Environmental Report for Decommissioning Ward Center for Nuclear Studies at Cornell University

Facilities Inventory Bldg. No. 2061

Revision 0 March 2003

Prepared for:
Cornell University
Ithaca, New York

Prepared by:
Duratek, Inc
Commercial Operations
628 Gallaher Rd.
Kingston, TN 37763

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1.0 PURPOSE AND NEED FOR ACTION

Cornell University's Ward Center for Nuclear Studies TRIGA Reactor and Zero Power Reactor (ZPR) provided training for Nuclear Engineering students and various services for researchers in all Departments of Engineering, the Departments of Physics, Chemistry, Biology, and Medicine. Cornell University stopped routine operation of the Ward Center TRIGA Reactor on June 30, 2002, and plans to submit a request for a possession-only license in 2003. The TRIGA is currently operated for short periods of time at low power levels in order to maintain operator qualifications. The University had previously permanently ceased operation of the ZPR reactor on May 1, 1997. Temporarily mothballing the TRIGA reactor is not a reasonable option. Hence, the University wishes to proceed with its decommissioning and the termination of the associated reactor license. Cornell therefore has filed this decommissioning plan with the NRC. As with other facilities of this nature, Ward Center is contaminated with varying amounts of radioactive material and small amounts of hazardous material. Decontamination and Decommissioning (D&D) of Ward Center will eliminate the potential for future inadvertent environmental releases. The goal of the proposed D&D activities is termination of the Ward Center TRIGA and ZPR Reactor Nuclear Regulatory Commission (NRC) licenses and the release of Ward Center for "unrestricted use" except for the gamma irradiation facility, which is licensed by the State of New York. The term "unrestricted use" means that the NRC will impose no future restrictions on the use of the site.

2.0 FACILITY, DESCRIPTION, PROPOSED ACTIONS, ALTERNATIVES AND ADMINISTRATIVE CONTROLS

2.1 Facility Description

In 1959 Cornell began construction of a facility to house the TRIGA Reactor, the ZPR Reactor, the Gamma Cell and supporting systems (e.g., Instrumentation and Control Systems, Forced Cooling System, Water Demineralization System, Ventilation/Exhaust System, Radiation Monitoring Systems, etc.). Following construction and reactor hardware installation, the TRIGA Reactor was brought to initial criticality in January of 1962. The TRIGA was routinely operational from that date until June 30, 2002. Cornell plans to request that the USNRC issue an amendment to the TRIGA facility license to place the reactor in Possession-Only-Amendment (POA) status. The ZPR reactor has been shut down since May 1, 1997 but parts of the system are still in place.

The regional location of Cornell University is shown in Figure B-1. Figure B-2 depicts the Cornell University Campus. The Ward Center site is depicted on Figure B-3. Figures B-4, B-5 & B-6 presents plan views of the three floors of Ward Center. This Decommissioning Plan has been prepared using the guidance and format of NUREG-1537 Rev. 0, *Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors* (Ref. 1.1) and includes additional guidance from NUREG–1727, *NMSS Decommissioning Standard Review Plan* (Ref. 1.2).

Figure B-1 Map of the Area Surrounding Cornell University

Figure B-2 Cornell University Campus

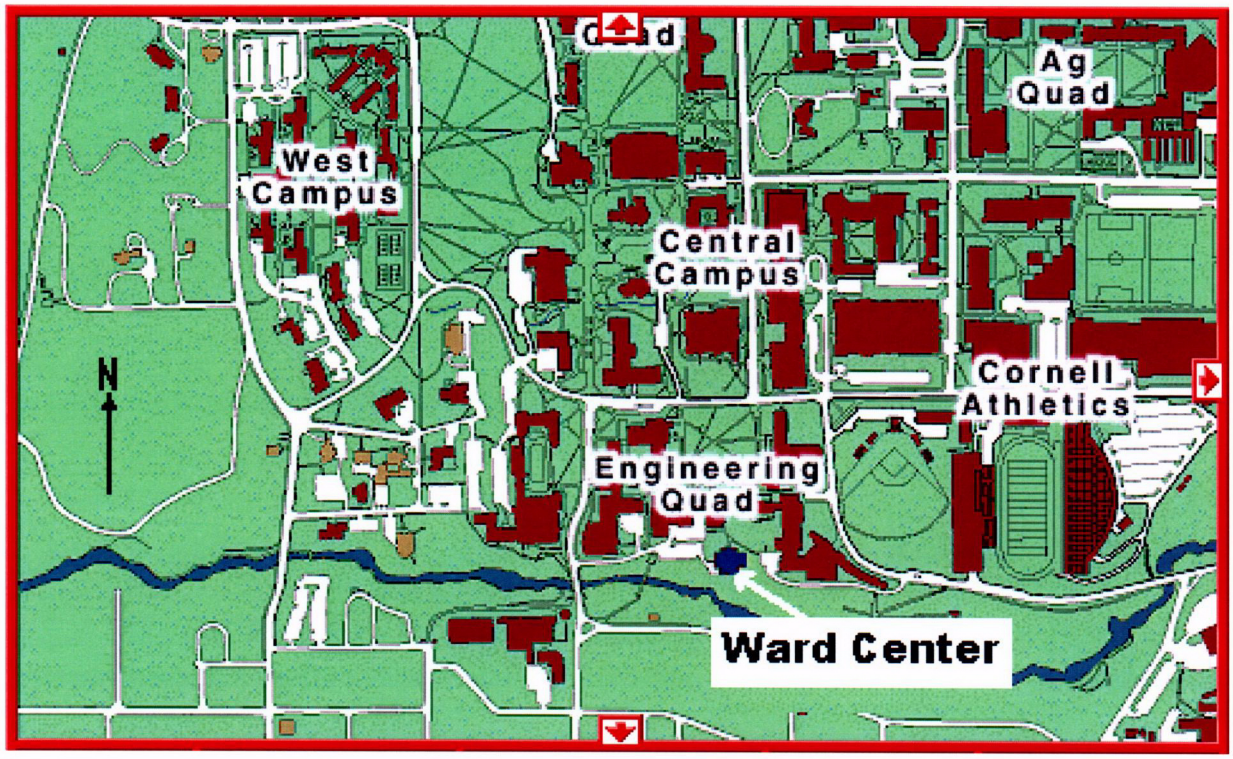


Figure B-3 Cornell University Ward Center Site

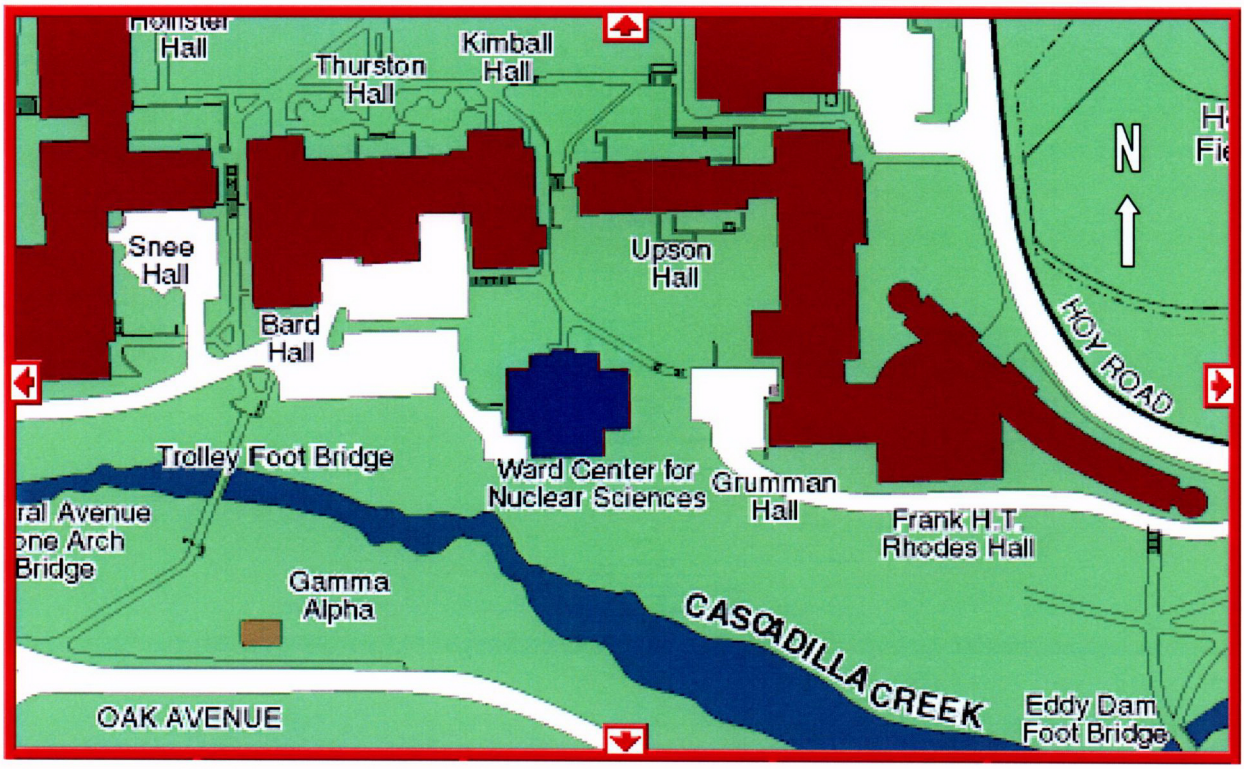


Figure B-4 Ward Center Basement Plan View

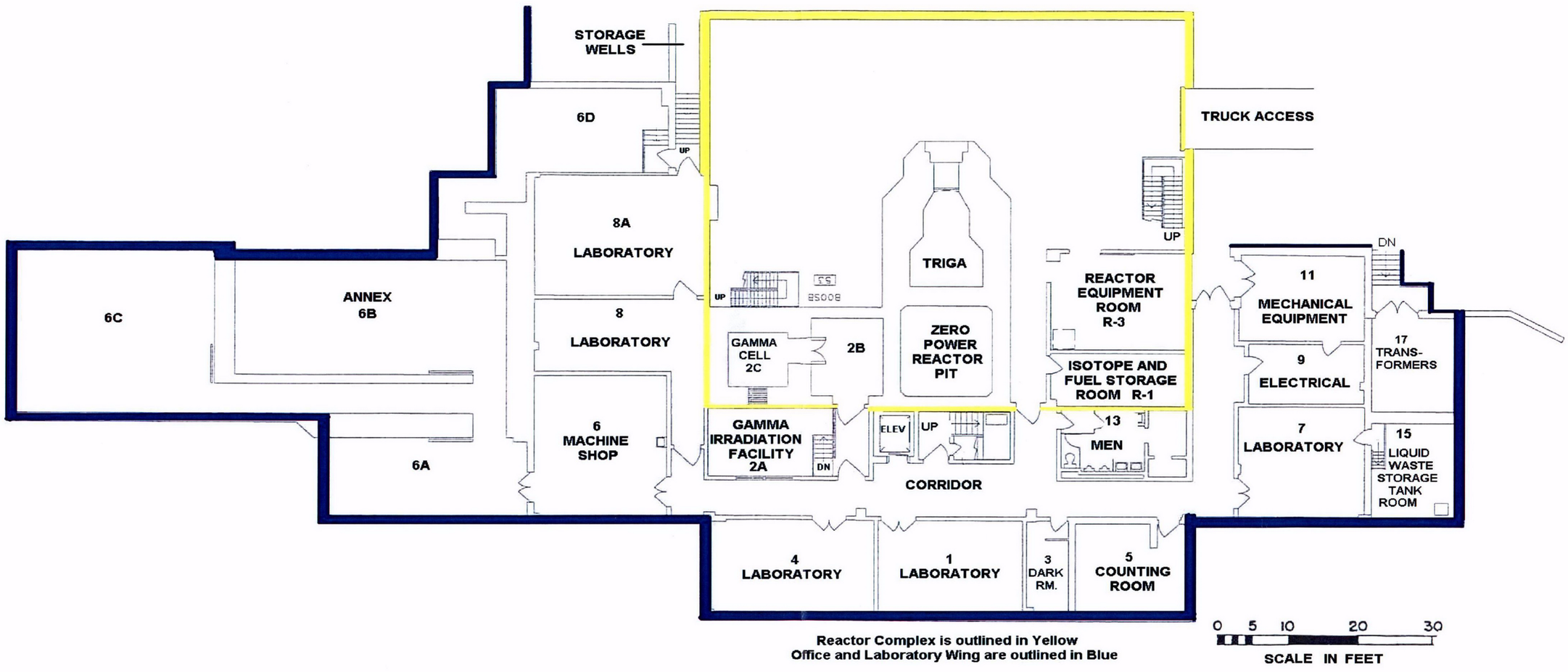


Figure B-5 Ward Center 1st Floor Plan View

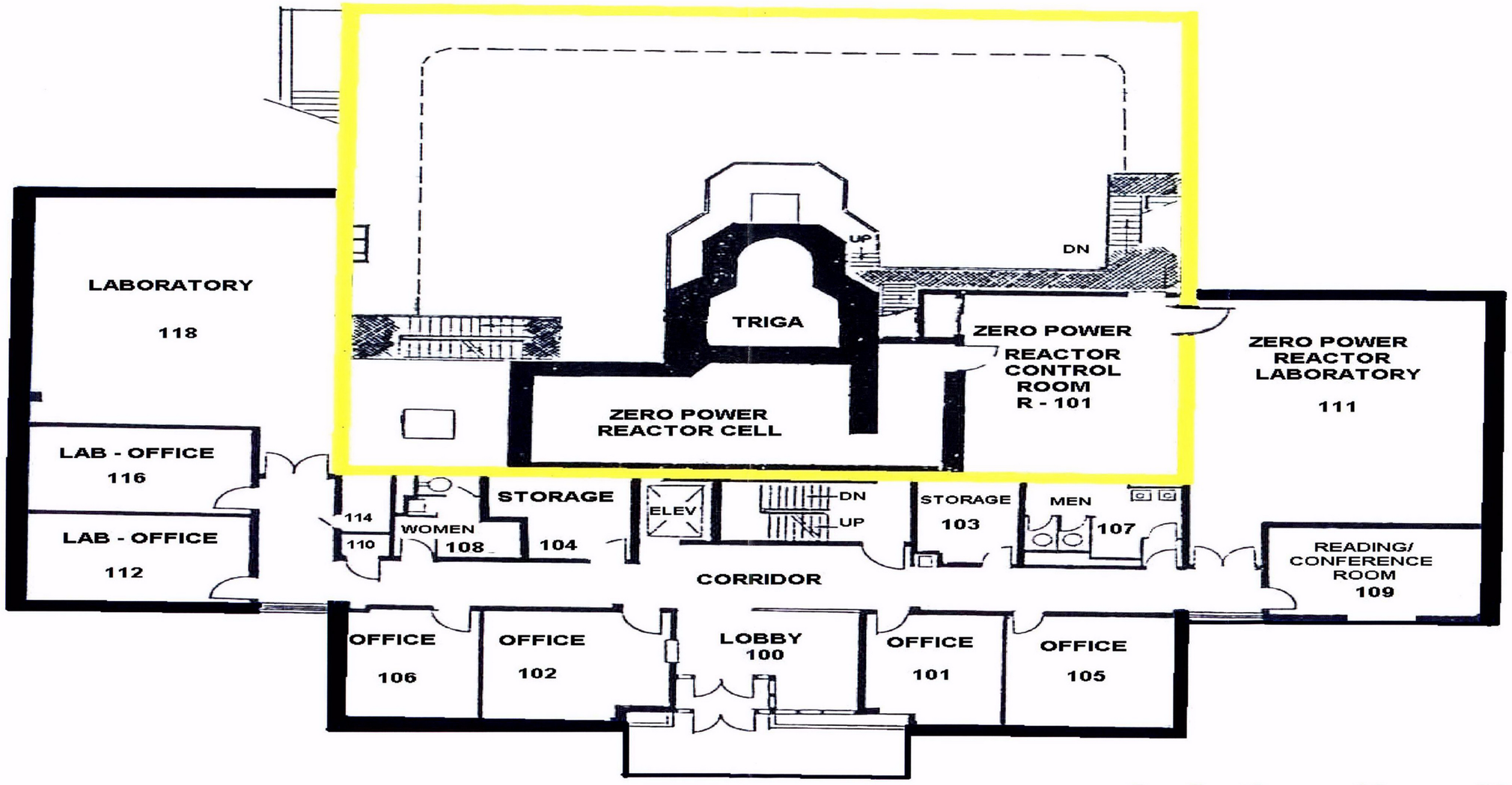
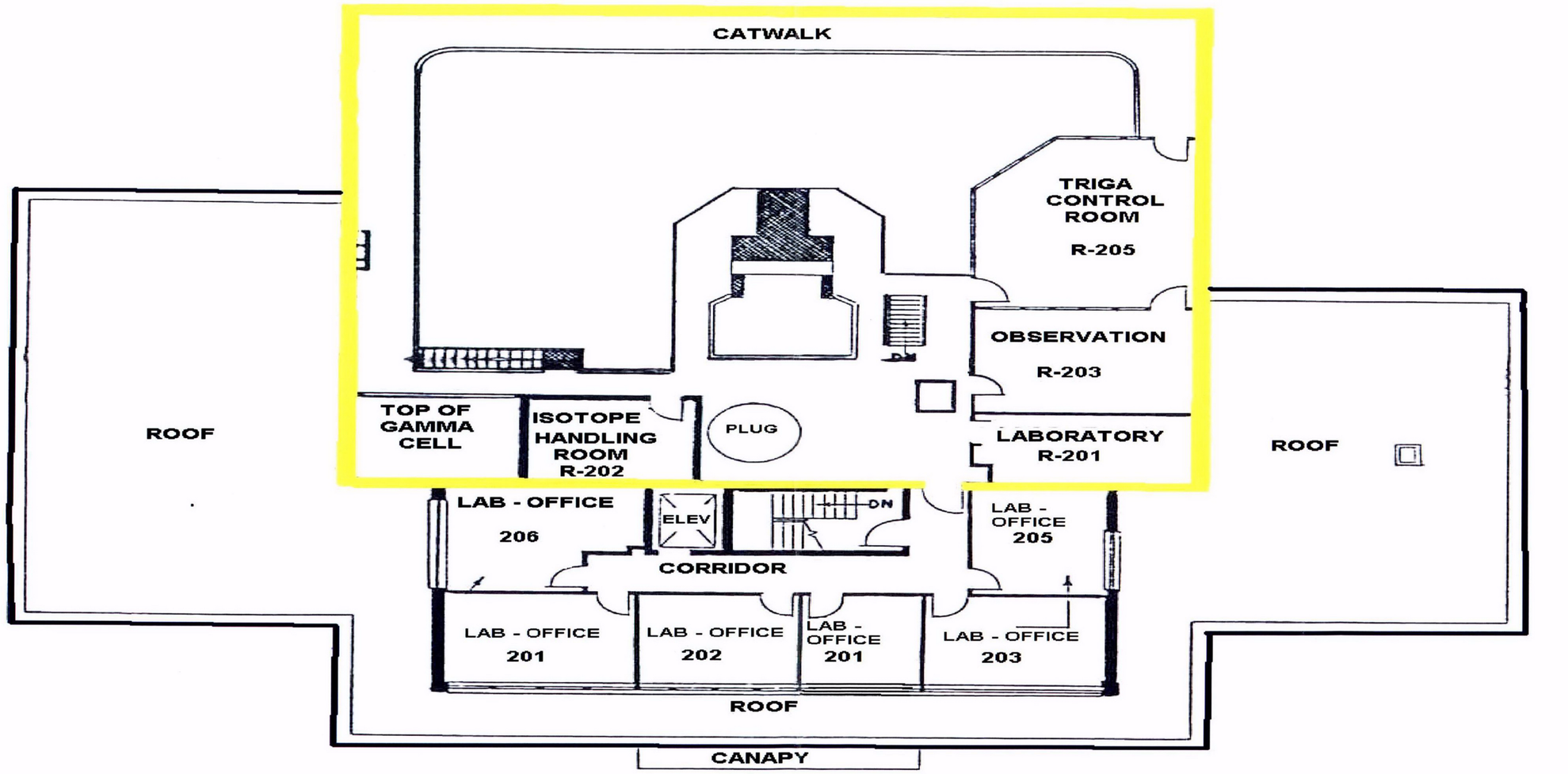


Figure B-6 Ward Center 2nd Floor Plan View



It is anticipated that the TRIGA Reactor, situated in the Reactor Complex, will be placed in "Possession-Only-Amendment" (POA) status, through an amendment to the USNRC License No. R-80, in 2003. The TRIGA is currently operated for short periods of time at low power levels in order to maintain operator qualifications.

The ZPR has been inoperable for more than 5 years. All reactor fuel elements were removed and returned to DOE.

All Ward Center building utility services required for facility operation and maintenance are active.

Ward Center license-required radiological monitoring and instrumentation systems remain operational.

There are manually actuated and automated fire alarm systems present in the Ward Center.

Existing physical security and material control and accounting plans approved by the Nuclear Regulatory Commission (as may be amended) will continue to be implemented.

The water demineralization system serving the Ward Center TRIGA Reactor remains operational.

2.2 Proposed Action and Alternatives

The Proposed Action and the Alternatives are as follows:

- Proposed Action (DECON) - Decontamination and Decommissioning of the Ward Center TRIGA and ZPR Reactors followed by Ward Center TRIGA and ZPR Reactor license termination and subsequent release of the site for unrestricted use.

- Alternative 1 (SAFSTOR) - In safe storage, the Ward Center TRIGA and ZPR Reactors are placed and maintained in a condition that allows it to be safely stored and subsequently decontaminated to a level permitting release of the property by the USNRC.

- Alternative 2 (ENTOMB) - In entombment, radioactive materials are encased in a structurally long-lived material such as concrete. The entombed structure is appropriately maintained and surveillance is continued until the radioactivity decays to a level permitting release of the property by the USNRC.

- No Action Alternative - A no-action alternative would leave the facility in its current status with the current support staff having to maintain the facility under the existing license conditions. This action will involve maintaining:

    - The facility license
    - Personnel to support facility maintenance and surveillance

- Surveillance and maintenance of Reactor Pool Water Level, Purity and pH
- The Reactor Facility physical security plan

The reactor pool still contains fuel and activated hardware with some items reading over 450R/hr on contact. The reactor pool does not have a history of significant leakage. However keeping the facility in this status over a long period of time may lead to a degradation of the pool. That degradation will require either the repair, or the decommissioning of that portion of the facility, which constitutes a major portion of the decommissioning.

The facility will not become available for conversion into useable space delaying the beneficial reuse of the site for other university educational needs. The university will incur expenses for maintenance of the facility without making beneficial use of the facility.

The NRC requirement in 10CFR 50.82(b)(1)(ii) providing for non-power reactor decommissioning without significant delay following permanent shutdown would not be satisfied.

Implementation of the Proposed Action will involve performance of the following tasks:

- Dismantlement, decontamination or packaging as low-level radioactive waste (LLRW) the Ward Center TRIGA and ZPR Reactor components and pool.
- Decontamination of any remaining contaminated areas.
- Shipment of the LLRW generated as a result of decommissioning activities.
- Performance of a final status survey and submission of a request to the USNRC for release of the subject areas for unrestricted use and termination of the Ward Center Reactor licenses.

2.3 Administrative Controls

To minimize the risks of inadvertent exposure, contamination and/or radioactive releases, all decommissioning operations will be implemented in accordance with appropriate technical and administrative controls, including:

- Performance of all project work pursuant to approved procedures implementing a USNRC-approved Decommissioning Plan. Cornell will continue to be responsible for assuring and demonstrating compliance with USNRC licenses, as well as other applicable federal, state or local laws, regulations, licenses and/or permits.
- Utilization of containment structures tents and bags under negative pressure and/or appropriate contamination barriers to isolate operation areas and prevent inadvertent release of contaminants.
- Employment of monitored, high-efficiency particulate air (HEPA) filtration systems for air ventilation in contaminated work areas.
- Maintenance of emergency ventilation, power and supplies, as appropriate.

- Application of ALARA principles by emphasizing radiation protection for workers and the general public, employing personnel and area dosimetry, using personal protective equipment and clothing and conducting work through approved Radiological Work Permits. The term "ALARA" means as low as is reasonably achievable, taking into account the state of technology and the economics of improvements in relation to the benefits to public health and safety, and other societal and socioeconomic considerations. Cornell Health Physics staff will have the authority to stop any operations that they believe may involve unusual, unnecessary or excessive radiological risk to the worker, the public or the environment.
- Maintenance of industrial security access control to the work site and facility to restrict unauthorized individuals from the work area.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Man-Made Environment

3.1.1 Radioactive Materials

The public is continuously exposed to radiation from natural sources, primarily from: cosmic radiation, external radiation from natural radioactive material in the earth and global fallout, and internal radiation from natural radioactive materials taken into the body via air, water, and food. The public receives and accepts the risks associated with radiation exposures from medical X-rays, nuclear medicine procedures and consumer products. On average, a member of the public in the United States receives approximately 300 mrem/yr from natural sources of radiation; approximately 50 mrem/yr from medical procedures; and approximately 10 mrem/yr from consumer products, for a total of 360 mrem/yr (Ref. 5-1). At the Cornell Reactor, elevation 770 feet, the background radiation from natural sources is about 240 mrem/yr and the total background radiation is approximately 300 mrem/yr.

Residual radioactive contamination resulting from past reactor operations is contained within the Ward Center, which is continuously monitored. Existing monitoring data, historical information, and current surveys indicate that building contamination is comprised of low levels of fission and activation products. The radionuclides listed in Table B-1 potentially exist in the Ward Center Facility.

Radioactive atoms undergo spontaneous nuclear transformations and release excess energy in the form of ionizing radiation. Such transformations are referred to as radioactive decay. As a result of the radioactive decay process, one element is transformed into another; the newly formed element, called a decay product, will possess physical and chemical properties different from those of its parent, and may also be radioactive. A radioactive species of a particular element is referred to as a radionuclide or radioisotope. Radiation emitted by radioactive substances can transfer sufficient localized energy to atoms to remove electrons from the electric field of their nucleus (ionization). In living tissue this energy transfer can destroy cellular constituents and produce electrically charged molecules (i.e., free radicals). Extensive biological damage can lead to adverse health effects (Ref.5-2). The adverse biological reactions associated with

ionizing radiation, and hence with radioactive materials, are skin injury, cancer, genetic mutation and birth defects (Ref. 5-3).

Table B-1 List of Expected Radionuclides

Nuclide	Half-Life (yr)	Decay Mode
^{3}H	12.28	β^-
^{14}C	5730	β^-
^{54}Mn	0.86	ε
^{55}Fe	2.73	ε
^{57}Co	0.74	ε
^{58}Co	0.19	ε
^{60}Co	5.27	β^-
^{59}Ni	76000	ε
^{63}Ni	100	β^-
^{65}Zn	0.67	ε
^{90}Sr	29.1	β^-
^{94}Nb	20000	β^-
^{99}Tc	213000	β^-
^{124}Sb	0.16	β^-
^{125}Sb	2.76	β^-
^{129}I	15,700,000	β^-
^{134}Cs	2.07	β^-
^{137}Cs	30.17	β^-
^{144}Ce	0.78	β^-
^{152}Eu	13.48	β^-, β^+, ε
^{154}Eu	8.8	β^-
^{155}Eu	4.96	β^-
^{210}Pb	22.26	β^-
^{230}Th	77,000.	α

Symbols/Abbreviations: α = Alpha
β^- = Beta
β^+ = Positron
ε = Electron Capture

The radionuclide half-life values and decay mode information used above are taken from Ref. 5-4.

The list of expected radionuclides provided above is based on the assumption that operations of the Cornell Reactor has resulted in the neutron activation of reactor core components and other integral hardware or structural members which were situated adjacent to, or in close proximity to, the reactor core during operations. Specific items, which are considered to have been exposed to neutron activation, include materials composed of aluminum, steel, stainless steel, graphite, lead, concrete and possibly others.

Major types of ionizing radiation include alpha particles, beta, and gamma or X-ray radiation. Alpha particles expend their energy in short distances and will not usually penetrate the outer layer of skin. Alpha particles represent a significant hazard only when taken into the body, where their energy is completely absorbed by small volumes of tissues. Beta particles constitute external hazards if the radiation is within a few centimeters of exposed skin surfaces and if the beta energy is greater than 70 keV. Internally, beta particles deposit much less energy to small volumes of tissue and, consequently, inflict much less damage than alpha particles. Gamma radiation is of the most concern as an external hazard because gamma radiation is very penetrating.

3.1.2 Hazardous Materials

Based on preliminary surveys and inspections of the subject work areas, the specific hazardous materials of concern in terms of potential exposure to project workers, on-site Cornell employees and off-site persons are elemental lead and asbestos.

3.1.2.1 Elemental Lead

The predominant hazardous material in Ward Center, in terms of mass, is elemental lead (used primarily in various radiation shielding applications). Most lead contained in the facility consists of solid, non-dispersible bricks, fittings, liners and weights. Lead is a cumulative poison. Increasing amounts can build up in the body eventually reaching a point where symptoms and disability occur. The effects of exposure to lead dust through inhalation and ingestion may not develop quickly. Symptoms may include decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, constipation, abdominal pains and decreased appetite. Lead can also cause irritation to the skin and eyes. These effects are reported to be reversible if exposure ceases. Systemic effects are possible if a long-term exposure occurs and birth defects have been reported.

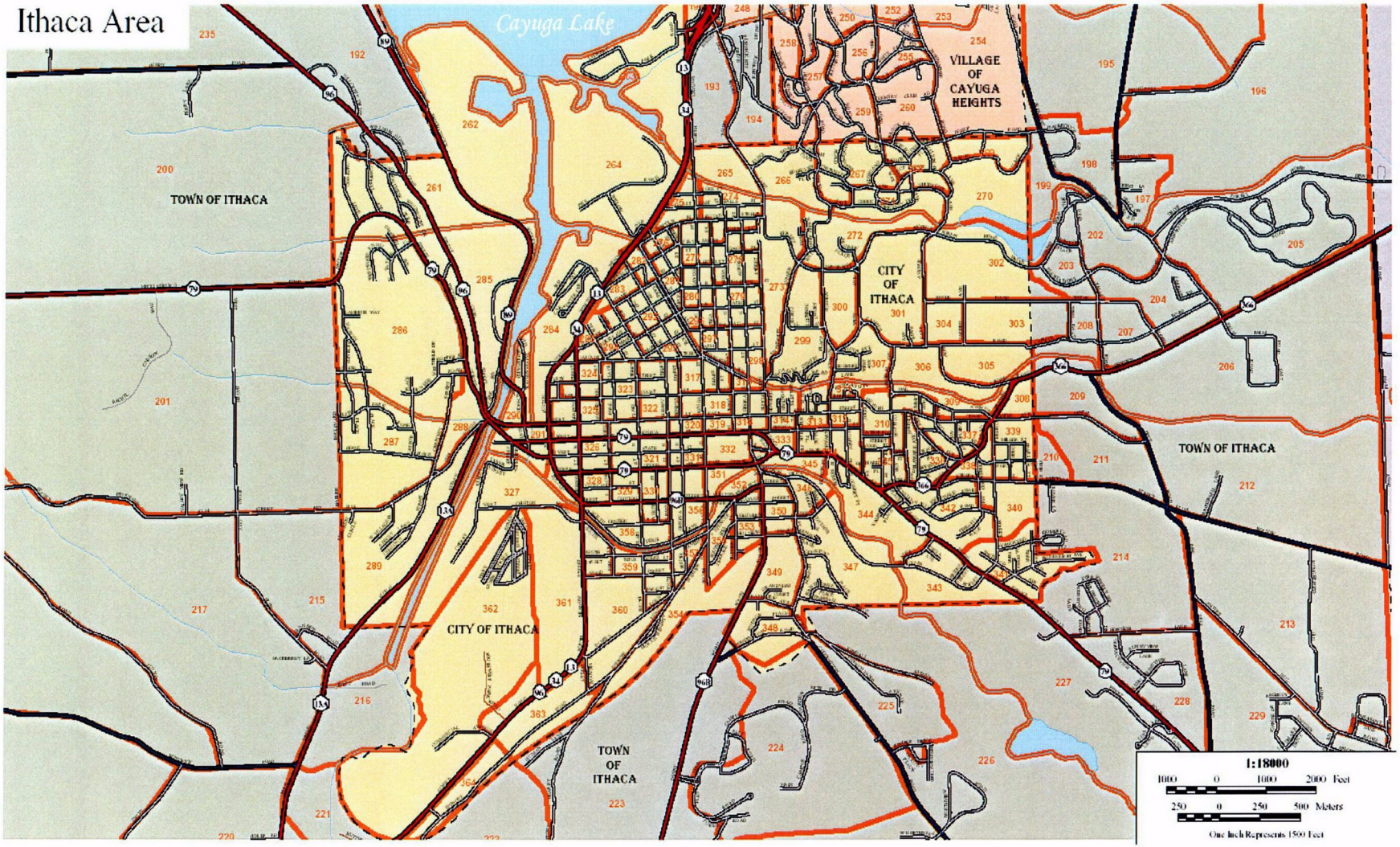
3.1.2.2 Asbestos

Asbestos is present in Ward Center construction materials (e.g., floor tiles, roofing material). Asbestos is not a hazard unless it is "friable," that is in powder or fiber form. Inhalation of the fibers can cause asbestosis and lung cancer. Gastrointestinal cancer can be caused by ingestion. Asbestos in the Ward Center will be removed, if required, by a licensed asbestos abatement contractor.

3.1.3 Transportation

The principal roadways in the Ithaca area are illustrated in Figure B-7. The urban principal arterials include Rt. 13 (Elmira Road and S. Meadow Street). The urban minor arterials include Rt. 79, Rt. 96, Rt. 13A, Rt. 96B,Rt. 89 and Rt. 366. These roads are part of the state highway system and provide access to Ithaca from all directions.

Figure B-7 Principal Roadways of the Ithaca Area



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The Ward Center site is generally accessed by foot from pathways to the north and east. Vehicle traffic access is from College Avenue along Cascadilla Creek. This same road provides access to Snee Hall, Bard Hall and Thurston Hall. There is very limited paved parking along this access road. Vehicle traffic access is also available from Hoy Road, which provides access to Frank HT Rhodes Hall and Grumman Hall. The closest general access parking is at the parking garage next to Hoy Field.

3.1.4 Cultural and Historical Resources

No significant archeological or cultural resources have been found in surveys of the Ward Center site. The National Register of Historic Places does not list Ward Center as a historical structure or site. Nearby Sage Hall is a local historic landmark and is located about 700 feet to the north of Ward Center. Sage Hall was designated a local historic landmark under Chapter 228 of the City of Ithaca Municipal Code, Landmarks Preservation in 1990. The building is not eligible for the state or National Register of Historic Places due to the many alterations over the years.

Ward Center decommissioning will have no impact on cultural and historic resources as the Ward Center building will be left in place and the appearance of the area will be unchanged.

3.1.5 Population and Land Use

As shown in Figure B-3, residential areas are found to the south and business districts to the west at approximately 300 feet and 900 feet respectively. The US Census Bureau estimated the population of Ithaca to be 29,287 in 2000. Within a ½-mile radius of Ward Center, there are campus classrooms, laboratory buildings, service buildings, student housing, and administrative buildings. Outside the campus boundary are residential and commercial areas. The site is separated from the residential areas to its south by the gorge of Cascadilla Creek. Surrounding land uses are shown graphically on Figure B-3.

The present population on University grounds consists of 2,991 faculty and staff, 13,658 full-time undergraduate students and 5,601 full-time graduate students/professionals. Engineering School buildings and office areas occupy the immediate vicinity of the Ward Center facility.

Nearby human populations include:

- Cornell non-radiological workers;
- Cornell student housing is located as close as 300 feet to the southwest (Gamma Alpha) and 600 feet to the south west (Sheldon Court);
- Cornell Engineer Quad buildings surrounding the Ward Center on west, north and east sides as located as close as 300 feet;
- Rte. 13 located ½-mile to the west, Rt. 13 is also known as S. Meadow Street as it passes through Ithaca and Elmira Road further south;

- Gannett Health Center, located 900 feet to the north west; and
- Residences, beginning at about 300 feet to the south.

3.1.6 Noise

Within Cornell site boundaries, vehicular traffic, jet aircraft, general aviation aircraft and building, heating, ventilating and air conditioning equipment generate the ambient noise environment.

3.1.7 Aesthetics

Ward Center is located on a rock ledge in the southern portion of the Engineering Quad and at the north edge of the Cascadilla Creek Gorge. Ward Center is visible from the buildings to the west, north and east, but it is generally not visible from the south across the Cascadilla Creek Gorge because it is shielded by heavy woods on the south side of the gorge.

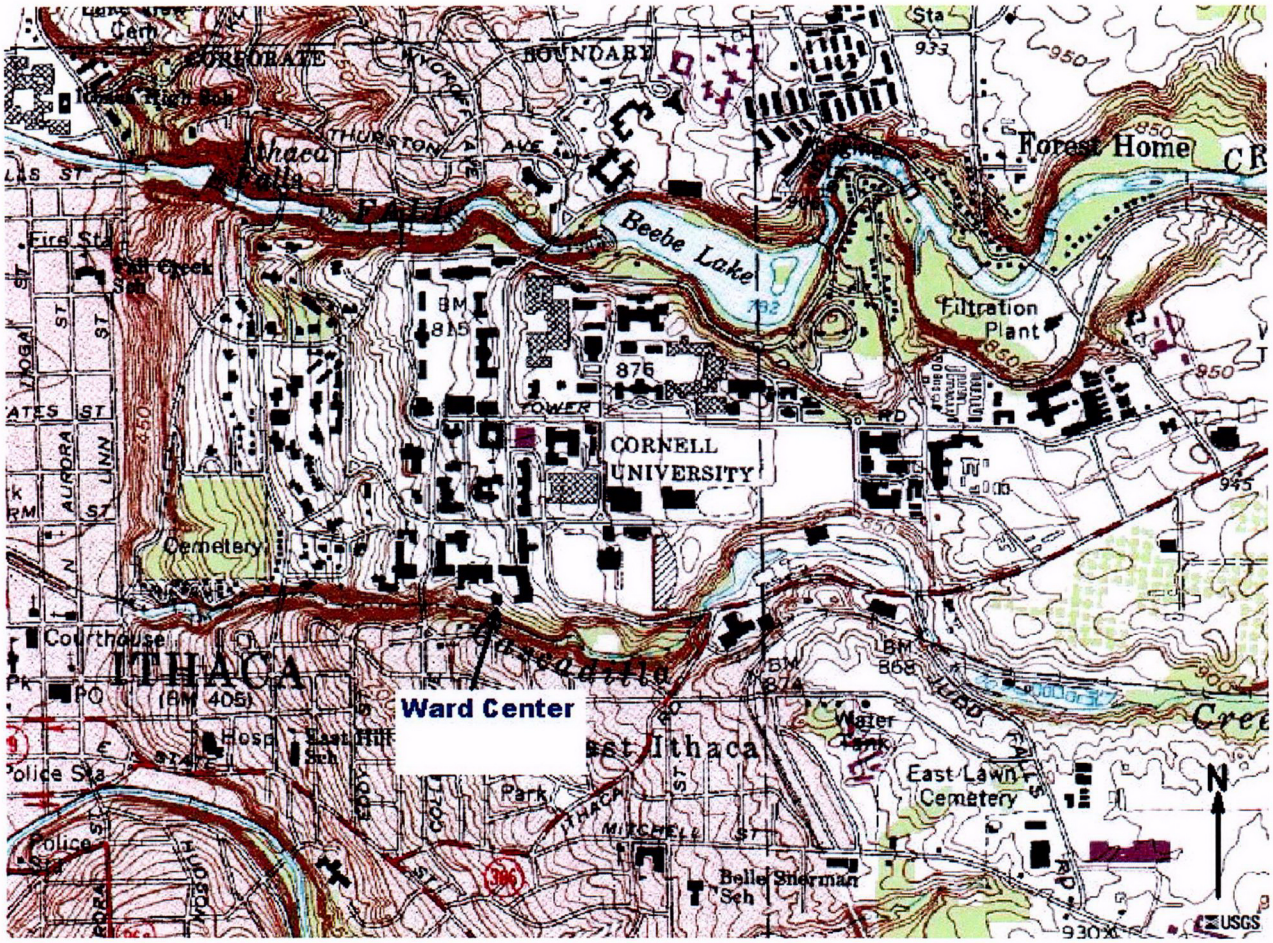
3.2 Natural Environment

3.2.1 Topology, Geology and Seismicity

3.2.1.1 Topology

Site topography is typical of Tompkins County. Hilly areas with intersecting ridges and draws between them provide for wet weather drainage. The site slopes strongly southward toward the Cascadilla Creek Gorge, with 60 feet of elevation drop in about 60 feet. The buildings to the north of Ward Center are at higher elevations ranging from 780 to 790 feet as compared to the Ward Center elevation of 760 to 770 feet. Figure B-8 shows the topographic of the area surrounding Cornell University.

Figure B-8 Topographic Location



3.2.1.2 Geology

Geologically, the mantle at the site is relatively porous consisting of lake-deposited silt and sand. The Site is underlain by bedrock of the Enfield and Ithaca Formations, both of which consist of shale with numerous interbedded flaggy silt-stone units.

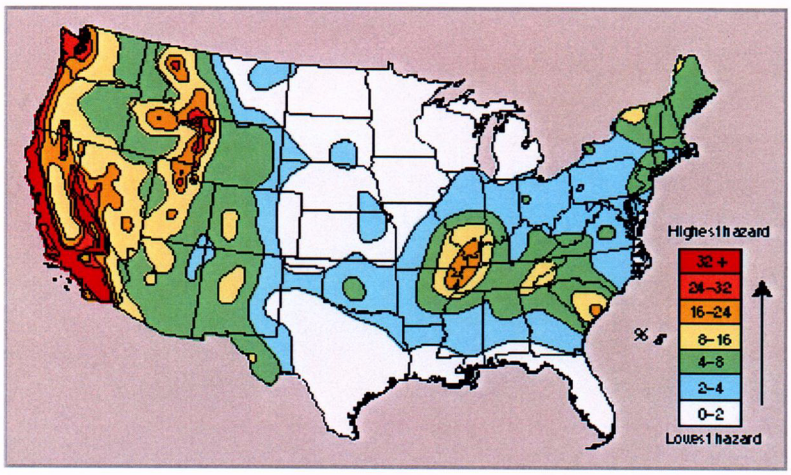
3.2.1.3 Soils

Above bedrock in this area is relatively porous soil consisting of lake-deposited silt and sand. Generally, the contact between the bedrock and the soil is gradational and occurs at depths ranging between a few inches and few feet below the surface.

3.2.1.4 Seismicity

According to information provided by the USGS National Earthquake Information Center New York is considered to be a relatively low risk for earthquakes, however, earthquakes can occur just about any place in the state as indicated in (Figure B-9).

Figure B-9 Earthquake Hazard Map, From USGS



The USGS provided additional data for the east cost indicating potential peak earthquake acceleration with a probability of 10% that the acceleration would be exceeded in 50 years (Figure B-10).

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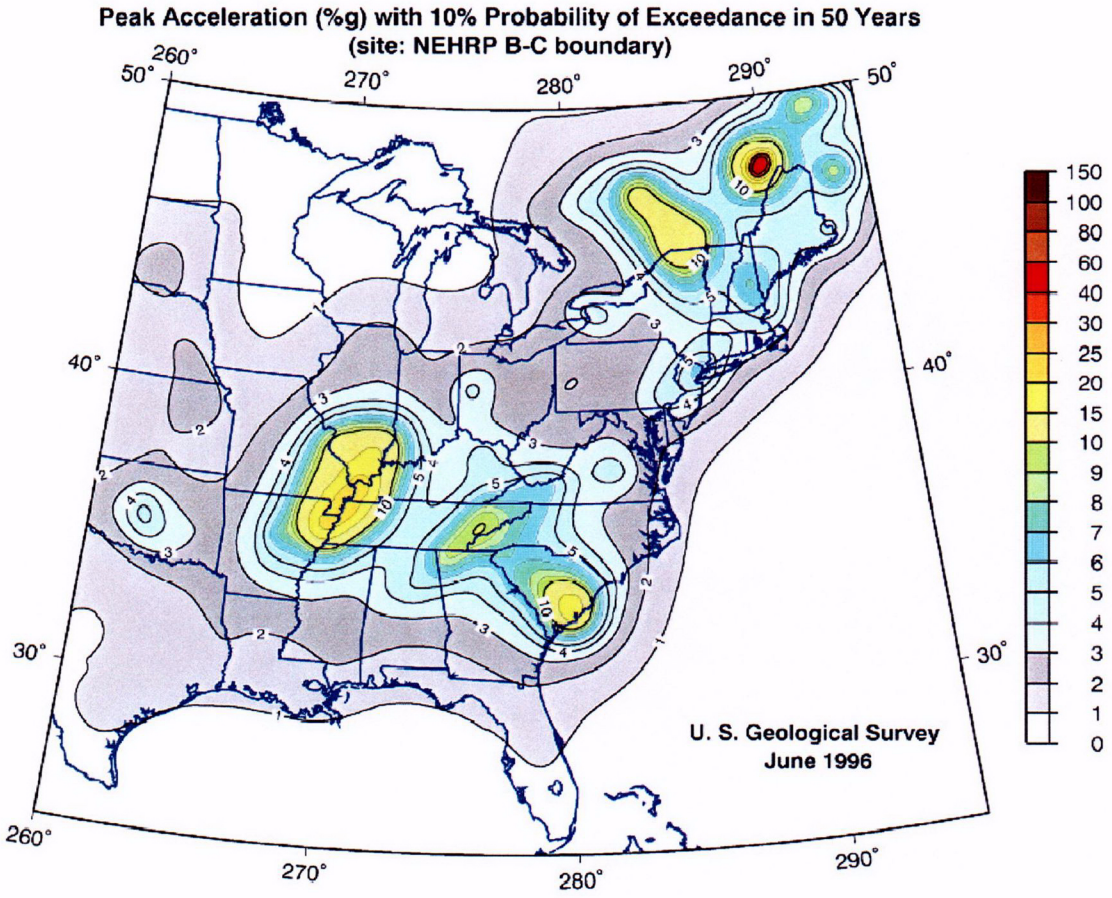
Figure B-10 Earthquake Acceleration and Probability-USGS 1966



Considering the low level of earthquake activity and intensity in this area and the reinforced construction of the pool, earthquake activity is not considered to present a danger to the facility.

3.2.2 Climate and Air Quality

3.2.2.1 Climatology

The climate of Ithaca, New York, is classified as humid continental. Humid continental is an inland, mid-latitude climate characterized by moderate to large diurnal (day/night) and annual ranges of temperature. Precipitation is moderate (about 36 inches annually) and evenly distributed throughout the year.

Winters in this area are cold (the mean temperature in January is about 20° F) and occasionally severe. Snowfall averages approximately 70 inches per year. The summer maximum temperatures are generally cool (the mean July temperature is about 70° F). Spring and autumn are varied, with the spring being generally cloudy and cool, and the autumn generally sunny and

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dry. The predominant winds for the Ithaca area are from the northwest, with a secondary maximum from the south-southeast and southeast.

3.2.2.2 Local Winds and Dispersion Data

The prevailing wind is from the southeast throughout the year and is especially dominant during the fall and winter seasons. There is also a strong wind from the northwest that blows with consistency throughout the year but is more prominent in the summer and spring months.

There is a "night wind" of the Cayuga Lake Valley that blows during the summer months at times when the absence of cyclonic disturbances gives full play to local influences. Commonly it sets in a few hours after sunset as a light breeze from the south, gradually increases in strength until a velocity of about eight miles an hour is reached, and then continues steadily throughout the night. This current has its origin on the hillsides at the southern end of the lake, and it flows northward down the watercourses converging into the main depression. As it moves northward over the smooth surface of the lake, it is augmented by the numerous cool currents that join the main stream through the watercourses that debouch upon the valley from either side.

3.2.2.3 Precipitation

The average annual rainfall for Ithaca is 35.41 inches with little monthly and seasonal variation. The monthly precipitation data as measured at the Game Farm Road Weather Station are presented in Table B-2 and the snowfall summary is presented in Table B-3.

Table B-2 Ithaca Precipitation Summary (Inches)

Month	Monthly Normal	Monthly Extremes				Daily Extremes		Number of Days >=		
		Most	Year	Least	Year	Most	Year	0.01"	0.10"	1.00"
Jan	1.82	6.37	1978	0.44	1933	1.96	1915	15	5	0
Feb	2.00	4.34	1911	0.25	1968	1.72	1958	13	5	0
Mar	2.27	6.92	1936	0.30	1910	2.46	1900	14	6	0
Apr	2.91	8.16	1993	0.55	1915	2.13	1993	13	7	0
May	3.31	8.07	1984	0.30	1903	2.07	1944	13	8	0
Jun	3.77	11.79	1972	0.87	1927	3.55	1972	12	8	1
Jul	3.45	12.59	1935	0.92	1983	4.60	1935	11	7	1
Aug	3.44	8.66	1922	0.54	1923	3.96	1947	11	7	1
Sep	3.53	9.13	1977	0.65	1943	3.14	1924	12	7	1
Oct	3.26	8.36	1981	0.19	1963	5.08	1981	13	7	1
Nov	3.08	6.41	1963	0.55	1939	2.31	1926	14	7	0
Dec	2.57	5.76	1901	0.13	1928	2.38	1901	16	7	0
Annual	**35.41**	**46.87**	**1958**	**25.53**	**1965**			**157**	**81**	**5**

Table B-3 Ithaca Snowfall Summary (Inches)

Month	Monthly Normal	Monthly & Daily Extremes				Number of Days >=		
		Monthly	Year	Daily	Year	0.1"	1.0"	3.0"
Jan	16.9	54.0	1978	15.0	1978	13	6	1
Feb	14.7	37.1	1972	21.0	1961	11	5	1
Mar	10.2	35.5	1956	16.5	1984	8	3	1
Apr	3.9	14.5	1983	9.5	1956	3	1	0
May	0.3	3.5	1966	2.0	1977	0	0	0
Jun-Sep	0.0	0.0		0.0		0	0	0
Oct	0.5	6.5	1988	5.0	1988	0	0	0
Nov	5.4	17.8	1951	12.0	1968	4	2	0
Dec	15.4	48.1	1969	13.0	1969	11	6	1
Season	**67.3**	**122.2**	**1977-78**			**50**	**24**	**4**

3.2.2.4 Air Quality

Based on the USEPA classification, the ambient air quality in the Ithaca area meets the National Air Quality Standards (NAAQS). These standards exist for air pollutants known as criteria pollutants (sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, inhalable particulate matter, and lead). The NAAQS were established by the USEPA based on ambient levels that would protect the public health and welfare.

New York State has adopted the NAAQS as well as established standards for additional pollutants, such as fluorides, beryllium, and hydrogen sulfide. In addition, NYSDEC's toxic air contaminant permitting program is implemented in conjunction with *New York State Air Guide-1: Guidelines for the Control of Toxic and Ambient Air Contaminants* (Air Guide-1). In accordance with this program, ambient levels of toxic contaminants, such as HRMs, from routine stack emissions are evaluated with respect to the Annual Guideline Concentration (AGC) and Short-term Guideline Concentration (SGC) for each contaminant. However, NYSDEC does not typically monitor the ambient air quality for toxic contaminant concentrations, except in specific areas of concern where certain chemicals are being emitted in large quantities (such as near large chemical manufacturing complexes). In these situations, NYSDEC relies on air quality models to determine compliance with Air Guide-1 concentrations.

3.2.3 Hydrology

3.2.3.1 Groundwater

For the most part, the bedrock does not have appreciable primary porosity or permeability, but transports water through secondary features such as the fractures, joints, and faults. In order for a bedrock well to be good water producer, the well must intersect these fractures and joints that are capable of yielding groundwater at rates required by the end user. The typical low yield produced by wells in the area has resulted in the development of public water supplies for larger towns and cities as well as the Cornell Water Filtration Plant.

Based on the topography in the local area, groundwater is expected to flow to the southeast discharging into the Cascadilla Creek that eventually flows into Cayuga Lake (67 square miles) to the northeast.

3.2.3.2 Surface Water

Based on ground surface elevations and surface drainage patterns, surface run-off from Ward Center currently flows primarily south, across paved and unpaved surfaces to the Cascadilla Creek Gorge.

There is an existing drainage shed for the Engineering Quadrangle area that includes Ward Center. This drainage shed discharges to a 20-inch corrugated metal pipe at the southwest end of the Engineering Quadrangle.

Floods do not represent a danger to the site as it is situated over 60 feet above the Cascadilla Creek Gorge. Also, drainage downstream from the site is unrestricted. Ward Center is not located within a 100-Year Flood Zone.

The Ithaca Area Wastewater Treatment Facility supplies wastewater collection services to the Cornell site. Wastewater from the site is discharged by gravity through the City's sewer system. Any wastewater released to the city treatment system must meet the requirements of the 10 CFR 20 limits for wastewater discharge.

The existing Cornell Water Filtration Plant provides the source of water for the Ward Center.

3.2.4 Biology

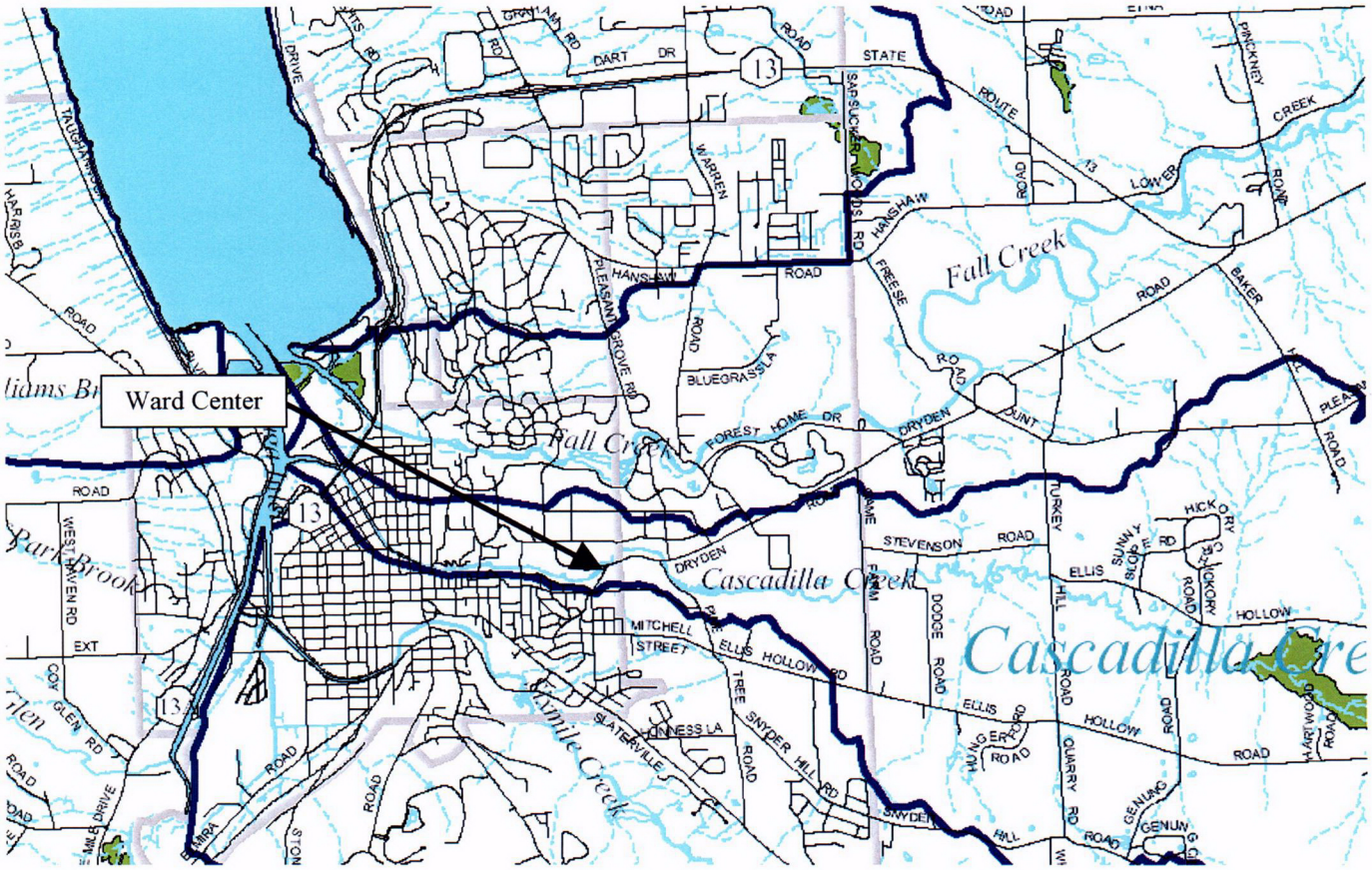
3.2.4.1 Vegetation

Vegetation on the Engineering Quadrangle site is turf grass and ornamental tree and shrub landscaping. No rare or endangered species were identified. Large shade trees are the predominant landscape type. The existing landscape design can generally be characterized as formal rows of trees that reinforce the circulation system contrasted by open sloped lawn with informal tree groupings. Formal rows of linden trees line the walkways on the east and west sides of the Engineering Quadrangle. These tree rows create a strong edge to the open lawn and reinforce the building edges behind them. The dense branching habit of the lindens creates a wall of vegetation along the eastern and western edges that also block views from buildings. Along Campus Road, the more open branching pattern of the red oaks creates a more transparent edge on the north side of the Engineering Quadrangle, more easily allowing views in and out of the Engineering Quadrangle. Within these tree rows is a relatively steeply sloping lawn. A row of large London plane trees defines the walkway along the east façade of Hollister Hall.

3.2.4.2 Regional Wetlands

Storm water run-off from the Ward Center site flows into Cascadilla Creek that eventually flows into Cayuga Lake (67 square miles) to the northeast. There are no wetlands located on or within the vicinity of the site based on a review of the United States Fish and Wildlife Service Wetlands Inventory (Figure B-11)

Figure B-11 Wetlands in the Ithaca Area



3.2.4.3 Wildlife

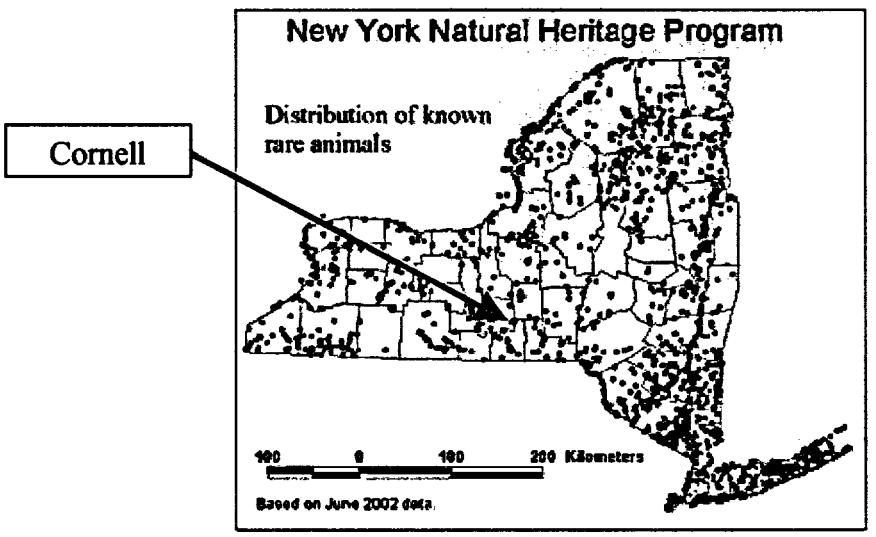
The site does not support a large wildlife population because of its small size, the highly developed nature of this site, and lack of cover. The wooded area surrounding the site supports a small population of animals including migratory songbirds, insects, gray squirrels, and other rodents. The Cascadilla Creek Gorge is expected to support aquatic organisms such as frogs, salamanders, turtles, newts, and insect larvae.

3.2.4.4 Endangered or Threatened Federal or State Species

There are no known endangered and threatened plant or animal species at the Ward Center site. There is however, a protected endangered salamander that lives in the gorge adjacent to the site. The New York State Department of Environmental Conservation database on endangered and threatened species was accessed to make this determination. The New York Natural Heritage Program was also consulted on the worldwide web and the following graphic (Figure B-12) indicating the distribution of known rare animals was obtained.

Figure B-12 Presence of Known Rare Animals

Endangered and Threatened Species



The data depicted here are not based on a comprehensive inventory of New York. The lack of data for any geographic area cannot be construed to mean that no significant features are present.

3.2.5 Socioeconomics and Environmental Justice

The socioeconomic environment of the Cornell facility consists of a well-established, diverse, middle-income community consisting of research institutions, a large university, light industry, tourism, and residences. The setting is attractive, with the hills and gorges and the town of Ithaca nearby. The road system is adequate with both interstate highways and secondary roads. Ward Center operations constitute a very small percentage of the area's economy.

4.0 POTENTIAL ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTION AND ALTERNATIVES

This section discusses the potential direct and cumulative effects of the proposed action on human health and the environment.

4.1 Human Health Effects

Types of exposures that could lead to human health effects considered in this report are worker and off-site exposures to hazardous chemicals or radioactive materials during routine activities or potential accidents on site, or during a transportation accident off site (involving hazardous or radioactive waste removal). This section identifies and discusses potential hazards that may affect workers on site or people off site during normal or routine Ward Center Decommissioning activities. Impacts of the hazards relative to human health and safety are summarized in Section 4.1.2.

4.1.1 Hazard Identification

During the site characterization and ongoing during the decommissioning, site workers will be taking readings and measurements of any contamination using direct reading instruments and sampling techniques. The key hazards during this work include external radiation, inhalation of hazardous or radioactive materials, or dermal contact with those materials during decontamination, dismantling, packaging and disposal of reactor and ancillary equipment, the Ward Center reactor structures, and contaminated soil.

Generally, the Decommissioning steps described in the Decommissioning Plan could involve the hazards as itemized below:

4.1.1.1 Hazards

Hazards include:

- External radiation for workers working around radioactively-contaminated equipment and materials.
- Dermal contact with both radioactive and hazardous materials.
- Inhalation of hazardous or radioactive materials.
- Possible confined spaces in tents, bags or small rooms with associated oxygen content and asphyxiant concerns.
- Heavy equipment movement dangers.

Note: No flammables or explosive materials are expected to be present.

4.1.1.2 Controls

For workers, project procedures and conformance with Cornell licenses and regulatory requirements including but not limited to:

- Radiological Work Permits and Hazardous Work Authorization procedures, as required;
- 29 CFR 1910.120 requirements for PPE, air monitoring, work zone controls, medical surveillance and bioassay program, personnel training, emergency response, and health and safety plan;
- personal dosimetry per 10 CFR 20;
- confined space entry procedures per 29 CFR 1910.146;
- HEPA filter removal of contaminants;
- Dust filter removal of contaminants.

4.1.2 Potential Exposures

The collective dose equivalent estimate to workers for the entire Decommissioning project is about 18 person-rem. The decommissioning tasks will take approximately 12 months. Total person hours involving radiological exposure is estimated to be 6,000 hours.

The potential exposures to the public as a result of decommissioning activities and radioactive waste shipments are estimated to be negligible. This is consistent with the estimate given for the

"reference research reactor" in the "*Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*" (NUREG-0586) (Ref. 5-5). The estimated dose to the public during decommissioning (DECON) and truck transport transportation of radioactive waste from the "reference research reactor" as given in the Final Generic Impact Statement is "negligible (less than 0.1 person-rem)."

The anticipated potential exposures to the public after license termination are also negligible. The site will have been released to unrestricted use, with all areas having been remediated to levels not to exceed the US Nuclear Regulatory Commission (NRC) provided screening values provided in NUREG-1727, *NMSS Decommissioning Standard Review Plan* (Ref. 5-7) or NUREG-1757 Vol. 1, *Consolidated NMSS Decommissioning Guidance Decommissioning Process for Materials Licenses* (Ref. 5-8).

A "Radiological Accident Analysis" was performed to estimate the exposures from potential accidents. This analysis, DRTK-CALC-WARD CENTER DECOMMISSIONING-001, Rev. 0, *Radiological Accident Analysis for Ward Center Decommissioning Plan*, is included as Attachment 1.

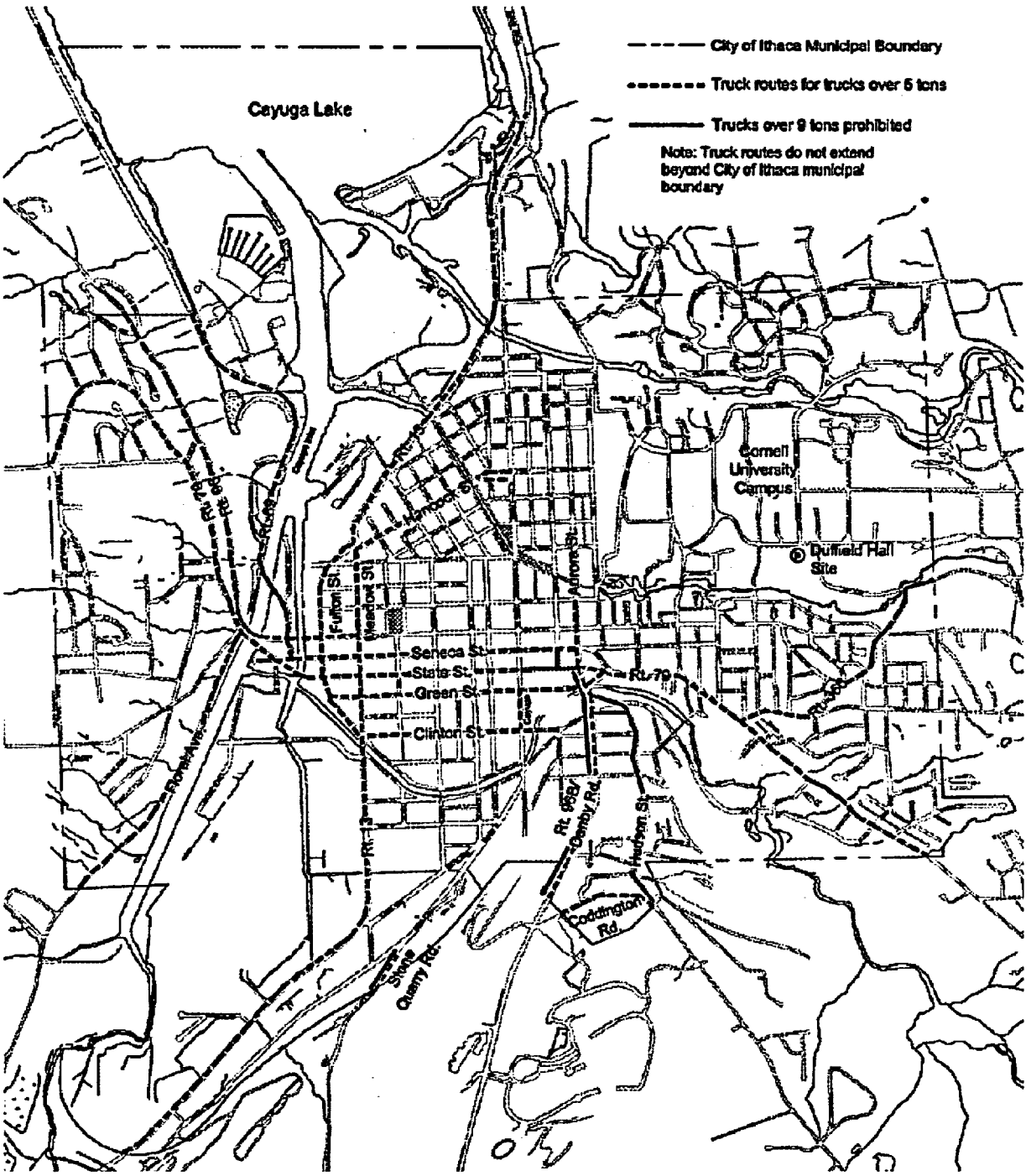
4.1.3 Transportation

The primary project impacts to the environment due to transportation could occur when shipments of waste travel from the site. Transportation would be conducted in accordance with applicable USDOT, USEPA, and USNRC regulations. During such transport, hazardous and radioactive materials would be effectively packaged to prevent significant radiation external to the truck. Thus, the primary impacts are accident risk and emissions/noise from the trucks themselves.

The city of Ithaca has designated truck routes based on truck weight, height, and width limitations. These routes are locally designated and enforced. Figure B-7, illustrates the designated routes. Trucks weighing over five tons are required to use the designated truck routes. Trucks that weigh in excess of nine tons are prohibited from certain routes. Most waste shipments from Ward Center will be made by tractor-trailers. These trucks typically exceed the five-ton limit and would be restricted to the truck routes.

Truck shipments of concern consist of hazardous waste and radioactive waste leaving the site. During Ward Center Decommissioning activities, short-term transportation effects would include employee and contractor trips, which occur under existing conditions, and fewer than 16 truck trips for hazardous and radiological waste transfer. Traffic, circulation and parking effects are expected to be minor due to the small increase in on-site personnel and trips and the short duration of this action, and would not significantly impact the surrounding roadways.

Figure B-13 City of Ithaca Truck Routes



4.2 Waste Disposal

4.2.1 Hazardous Waste

Small amounts of solid and liquid hazardous waste from Ward Center decommissioning activities would be accumulated in satellite accumulation areas. After accumulation for up to 90 days, a licensed contractor would transfer the waste to authorized off-site commercial treatment and disposal facilities or recyclers. The Hazardous waste will be included as part of the regular shipments made by Cornell's contractor.

4.2.2 Low-Level Radioactive and Mixed Waste

Low-level radioactive waste, including any contaminated soil, would be packaged in accordance with waste processor or disposal site Waste Acceptance Criteria. Liquid waste is filtered or solidified and solid waste is compacted, whenever possible, in accordance with the appropriate regulations prior to disposal. The waste for disposal would be shipped to either the Barnwell, South Carolina, or the Envirocare of Utah disposal sites. The waste to be processed prior to disposal would be shipped to a licensed waste processor.

Low-level radioactive waste generated during the Ward Center Decommissioning are expected to consist of two (2) shipments (approximately 120 ft^3) of irradiated hardware requiring a Type B shipping cask and eighteen (18) truck shipments (approximately 4,500 ft^3) of "strong tight" containers to the Envirocare of Utah disposal facility.

Mixed waste on site or generated during the Ward Center Decommissioning is expected to consist of activated/contaminated lead from the TRIGA thermal column area and other miscellaneous activated materials. Disposal of these wastes was included in the waste shipments above.

4.2.3 Non-Hazardous Solid Waste

Bulk waste that is not hazardous and not expected to be radioactive may be shipped to an off-site licensed processing facility for surveying and disposal. Some of this waste may also be surveyed and released at Ward Center for disposal at a local licensed disposal facility.

4.3 Noise

During Ward Center TRIGA Reactor Decommissioning activities, noise will be generated indoors by equipment, such as jackhammers, scabblers and concrete saws. Backhoes and other heavy equipment could also be used for outdoor remediation activities.

On-site workers will be outfitted with ear protection devices as required by the project health and safety plan. The closest off-site residential area south across the Cascadilla Creek Gorge is approximately 300 feet away. Noise from Ward Center Decommissioning activities would not impact employees or off-site residences.

4.4 Seismicity

Ward Center Decommissioning activities would involve the removal of surface contamination but not structural dismantlement activities. If structural dismantlement activities are added at a later date, any dismantlement plans and specifications would be reviewed by a structural engineer to assure that activities would not render the Ward Center building structurally unsafe should an earthquake occur. Decommissioning activities would not increase the risk to Ward Center TRIGA Reactor workers during a seismic event.

4.5 Air Quality

Several Decommissioning-related activities could minimally impact air quality due to both mobile and stationary source emissions. A small increase in the amount of mobile source emissions, such as carbon monoxide and nitrogen oxides, could be released from contractor's trucks and cars. Due to the temporary nature and small number of truck trips, mobile source emissions would be low.

Stationary source emissions that could occur during decontamination and solid remediation are expected to be negligible. Any releases from decontamination would occur within Ward Center. Hazardous materials would be located inside the building. Standard asbestos abatement procedures implemented by a contractor licensed by the state of New York will be used to remove any asbestos.

Site workers would be protected during decontamination activities through air monitoring and the use of PPE and respirators when required.

The proposed action would only be a temporary potential source of air emissions. Negligible amounts of mobile sources, stationary sources, and soil remediation emissions would be produced and would not affect regional attainment standards.

4.6 Regulatory Issues

Table B-4 discusses the applicability of various state and federal regulations for the proposed action.

Table B-4 Applicability of Environmental Statutes and Regulations

Statute/Regulation	Evaluation	Applicability
National Environmental Policy Act (NEPA)	The evaluation for potential environmental impacts are contained in the document	Yes
Endangered Species Act	No critical habitats exist in the affected area, and no adverse impacts to threatened or endangered species are expected to result form the proposed action	No
Floodplain/Wetlands Regulations	The proposed action is not located within a wetland or in a floodplain.	No
Fish and Wildlife Coordination Act	The proposed action does not modify or impact fish and wildlife in any way or modify any bodies of water more than 10 acres in surface area.	No
Farmland Protection Policy Act	The proposed action does not affect prime or unique farmlands.	No
National Historic Preservation Act	There are no historical sites or areas in the location of the proposed action.	No
American Indian Religious Freedom Act	The proposed action does not interfere with the right of Native Americans to exercise their traditional freedom.	No
Wild and Scenic Rivers Act	The proposed action does not involve waterways designated as wild and scenic rivers.	No
Resource and Conservation Recovery Act (RCRA)	The proposed action may include the generation, packaging and transportation of mixed and hazardous waste.	Yes
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	Any required release reporting would be performed in compliance with CERCLA requirements.	Yes
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)	The proposed action is not involved in the distribution, use or disposal of any insecticides, fungicides or rodenticides.	No
Toxic Substance Control Act (TSCA)	Asbestos may be encountered during D&D operations that would be properly packaged and disposed of in accordance with TSCA.	Yes
Clean Air Act (CAA)	Asbestos may be encountered during the project that will be contained in enclosed spaces, properly packaged and disposed of. Other air emissions would be below warning levels.	Yes
Clean Water Act and Safe Drinking Water Act	The proposed action is not expected to affect surface water bodies or water supplies.	No
Noise Control Act	Noise levels that could adversely affect workers and staff will be mitigated by providing ear protection for workers and relocation of staff to areas away from the activities. No impact to the public is expected from the noise.	No

Statute/Regulation	Evaluation	Applicability
Hazardous Materials Transportation Act (HMTA)	The proposed action will require shipment of radioactive materials, hazardous materials and mixed wastes. All waste will be packaged and shipped in appropriate containers and disposed of at licensed facilities.	Yes
National Emissions Standards for Hazardous Air Pollutants (NESHAPS)	The EPA has stated that NESHAPS are applicable to NRC licensed facilities. Compliance with emission standard would be demonstrated.	Yes
Atomic Energy Act	License required. Compliance with environmental and worker protection standard.	Yes
New York Department of Environmental Quality (NYDEQ)	Proposed action does not trigger discretionary review by a state agency	No
New York Department of Labor, Code Rule 59 Workplace Safety and Loss Prevention	Proposed action must comply with worker safety regulations.	Yes
New York low level radioactive waste (LLRW) permit & manifest tracking system regulations (6 NYCRR Part 364)	Transportation of hazardous, mixed and low-level radioactive waste would require notification, permit and manifest.	Yes

4.7 Areas Not Affected

The proposed action would not affect the following areas:

Population and Land Use - The proposed action would increase the compatibility of the site with other science research activities on-going at Cornell. Future use of the Ward Center site is expected to result in the addition of students and professors at Cornell.

Cultural Resources - There are no cultural resources on the Ward Center site.

Aesthetics - The proposed action would only be visible in the immediate vicinity of Ward Center. Ward Center is visible from adjacent buildings, however the externally visible activities will occur at the end of the paved access road at west side of the facility where there is minimal visibility. Temporary Decommissioning activities will be compatible with continuing development of the surrounding areas.

Biology - There are no known sensitive or endangered species on the Ward Center site.

Hydrology - The site elevation is over 60 feet above the Cascadilla Creek Gorge. It is not in a wetland, nor is it in a 100-year flood plain.

4.8 Cumulative Effects

No significant cumulative effects are expected from the proposed action, as discussed below: Human Health - The total dose estimated for decommissioning workers is 4 person-rem for the entire project evolution. This estimate will be achieved by utilizing ALARA practices including planning of work activities, utilization of engineered safeguards, and minimization of exposure times. The decommissioning will be conducted under a Radiation Work Permit system using written procedures to ensure proper planning, training, and evaluation of potential risks. It should be noted that a total dose of 4 person-rem is consistent with collective exposures reported in Figure 17 of *Decommissioning Techniques for Research Reactors* (Ref 5-9). This figure reported collective exposures during research reactor decommissioning relative to reactor power. These collective exposures ranged from 3 person-rem to 15 person-rem for reactor power ranging from 1 to 3 MW. The average was about 3 person-rem and is less than the 4 person-rem anticipated for the Ward Center reactor decommissioning.

The doses to members of the general public, as a result of decommissioning activities described in the Ward Center Decommissioning Plan, are expected to be negligible. The dominant internal exposure pathway for members of the public is inhalation. The dose to the public is estimated to be negligible as access to the area surrounding the facility is restricted and decontamination activities with potential for airborne activity will be conducted utilizing engineered safeguards such as HEPA-equipped enclosures. In addition, temporary barriers with a HEPA filter system will be utilized during activities that have the potential to generate airborne radioactivity. Potential airborne radioactivity should be negligible resulting in a negligible potential internal dose to the general public.

The estimate of negligible dose to members of the public can also be obtained from the estimate given for the reference research reactor in the *Final Generic Environmental Impact Statement on Decommissioning Nuclear Facilities* (NUREG-0586) (Ref. 5-5). In Section 7.3.1 of NUREG-0586, the dose to the public as a result of decommissioning operations at the reference research reactor - including truck transportation of radioactive waste - is "estimated to be negligible (less than 0.1 person-rem)." This estimate of less than 0.1 person-rem includes both internal (from inhalation and ingestion) and external exposure doses.

Waste Generation – The proposed action could generate approximately 12,000 cubic feet of low-level radioactive waste. The waste requiring disposal would be shipped to either the Barnwell, South Carolina, or the Envirocare of Utah disposal site. Both waste sites have sufficient capacity to receive the waste. The waste to be processed prior to disposal would be shipped to a licensed waste processor.

Cultural Resources - No cultural resources would be impacted by the proposed action.

Population and Land Use - Only temporary employment for a few contractors would be provided by the proposed action. No increase in population would occur. Land use would not change.

Noise - Ward Center decommissioning activities would occur in a non-residential area and would largely occur within the Ward Center Building. The proposed action would not contribute significantly to off-site background noise levels due to the relative isolation of the work site.

Aesthetics - Ward Center TRIGA Reactor Decommissioning activities would not be visible to adjacent site neighbors, with the exception of limited visibility during waste shipping and when removing a storage tank using access from the outside of the building. Following release to unrestricted use, the Ward Center site would be used in a manner consistent with the existing Cornell site land use practices.

Traffic - The temporary contractor and waste transport trips would result in an insignificant increase in the average number of daily trips designed for the local roads.

Geology, Soils, Seismicity and Hydrology - All Ward Center TRIGA Reactor decommissioning activities would be localized; no changes to any landforms would occur; there are no exposed areas that are radiologically contaminated and no radioactive or hazardous materials would be released to storm water runoff as a result of the proposed action.

Regional Air Quality - Tompkins County meets the National Air Quality Standards (NAAQS) and New York State Air Guide-1 requirements. The proposed decommissioning action is temporary in nature. A small number of vehicle trips would be generated during off-site shipment of waste materials and would contribute only negligible amounts of these pollutants to the region.

Biological Resources - No biological resources have been identified on the Ward Center site; moreover, Ward Center decommissioning activities are not expected to affect off-site biological resources.

4.9 Alternatives to Proposed Action

Alternative 1 to Proposed Action - Safe Storage (SAFSTOR)

This alternative poses essentially the same potential risks and environmental impacts as the proposed project but for a potentially much greater time period. This alternative would necessitate continued surveillance and maintenance of Ward Center over a substantial time period. During this period, the risk of environmental contamination would continue to exist. This alternative is not environmentally preferable.

Alternative 2 to Proposed Action - Entombment (ENTOMB)

This alternative would necessitate continued surveillance and maintenance of the Ward Center TRIGA Reactor over a substantial time period. During this period, the risk of environmental contamination would continue to exist. This alternative is not environmentally preferable.

5.0 REFERENCES

5-1 National Council on Radiation Protection and Measurements (NCRP). Ionizing Radiation Exposure of the Population of the United States. Report No. 93. 1987.

5-2 U.S. EPA. "Risk Assessment Guidance for Superfund, Volume 1 Human Health Evaluation Manual (Part A)." Office of Emergency and Remedial Response, U.S. EPA, Washington D.C. 1989.

5-3 U.S. EPA. "Risk Assessment Methodology Draft Environmental Impact Statement for Proposed NESHAPS for Radionuclides." Vol. 1. U.S. Environmental Protection Agency, Office of Radiation Programs. Washington D.C.

5-4 *Nuclides and Isotopes, Chart of Nuclides; 14th Edition*, Nuclear Energy Operations, General Electric Company, San Jose, CA; 1989.

5-5 US NRC, NUREG-0586, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, August 1988.

5-6 NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*

5-7 US NRC, NUREG-1727, *NMSS Decommissioning Standard Review Plan*, September 2000

5-8 US NRC, NUREG-1757 Vol. 1, *Consolidated NMSS Decommissioning Guidance Decommissioning Process for Materials Licenses*, September 2002.

5-9 *Decommissioning Techniques for Research Reactors*, Vienna, International Atomic Energy Agency, 1994, (Technical reports series ISSN 0074-1914; 373)