total lead concentration. LBP was inspected to provide the renovation/demolition contractor(s) with information to take appropriate actions to protect employees (OSHA, 29 CFR, Part 1926.62, "Lead Exposure in Construction") and the environment (EPA, 40 CFR, Part 261, Subpart C, RCRA). Employees who are occupationally exposed to LBP at or above the OSHA Action Level of 30 micrograms per cubic meter of air ($\mu g/m^3$) must receive hazardous waste training in accordance with OSHA, 29 CFR, Part 1910.120 ("Hazard Communication Standard"). Building components that leach lead at concentrations greater than 5 milligrams per Kilogram (mg/Kg), EPA's waste characterization threshold limit must be disposed as hazardous waste. Waste characterization of selected lead-based paint (LBP)-coated building materials was not performed as part of this survey, however, reasonable assumptions for waste characterization can be made from identifying total lead concentrations on specific types of substrates.

The interior and exterior surfaces of the 15 buildings were visually inspected for surfaces coated with paint to identify different colors of paint, approximate quantities of building components coated with paint, locations of the painted components, and potential sampling areas. A NITON Corporation (Model XL-309) was used to determine lead in paint concentrations during this inspection. The concentrations were reported as milligrams per square centimeter (mg/cm^2) of surface area. The XRF uses a radioactive source that excites lead atoms when present. As the atoms return to their normal state, they emit x-rays that are characteristic of lead, if present. The XRF identifies and quantifies these x-rays to provide a lead concentration in mg/cm^2 of surface area.

The EPA defines "lead hazardous waste" as waste materials that leach lead at greater than 5 mg/Kg when subject to toxicity characteristic leaching procedure (TCLP) testing. The purpose of the TCLP testing is to determine appropriate segregation and disposal requirements for LBP-coated building components. As a general industry rule, building components coated with LBP (> 1.0 mg/cm^2) that comprise greater than 5% of the demolition debris waste stream should be segregated prior to demolition and disposed as hazardous waste at an appropriate landfill. For this reason, some buildings where LBP was identified do not require waste management because the LBP components do not comprise > 5% of the total waste stream. Once a singular building component is determined by TCLP analysis to leach lead at concentrations greater than 5 mg/Kg, it must be managed as hazardous waste, (i.e. cannot be commingled with demolition debris).

The following types of building components were tested at the facility:

- Window casings;
- Walls;
- Baseboards;
- Cabinets;
- Shelves;
- Ceilings
- Floors;
- Doors;
- Door casings;
- Exterior vestibules;
- Overhead garage doors;
- Exterior cornerboards;
- Radiators;
- Exterior trim;
- Bathroom stall dividers;
- Chair rails;
- Exterior vent casings;
- Exterior gutters;

- Bowling gutters;
- Exterior flashing;
- Floor striping;
- Vertical supports;
- Sink splash guards;
- Bathroom vanities;
- Above-ground storage tanks;
- Ladders/railings;
- Louvres;
- HVAC vents;
- Bulkheads;
- Stair treads, stringers and hand rails; and
- Interior chimneys;

Detectable levels of lead (> 0.1 and < 1.2 milligrams per square centimeter) were identified on several of these building components.

The following LBP-coated building components were identified:

- Split door;
- Exterior eves;
- Sheet rock walls;
- Exterior trims;
- Bowling gutters;
- Exterior doors;
- Interior chimney;
- Fire door;
- Bathroom stall divider;
- Exterior heat vent casings;
- Aboveground storage tanks;
- Support columns and ladders;
- Desks;
- Concrete block walls; and
- Exterior vestibules.

LBP-coated components were identified in/on each of the 15 buildings. Refer to Attachment C for a complete list of XRF field testing results and inventory of LBP identified.

Estimates for probable abatement (Attachment D) were developed for interior materials only in buildings assumed to be rehabilitated. The estimates do not always reflect complete removal of LBP from building components; in some cases (perimeter walls and other building components not scheduled for demolition), the estimates reflect restoring surfaces by scraping peeling/flaking paint and repainting (making "intact"). If exterior surfaces such as trim, eves, window casings or heat vent casings identified as LBP are disturbed, the estimates for probable abatement should be increased.

OIL AND OTHER HAZARDOUS MATERIALS (OHM)

A survey for miscellaneous containers of oil and/or hazardous materials (OHM) was performed in order to identify all regulated and special wastes that would require removal prior to building demolition. VHB identified several types of OHM at the 15 buildings. The majority of the OHM identified were miscellaneous containers used for cleaning/housekeeping or vehicle maintenance operations. In addition to the miscellaneous containers, the following OHM were identified:

- Mercury-containing thermostat ampules;
- Mercury-containing fluorescent light tubes;
- Sodium-containing light tubes
- PCB-containing light ballasts and starters;
- Diesel fuel aboveground storage tanks (ASTs);
- Lubricating oil ASTs;
- Waste oil AST;
- diesel generator;
- turbine engine;
- CFC-containing air conditioners and refrigeration equipment;
- Dry chemical fire extinguishers; and
- Air compressors.

Previous reports provided to VHB by National Parks Service indicate all transformers not labeled "no PCBs" have been tested for PCB's and determined to be PCB free (Radian Corporation, November 1994).

Although the pre-demolition survey was limited to the buildings, other miscellaneous OHM were observed on the Site that the National Park Service should note. These included utility poles potentially coated with creosote (Building #22 and #217), white goods (appliances) outside Building #34, and a demolition waste pile located behind Building #34.

It is our understanding that the majority of these materials/stored appliances and equipment (refrigerators, lawn tractors, compressors, etc.) may be reused or relocated to other portions of the site. The estimates of probable abatement reflect this understanding. VHB recommends that:

- All OHM located at the buildings should either be relocated/reused or properly recycled or disposed prior to demolition.
- All of the materials that are not reused must be properly removed, transported and recycled/disposed by licensed contractors following all applicable federal, state, and local regulations.
- Utility poles discarded in front of Building #22 and #217 should be treated as special waste due to the potential of wood preservatives.
- Prior to off-site management, refrigeration equipment/compressors (CFC's), interior turbine engine lubricating oils (PCBs), and all motorized equipment (oils) should be tested for the presence of hazardous/regulated materials. If any hazardous or regulated materials are detected, they must be managed (recycled/recaptured/disposed) in accordance with all federal, sate and local regulations.

Please call me at 617-924-1770 extension 1243 or Doug Burgess at extension 1509, if you have any questions.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

Timothy M. Downey
Hazardous Materials Specialist

Alan D. Hanscom, P.E., L.S.P.
Director of Environmental Engineering

Attachments

A	Limitations
B	Smith & Wessel Associates, Inc. Asbestos Survey Report
C	Results of XRF Field Results
D	Estimates of Probable Abatement
E	Photographs

cc: Doug Burgess, VHB

APPENDIX A - LIMITATIONS

15 ***Buildings***

Former North Truro Air Force Station

Truro, Massachusetts

- This report has been prepared for the sole and exclusive use of Bargmann Hendrie + Archetype ("Client"), on behalf of the National Park Service, and is subject to and issued in connection with the Agreement and the provisions thereof. Any use or reliance upon information provided in this report, without the specific written authorization of Client and VHB, shall be at User's sole risk.

- In conducting this assessment, VHB has obtained and relied upon laboratory analytical results from SciLab Boston, Inc. This information was used to form conclusions regarding the types and quantities of ACM that must be managed prior to demolition of the building.

- No attempt has been made to assess the compliance status of any past or present Owner or Operator of the subject property with any federal, state or local laws or regulations.

- The findings, observations and conclusions presented in this report are limited by the scope of services outlined in our Agreement, which reflects schedule and budgetary constraints for the current phase of the assessment. Furthermore, the assessment has been performed in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.

- The assessment presented in this report is based solely upon information gathered to date. Should further environmental or other relevant information be developed at a later date, Client should bring the information to the attention of VHB as soon as possible. Based upon an evaluation, VHB may modify the report and its conclusions.

Attachment A