ATTACHMENT I

Consumers Energy Company
Big Rock Point Plant
Dockets 50-155 and 72-043

DESCRIPTION OF CHANGES PROPOSED LICENSE AMENDMENT FOR LICENSE TERMINATION PLAN

April 1, 2003

7 pages

ATTACHMENT I
DESCRIPTION OF CHANGES
PROPOSED LICENSE AMENDMENT FOR LICENSE TERMINATION PLAN

BACKGROUND

Big Rock Point Plant permanently ceased operation on August 29, 1997. The fuel was permanently removed from the reactor vessel on September 20, 1997. On September 23, 1997, Consumers Energy notified the Nuclear Regulatory Commission (NRC) of the permanent cessation of operations and the permanent removal of all fuel assemblies from the reactor pressure vessel and their placement into the spent fuel pool. Following the cessation of operations, Consumers Energy began the decommissioning of Big Rock Point Nuclear Plant. The Post Shutdown Decommissioning Activities Report (PSDAR) was submitted in accordance with 10CFR50.82(a)(4) on September 19, 1997 along with other documents associated with decommissioning.

Pursuant to 10CFR50.82(a)(9), nuclear power reactor licensees are required to submit a License Termination Plan (LTP) prior to or along with their application for termination of license. Pursuant to 10CFR50.82(a)(10), the Nuclear Regulatory Commission shall approve the plan if it, "... demonstrates that the remainder of decommissioning activities will be performed in accordance with the regulations in this chapter (10CFR50), will not be inimical to the common defense and security or to the health and safety of the public, will not have a significant effect on the quality of the environment ..."

Accordingly, Big Rock Point is hereby submitting its LTP for NRC review and approval. This plan is being submitted as a supplement to the UFHSR in accordance with 10CFR50.82(a)(9)(i). Big Rock Point is not submitting, at this time, an application for termination of license.

Pursuant to 10CFR50.82(a)(10), the Commission's approval of the plan shall be executed by license amendment, subject to such conditions and limitations, as it deems appropriate and necessary. This approval will authorize the implementation of the LTP. This approval includes approval of the method outlined in Chapter 5 of the LTP for site compliance with dose-based release criteria. Attached is a proposed change to the license authorizing the implementation of the LTP and providing appropriate and necessary conditions regarding the licensees' authority to make changes to it without prior NRC review and approval.

ATTACHMENT I
DESCRIPTION OF CHANGES
PROPOSED LICENSE AMENDMENT FOR LICENSE TERMINATION PLAN

DESCRIPTION OF CHANGES

Big Rock Point proposes to amend the license to incorporate a new License Condition 2.C.(4). Attachment II provides a copy of the affected Facility Operating License DPR-6 page with the proposed changes annotated.

"2.C.(4). License Termination Plan (LTP)

The License Termination Plan dated April 1, 2003, is approved by NRC License Amendment No. ___.

In addition to those criteria specified in 10CFR50.59, 10CFR50.82(a)(6), and 10CFR50.82(a)(7), changes to the approved License Termination Plan shall require NRC approval prior to being implemented if the change:

(a) Increases the radionuclide-specific derived concentration guideline levels or area factors (as discussed in Chapter 6 of the LTP);

(b) Increases the probability of making a Type I decision error above the level stated in the LTP (discussed in Chapter 5 of the LTP);

(c) Increases the investigation level thresholds for a given survey unit classification (as given in Table 5-7 of the LTP);

(d) Changes to the classifications of a survey unit from a more restrictive classification to a less restrictive classification (e.g., Class 1 to Class 2). Definitions for the different classifications for surface soils are provided in Chapter 5 of the LTP;

(e) Reduces the coverage requirements for scan measurements (Table 5-4 of the LTP); or

(f) Involves reliance upon statistical tests other than the Sign Test (as discussed in Chapter 5 of the LTP) for data evaluation.

Prior to a request to release a survey area from the license, the licensee shall assure that the site is in compliance with the dose-based release criteria per the process described in Chapter 5 of the LTP.

ATTACHMENT I
DESCRIPTION OF CHANGES
PROPOSED LICENSE AMENDMENT FOR LICENSE TERMINATION PLAN

The Licensee shall submit any updates to License Termination Plan in accordance with 10CFR50.71(e).

The licensee may make changes to the License Termination Plan without prior NRC approval using the 10CFR50.59 process in conjunction with the afore mentioned restrictions. "

No Significant Hazards Consideration Determination

Big Rock Point has reviewed the proposed change to the Operating License in accordance with the requirements of 10CFR50.92, "Issuance of Amendment," and concluded that the change does not involve a significant hazards consideration. The proposed change does not involve a Significant Hazards Consideration because the change would not:

1. *Involve a significant increase in the probability or consequences of an accident previously evaluated.*

   Accidents the License Termination Plan may potentially affect include only the non-fuel related decommissioning accidents. No spent fuel will be involved in License Termination Plan activities.

   Non-fuel related decommissioning activities following final plant shutdown were evaluated, including system and equipment deactivation, decontamination, and dismantlement; radioactive material handling and storage; and transportation of radioactive materials. Types of postulated accidents reviewed were: explosions and fires, loss of contamination control, waste transportation accidents, external events, and natural phenomena. In addition to the standard decommissioning activities, postulated accidents associated with potential long-term storage of radioactive waste during decommissioning also were evaluated.

   Based on this review, it was concluded that all postulated decommissioning accidents for Big Rock Point are bounded by the results described in NUREG-0586, Generic Environmental Impact Statement (GEIS) on Decommissioning Nuclear Facilities.

   The License Termination Plan and this license amendment request is consistent with this evaluation. Any new activities as a result of the License Termination Plan will require evaluation to ensure it is bounded by the analyses and assumptions in the GEIS and non-fuel accident analyses.

The requested license amendment is consistent with plant activities described in the Post Shutdown Decommissioning Activities Report (PSDAR) and the Big Rock Point Updated Final Hazards Summary Report (UFHSR). The PSDAR has been revised to be consistent with the schedule outline in the LTP. Accordingly, no systems, structures, or components that could initiate a previously evaluated accident or were required to mitigate this accident are adversely affected by this proposed change. Therefore, the proposed change does not involve an increase in the probability or consequences of any previously evaluated accident.

2. *Create the possibility of a new or different kind of accident from any accident previously evaluated.*

   Accident analyses related to decommissioning activities are addressed in the UFHSR. The requested license amendment is consistent with the plant activities described in the Big Rock Point UFHSR and the PSDAR. The proposed change does not affect plant systems, structures, or components in a way not previously evaluated. No new failure mechanisms will be created by this activity, and the proposed activity does not create the possibility of a new or different kind of accident than those previously evaluated. This proposed License Amendment requires evaluation of any changes to the LTP in accordance with 10CFR50.59. Demolition techniques and associated activities will be reviewed and controlled to ensure they comply with the GEIS and LTP.

3. *Involve a significant reduction in a margin of safety.*

   The License Termination Plan (LTP) is a plan for demonstrating compliance with the radiological criteria for license termination as provided in 10CFR20.1402. The margin of safety defined in the statements of consideration for the final rule on Radiological Criteria for License Termination is described as the margin between the 100 mrem/yr public dose limit established in 10CFR20.1301 for licensed operation and the 25 mrem/yr limit to the average member of the critical group at a site considered for unrestricted use (one of the criteria of 10CFR20.1402). The margin of safety accounts for the potential effect of multiple sources of radiation exposure to the critical group. Since the LTP was designed to comply with the radiological criteria for license termination for unrestricted use, the LTP supports this margin of safety.

   The LTP and radiation protection practices and procedures (which comply with the requirements of 10CFR Part 50, Appendix B for Quality Assurance) are in place and provide the methodologies and criteria that will be used to perform remediation activities of residual radioactivity to demonstrate compliance with the ALARA criterion of 10CFR20.1402.

Additionally, Big Rock Point is currently conducting decontamination and dismantlement activities at the BRP site in accordance with the BRP PSDAR and UFHSR. Decommissioning activities are being coordinated with the appropriate Federal and State regulatory agencies in accordance with plant administrative procedures.

Structures, systems, and components surveyed and evaluated as part of normal decommissioning activities will be surveyed for disposal using current site procedures to demonstrate compliance with 10CFR Part 20 criteria. Appropriate procedural controls shall be applied to disposal of structures, systems, and components.

Decommissioning accidents are bounded by accidents involving fuel. Since the accident results in more radioactivity than can be released from other non-fuel decommissioning events, the margin of safety associated with the consequences of the decommissioning accidents is not reduced by this activity.

Therefore, the proposed change does not involve a significant reduction in the margin of safety.

CONCLUSION

The Big Rock Point License Termination Plan does not involve a significant hazards consideration as defined in 10CFR50.92.

Environmental Impact Considerations

This proposed amendment request satisfies the criteria specified in 10CFR51.22(c)(9) for a categorical exclusion from the requirements to perform an environmental assessment or to prepare an environmental impact statement. The criteria of 10CFR51.22(c)(9) are addressed as follows:

(i) The amendment involves no significant hazards consideration.

As discussed in the "No Significant Hazards" Section above, this activity does not involve a significant hazards consideration.

(ii) *There is no significant change in the types or significant increase in the amounts of effluents that may be released offsite.*

The proposed license amendment is consistent with plant activities described in the Big Rock Point Operating License. The environmental impacts associated with doses to members of the public related to decommissioning activities, and site release for unrestricted use were considered in NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities" (FGEIS). As discussed in Chapter 8 of the LTP, no adverse impacts on groundwater are anticipated from specific decommissioning activities.

In support of the Big Rock Point PSDAR, an environmental review of site-specific decommissioning activities was performed. The PSDAR concluded that the environmental impacts associated with Big Rock Point decommissioning activities were bounded by NUREG-0586. The release of effluents from the plant will continue to be controlled by approved plant procedures throughout decommissioning. Activities will continue to be performed in accordance with Big Rock Point Radiation Protection Program and Offsite Dose Calculation Manual.

(iii) *There is no significant increase in individual or cumulative occupational radiation exposure.*

Big Rock Point performed an environmental review of site-specific decommissioning activities as part of PSDAR development. Information from that environmental review was incorporated by reference into the Big Rock Point Updated Final Hazards Summary Report (UFHSR). That review is also referenced in the License Termination Plan (LTP).

As discussed in Chapter 8 of the LTP, the total occupational radiation exposure (excluding public and transportation dose) impact for the proposed decommissioning activities (including complete decontamination of the primary coolant system and reactor vessel) has been estimated in the PSDAR at approximately 700 person-rem, which is less than the 1,845 person-rem estimate of the NUREG-0586, "Final Generic Environmental Impact Statement (FGEIS) on Decommissioning of Nuclear Facilities."

As discussed in the PSDAR, the total occupational radiation exposure due to transportation of radioactive waste has been estimated to be well below (on the order of 10 to 20% based on waste volume and activity ratios) the 110 person-rem for transport workers and 10 person-rem for the public presented by the FGEIS.

For each defined survey area, the LTP also describes the process and modeling to demonstrate compliance with the radiological criteria of 10CFR20.1402 for unrestricted future use of the Big Rock Point Site. These criteria are: (a) Residual radioactivity from plant operational activities that results in a TEDE to an average member of the critical group that does not exceed 25 mrem/year and (b) Residual radioactivity levels are consistent with ALARA (as low as reasonably achievable) criteria defined by the LTP.

The foregoing discussions demonstrate that there is no significant increase in individual or cumulative occupational radiation exposure.

Conclusion

This activity satisfies the criteria provided in 10CFR51.22(c)(9) for categorical exclusion from the requirements of an environmental impact statement for environmental assessment.

ATTACHMENT II

Consumers Energy Company
Big Rock Point Plant
Dockets 50-155 and 72-043

COPY OF AFFECTED LICENSE PAGE CHANGES

April 1, 2003

5 pages

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555

CONSUMERS ENERGY COMPANY

DOCKET NO 50-155

BIG ROCK POINT PLANT

FACILITY OPERATING LICENSE

License No DPR-6

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Consumers Power Company (renamed Consumers Energy Company by Amendment No. 119, the licensee) dated January 13, 1975, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. Construction of the Big Rock Point Plant (the facility) has been substantially completed in conformity with Construction Permit No. CPPR-9 and the application, as amended, the provisions of the Act and the rules and regulations of the Commission;

   C. The facility will operate in conformity with the application, as amended, the provisions of the Act, and the rules and regulations of the Commission;

   D. There is reasonable assurance: (i) that the activities authorized by this operating license can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the rules and regulations of the Commission;

   E. The licensee is technically and financially qualified to engage in the activities authorized by this operating license in accordance with the rules and regulations of the Commission;

   F. The licensee has satisfied the applicable provisions of 10 CFR Part 140, "Financial Protection Requirements and Indemnity Agreements," of the Commission's regulations;

   G. The issuance of this operating license will not be inimical to the common defense and security or to the health and safety of the public; and

H. The receipt, possession, and use of source, byproduct and special nuclear material as authorized by this license will be in accordance with the Commission's regulations in 10 CFR Parts 30, 40, and 70, including 10 CFR Sections 30.33, 40.32, and 70.23 and 70.31.

2. Facility Operating License No. DPR-6, issued to the Consumers Energy Company, is hereby amended in its entirety to read as follows:

A. This license applies to the Big Rock Point Plant (the facility) owned by Consumers Energy Company (the licensee). The facility is located in Charlevoix County, Michigan, and is described in the licensee's application dated January 14, 1960, and the Final Hazards Summary Report, as supplemented, updated, and amended by subsequent filings by the licensee.

B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses Consumers Energy Company:

B.(1) Pursuant to Section 104b of the Act and 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities" to possess the facility at the designated location in Charlevoix County, Michigan, in accordance with the procedures and limitations set forth in this license;

B.(2) Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," to possess at any one time up to (a) 2500 kilograms of contained uranium 235 in fuel rods, (b) 10.32 grams of uranium 235 as contained in fission counters, (c) 150 kilograms of plutonium contained in PuO_2-UO_2 fuel rods, and (d) 5 curies of plutonium encapsulated as a plutonium-beryllium neutron source;

(a) Deleted
(b) Deleted
(c) Deleted
(d) Deleted
(e) Deleted
(f) Deleted
(g) Deleted

(3) Pursuant to the Act and 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of By-product Material," to receive, possess and use at any one time up to 7000 curies of antimony-beryllium in the form of neutron sources, 3.7 curies of colbalt-60 as sealed sources, 45 curies of cesium-137 as sealed sources, 10 microcuries of miscellaneous alpha emitting material as sealed sources, and up to 500 millicuries per nuclide of any byproduct material between atomic numbers 1 and 83, inclusive, without restriction as to chemical and physical form;

2.B.(4) Pursuant to the Act and 10 CFR Part 40, "Domestic Licensing of Source Material," to possess at any one time up to 500 kilograms of depleted uranium dioxide contained in the facility's fuel assemblies;

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, to possess, but not separate, such by product and special nuclear materials as may be produced by the operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

C.(1) Reactor Operation

The reactor is not licensed for power operation. Fuel shall not be placed in the reactor vessel.

C.(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. ~~124~~XXX, are hereby incorporated in the license. The licensee shall maintain the facility in accordance with the Technical Specifications.

C.(3) Physical Protection

The licensee shall fully implement and maintain in effect all provision of the physical security, guard training and qualification, and safeguards contingency plans approved by the Commission and all amendments and revisions to such plans made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p), as modified by NRC-approved exemptions. The plans, which contain Safeguards information protected under 10 CFR 73.21, are entitled: "Big Rock Point Plant Defueled Security Plan," with revisions submitted through January 16, 2002; "Big Rock Point Defueled Suitability Training and Qualification Plan," with revisions submitted through March 12, 2002; "Big Rock Point Plant Defueled Safeguards Contingency Plan," with revisions submitted through January 14, 2002; and "Big Rock Point ISFSI Security Plan" as submitted on July 31, 2001 and modified by letter dated March 6, 2002. Changes made in accordance with 10 CFR 73.55 shall be implemented in accordance with the schedule set forth therein.

C.(4). License Termination Plan (LTP)

The License Termination Plan dated April 1, 2003, is approved by NRC License Amendment No. ___.

In addition to those criteria specified in 10CFR50.59, 10CFR50.82(a)(6), and 10CFR50.82(a)(7), changes to the approved License Termination Plan shall require NRC approval prior to being implemented if the change:

(a) Increases the radionuclide-specific derived concentration guideline levels or area factors (as discussed in Chapter 6 of the LTP);

(b) Increases the probability of making a Type I decision error above the level stated in the LTP (discussed in Chapter 5 of the LTP);

(c) Increases the investigation level thresholds for a given survey unit classification (as given in Table 5-7 of the LTP);

(d) Changes the classification of a survey unit from a more restrictive classification to a less restrictive classification (e.g., Class 1 to Class 2). Definitions for the different classifications for surface soils are provided in Chapter 5 of the LTP;

(e) Reduces the coverage requirements for scan measurements (Table 5-4 of the LTP); or

(f) Involves reliance upon statistical tests other than the Sign Test (as discussed in Chapter 5 of the LTP) for data evaluation.

Prior to a request to release a survey area from the license, the licensee shall assure that site is in compliance with the dose-based release criteria per the process described in Chapter 5 of the LTP.

The Licensee shall submit an updated License Termination Plan in accordance with 10 CFR 50.71(e).

The licensee may make changes to the License Termination Plan without prior NRC approval using the 10CFR50.59 process.~~2.C.(4) Deleted~~

2.C.(5) Deleted

2.C.(6) Deleted

2.C.(7) Deleted

D. This amended license becomes effective as of the date of its issuance ~~and shall expire at midnight, May 31, 2000~~.

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by Richard D. Silver
for

Dennis L. Ziemann, Chief
Operating Reactor Branch No. 2
Division of Licensing

Attachment:
Change No. ~~46~~ XX to the
Technical Specifications

Date of Issuance: ~~December 19, 1975~~DATE

ATTACHMENT III

Consumers Energy Company
Big Rock Point Plant
Dockets 50-155 and 72-043

LICENSE TERMINATION PLAN

April 1, 2003

Big Rock Point Restoration Project
LICENSE TERMINATION PLAN

Revision 0
April 1, 2003

Prepared by Consumers Energy Company

BIG ROCK POINT PLANT
LICENSE TERMINATION PLAN

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Chapter 7, Update of Site-Specific Decommissioning Costs

Chapter 8, Supplement to the Environmental Report

Glossary of Terms, Acronyms and Abbreviations

Background Radiation – Radiation from cosmic sources, naturally occurring radioactive material, and global fallout, which contributes to the background radiation.

Containment – (a.k.a. sphere or enclosure.) The building during plant operation that contained the reactor vessel, fuel pool, recirculating pumps, clean-up pumps, steam drum and shutdown cooling, and other systems.

Contamination – Deposition of reactor-generated radioactive material.

Corrective Action Records - Documentation for occurrences or events that recognized safety-related deficiencies, identified conditions adverse to quality, or were reportable to regulatory agencies. Corrective action documentation includes evaluations, actions, results and responses that were associated with an event or condition that documented in Condition Reports, Deviation Reports, or Event Reports.

DCGL - (derived concentration guideline level) The derived radionuclide-specific activity concentration that corresponds to the release criterion (25mrem/y) within a survey unit.

Drumlin – A deposit of clay, sand, gravel and boulders pushed into a hill formation by a glacier or running water from a glacier

Greenfield - No visible building structures remain in the vicinity of the former industrial area, the shoreline has been returned to its original contour, all subsurface structures have been removed, topsoil, seed, and other plantings will be utilized, where appropriate, to achieve the final Greenfield condition.

Health Physics Logbook – The logbook detailing the day-to-day site Health Physics activities.

Impacted Area – An area that has some potential for containing residual radioactivity.

Industrial Area - The land area of potential radiological and non-radiological impact is that portion of the site where licensed activities took place. This location encompasses less than 20 acres and includes the protected area, the radwaste compound, and adjacent support structures and transport routes.

Independent Spent Fuel Storage Installation (ISFSI) – The area that will contain the dry fuel storage facility.

"Known" Classification – Portion of the impacted area that is known to contain residual radioactivity determined by the Historical Site Assessment.

Legacy Materials – Buried materials of plant origin or non-native objects including construction debris, abandoned piping, abandoned materials, etc.

Non-Impacted Area – An area where there is no reasonable possibility for residual radioactivity to exist.

pCi/g – Picocurie per gram, a concentration scale typically used in the measurement of radioactivity in soil.

"Potential" Classification – Portion of the impacted area that has the potential to contain residual radioactivity as determined by the Historical Site Assessment.

"Potentially Elevated" Classification – Portion of the impacted area with known or potential residual radioactivity greater than allowed for unrestricted release of the site as determined by the Historical Site Assessment.

Protected Area – The area controlled by the NRC licensee to restrict access to plant facilities. At Big Rock Point, this area is defined by the security fence, which encloses the protected area.

Piezometer – a type of well used to measure differences in hydrostatic pressure

QA/QC Warehouse – A building located in the southwest corner of the protected area, which in the past has also been known as the West Warehouse, Stockroom, Radwaste Offices and Carpenters Shop.

Radwaste – An area of the plant located in the Turbine Building where processing of liquid streams for recycle or disposal took place.

Radwaste Building – A building where the storage of dry radioactive waste was taken for storage and preparation for offsite disposal. This building was built over the former radwaste vaults.

Radwaste Compound – The fenced area surrounding the Radwaste Building.

Residual Radioactivity – Radioactivity in structures, materials, soil, groundwater and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee. It also includes radioactive materials remaining at the site as a result of routine or accidental releases. Residual radioactivity does not include background radiation from naturally occurring isotopes or fallout from nuclear bomb testing.

SAFSTOR – The alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use.

Scoping Survey – An initial survey performed to evaluate: 1) radionuclide contaminants, 2) relative radionuclide ratios, and 3) general levels and extent of contamination.

Till Plain – A flat area of glacial deposits consisting of sand, gravel and boulders.

Turbine Building – The building that once contained the feed pumps, condensate pumps, radwaste processing system, and main turbine generator.

"Unlikely" Classification – Portion of the impacted area that is unlikely to contain residual radioactivity as determined by the Historical Site Assessment.

Acronym Table

Acronym	Description
AEC	Atomic Energy Commission
AES	Air Ejector System
ALARA	As Low As Reasonably Achievable
ASD	Alternate Shutdown System
BNFL	British Nuclear Fuels, Limited
BRP	Big Rock Point / Big Rock Point Plant
CAB	Citizens Advisory Board
CAS	Control Air System (Compressed)
CDS	Condensate System
CFR	Code of Federal Regulations
Ci	Curie
CIS	Containment Isolation System
Cm	centimeters
COTFMA	Chippewa/Ottawa Treaty Fishery Management Authority
CRD	Control Rod Drive System
CRs	Condition Reports
D&D	Decontamination and Dismantlement
DAW	Dry Activated Waste
DCC	Document Control Center
DCGL	Derived Concentration Guideline Level
DfD	Decontamination for Decommissioning
DMW	Demineralized Water System
DOE	Department of Energy
Dpm	disintegrations per minute
DQOs	Data Quality Objectives
DTS	Defueled Technical Specifications
ECS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EIS	Environmental Impact Statement
EMC	Elevated Measurement Comparison
EPA	Environmental Protection Agency

Acronym	Description
EPRI	Electric Power Research Institute
EPS	Emergency Power System
ER	Environmental Report
ESI	Environmental Status Investigation
FCC	Federal Communications Commission
FGEIS	Final Generic Environmental Impact Statement
FHSR	Final Hazards Summary Report
FSS	Final Status Survey
FWS	Feedwater System
GEIS	Generic Environmental Impact Statement
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HED	Heater Extraction Drain System
HEPA	High Efficiency Particulate Absorber
HAS	Historical Site Assessment
HTD	Hard-to-Detect
HVAC	Heating, Ventilating, and Air Conditioning
I&C	Instrument and Control
IDCGL	Initial Derived Concentration Guideline Level
IMCRH	Important for the Monitoring and Control of Radiological Hazards
ISFSI	Independent Spent Fuel Storage Installation
ISSSF	Important for the Safe Storage of Spent Fuel
LAN	Local Area Network
LBGR	Lower Boundary of the Gray Region
LLRW	Low-Level Radioactive Waste
LLW	Low-Level Waste
LPS	Liquid Poison System
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey & Site Investigation Manual
MCC	Maintenance/Construction Complex
MDC	Minimum Detectable Concentration
MDCRs	Minimum Detectable Count Rate surveyor
MDEQ	Michigan Department of Environmental Quality

Acronym	Description
MDER	Minimum Detector Exposure Rate
MDG	Main Diesel Generator
MDNR	Michigan Department of Natural Resources
MIOSHA	Michigan Occupational Safety & Health Administration
MNFI	Michigan Natural Features Inventory
MSS	Main Steam System
NAC	New Access Control
NIST	National Institute of Standards and Technology
NMS	Neutron Monitoring System
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NWS	National Weather Service
ODCM	Offsite Dose Calculation Manual
OJT	On-the-Job Training
OSHA	Occupational Safety & Health Administration
PAG	Protective Action Guidelines
PCB	Poly-Chlorinated Biphenol
PCS	Primary Coolant System
PIS	Post-Incident System
PRCC	Partial Ranked Correlation Coefficient
PSDAR	Post Shutdown Decommissioning Activities Report
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QPD	Quality Program Description
QVA	Quality Verification Area
RCA	Radiologically Controlled Area
RCS	Reactor Cleanup System
RCW	Reactor Cooling Water System
REMP	Radiological Environmental Monitoring Program
RGS	Resin Regeneration System
RP&ES	Radiation Protection & Environmental Services
RPS	Reactor Protection System

Acronym	Description
RSD	Reactor Steam Drum System
RWS	Radwaste System
SAR	Safety Analysis Report
SCS	Shutdown Cooling System
SFP	Spent Fuel Pool / Spent Fuel Pool System
SLO	Turbine Lube Oil System
SPS	Station Power System
SSC	Structures, Systems, or Components
TEDE	Total Effective Dose Equivalent
TGS	Turbine Generator System
TLD	Thermoluminescent Dosimeter
TSCA	Toxic Substances Control Act
UFHSR	Updated Final Hazards Summary Report
VAS	Ventilation Air System
WGS	Waste Gas System
WWS	Well Water System

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1.0 GENERAL INFORMATION

1.1 PURPOSE

The objective for decommissioning the Big Rock Point (BRP) Nuclear Plant site is to reduce residual radioactivity to levels that permit release of the site for unrestricted use and for termination of the 10 CFR 50 license. The purpose of the BRP License Termination Plan (LTP) is to satisfy the requirements of 10 CFR 50.82(a)(9), *Termination of License*, using the guidance provided by Nuclear Regulatory Commission (NRC) Regulatory Guide 1.179, *Standard Format and Content of License Termination Plans for Nuclear Power Reactors*, NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1700, *Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans*, NUREG-1727, *NMSS Decommissioning Standard Review Plan*, and NUREG-1757, *Consolidated NMSS Decommissioning Guidance* [References 1-13, 1-14, 1-15, 1-16, and 1-17].

This LTP will be incorporated by reference into the BRP Updated Final Hazards Summary Report (UFHSR). An application for amendment of the license is being provided to facilitate authorization/approval of the LTP as required by 10 CFR 50.82(a)(9). The license condition includes a LTP change process similar to that which is required for the UFHSR. The LTP will be updated in accordance with 10 CFR 50.71(e). The LTP is being submitted along with an application for license amendment.

1.2 SCOPE

The LTP describes the decommissioning activities that will be performed, the process for performing final status surveys, and the method for demonstrating that the site meets the criteria for unrestricted use. The LTP contains information on:

- Historical Site Assessment and Site Characterization,
- Remaining Decommissioning Activities,
- Site Remediation Plans,
- Final Status Survey (FSS) Plan,
- Dose Modeling Scenarios,
- Update to the Site-Specific Decommissioning Cost Estimate, and
- Supplement to the Environmental Report.

The purpose and content of each chapter of the LTP is summarized in Section 1.4.

1.3 SITE DESCRIPTION AND HISTORICAL BACKGROUND

Big Rock Point Restoration Project[1] is located in Charlevoix County, Michigan, approximately four miles northeast of Charlevoix, Michigan, and approximately eleven miles west of Petoskey, Michigan, on the northern shore of Michigan's lower peninsula. The BRP site is owned by Consumers Energy Company. Figure 1-1 shows the BRP site. The BRP Nuclear Plant was a boiling water reactor rated at 75mW electric, designed by General Electric Company.

For the BRP Nuclear Plant, Operating License Docket No. 50-155 (License Number DPR-6) and General Independent Spent Fuel Storage Installation (ISFSI) License Docket Number 72-043, events of significance are:

- Provisional Operating License issued August 30, 1962
- Initial Criticality achieved September 27, 1962
- Initial Power Operation achieved December 8, 1962
- Commercial Operation began March 29, 1963
- Full-Term Operating License issued May 1, 1964
- Power level increased from 157 MWt to 240 MWt May, 1964
- Operation permanently ceased August 29, 1997
- Fuel permanently removed from the reactor vessel September 20, 1997.

The Post Shutdown Decommissioning Activities Report (PSDAR) was submitted in accordance with 10 CFR 50.82(a)(4) on September 19, 1997, along with other documents associated with decommissioning (Offsite Dose Calculation Manual, Defueled Technical Specifications, Defueled Emergency Plan, and Emergency Plan Exemption) [Reference 1-4]. On September 23, 1997, Consumers Energy notified the NRC of the permanent cessation of operations and the permanent removal of all fuel assemblies from the reactor pressure vessel and their placement into the spent fuel pool [Reference 1-5]. Following the cessation of operations, Consumers Energy began decommissioning BRP.

[1] In 1997 the site name was changed from Big Rock Point Nuclear Plant to Big Rock Point Restoration Project.

1.4 DECOMMISSIONING APPROACH

1.4.1 Overview

This chapter provides an overview of Consumers Energy's approach to decommissioning the BRP site. References to the chapter in the LTP, where details are provided concerning the particular step or stage of the decommissioning process, are given in parentheses. Upon the decision to permanently cease power operations at BRP in 1997, Consumers Energy began characterization activities (Chapter 2, *Site Characterization*). This characterization effort, performed to the guidelines of NUREG-1575, included a historical site assessment (HSA); hydrogeological investigation; and measurements, samples and analyses to further define the present radiological conditions of the site. This effort also addressed the status of the site relative to non-radioactive contamination from hazardous and other state-regulated materials.

Decommissioning activities at BRP shall be conducted in accordance with the BRP Updated Final Hazards Summary Report (UFHSR), Defueled Technical Specifications, Consumers Energy Quality Program Description for Nuclear Power Plants (Part 1) – Big Rock Point (CPC-2A), the existing 10 CFR Part 50 license, and the requirements of 10 CFR 50.82(a)(6) and (a)(7). If a decommissioning activity requires prior NRC approval under 10 CFR 50.59(c)(2) or a change to the BRP Defueled Technical Specifications or license, a submittal shall be made to the NRC for review and approval before implementation of the activity in question. Decommissioning activities are conducted in accordance with the BRP Defueled Technical Specifications, PSDAR, Radiation Protection Program, Off-Site Dose Calculation Manual (ODCM), Industrial Safety Program, and Bulk Material Control Program. These programs are established and frequently inspected by the NRC.

Activities conducted during decommissioning do not pose any greater radiological or safety risk than those conducted during former plant operations. Radiological assessments of the Radiation Protection Program are performed annually pursuant to 10 CFR 20.1101(c). This assessment and the Big Rock PSDAR conclude that projected dose for decommissioning falls well within NUREG-0586, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* estimates [References 1-2 and 1-11].

The initial site characterization, together with HSA and hydrogeological investigations, provide the basis for selection of the appropriate dose modeling scenarios and critical groups to address possible future uses of the site. The computer code used for dose modeling calculates the Derived Concentration Guideline Levels (DCGLs). Derived Concentration Guideline Levels correspond to a dose to the average member of the selected critical group that is as low as reasonably achievable (ALARA) and does not exceed the total effective dose equivalent (TEDE) 25 mrem/year criteria for unrestricted use (Chapter 4, *Site Remediation Plan*, and Chapter 6, *Compliance with the Radiological Criteria for License Termination*).

Concurrent with characterization of the site, decommissioning activities are ongoing. Activities performed during this period include the removal of contaminated components from the site for final disposition and the demolition of site buildings (Chapter 3, *Identification of Remaining Site Dismantlement Activities*).

Remediation of soils will be performed based upon the input of the initial site characterization and cleanup levels determined by dose modeling. Title 10 of the CFR, Section 20.1402, has two criteria for evaluating site conditions for unrestricted use; 25 mrem/year TEDE and ALARA. A site dose limit of 25 mrem/year for soils and groundwater has been chosen as the ALARA values for BRP, as it is consistent with Section 7 of NUREG-1575. If additional remediation activities are required to meet DCGLs, they will be performed as necessary. Once areas have been remediated to the required level, administrative controls will be put into place to prevent recontamination of the area(s) (Chapter 5, *Final Status Survey Plan*).

The FSS Plan describes the methodology by which plant areas will be verified to be at or below the DCGLs required to meet the site release criteria for unrestricted use. The FSS will be conducted on site soils and groundwater in accordance with approved procedures and industry guidance. The NRC will be notified so independent confirmatory surveys can be scheduled and performed, as necessary. The FSS results will be compiled in a series of reports by survey area(s) and will be submitted to the NRC for review.

Consumers Energy intends to demolish structure(s) and release the demolition debris to either a State of Michigan licensed landfill in accordance with a 10 CFR 20.2002 alternate disposal method approval by the NRC dated February 5, 2002 or to a NRC licensed radioactive disposal facility. The only structures that will remain onsite will be those supporting Independent Spent Fuel Storage Installation (ISFSI) operations. Although no buildings utilized during power operation are expected to remain on the site at the time of the FSS, it is recognized a contingency might arise for a specific structure to be in use at the time of the FSS. If so, any such building would be surveyed in accordance with NUREG-1575 guidelines, and would be included in the FSS results provided to the NRC. Consumers Energy does not intend to use onsite burial, disposal, or incineration of any low-level radioactive waste. Any materials remaining onsite (e.g., septic field) will meet the appropriate DCGLs for unrestricted release.

Consumers Energy may release specific areas from the 10 CFR 50 license after they have been surveyed and the results documented and provided to the NRC for review. Consumers Energy will conclude the decommissioning process upon completion of remediation, final status surveys, and confirmation the site release criteria have been met.

1.4.2 Phased Release Approach to License Termination

Consumers Energy may remove specific areas from the license in a phased manner. The approach for phased release and removal from the license, after approval of the LTP, is explained below.

Following completion of decommissioning activities and FSS of a survey unit, Consumers Energy will compile a FSS report to address the area(s) where decommissioning or remediation tasks are complete and the criteria of 10 CFR 20.1402 have been met. The results of these surveys will be documented in a report and submitted to the NRC. The FSS report contents are discussed in Chapter 5, *Final Status Survey Plan.*

Once an area has been verified ready for release, no additional surveys or decontamination of the subject area will be required unless administrative controls to prevent recontamination are known or suspected to have been compromised.

Consumers Energy will review and assess the impacts on the following documents before releasing land areas from the license:

- Updated Final Hazards Summary Report and Technical Specifications,
- Environmental Monitoring Program,
- Offsite Dose Calculation Manual,
- Defueled Emergency Plan,
- Security Plan,
- Post Shutdown Decommissioning Activities Report,
- 10 CFR 100 Siting Criteria, and
- Environmental Report.

Consumers Energy has chosen a phased release approach for release of land from the operating license as follows:

- The majority of the site land, including non-impacted and areas impacted by power generation activities (approximately 2.281 km^2 or 563.6 acres), and
- The portion of the site associated with ISFSI operations (approximately 0.1 km^2 or 20 acres).

Upon completion of the BRP Restoration Project, a final report will be prepared summarizing the release of site land from the 10 CFR 50 license.

1.5 PLAN SUMMARY

Termination or partial release of the NRC license and environmental closure of the BRP site are closely related activities, completion of which will allow the site to be released for future unrestricted use. The LTP describes the processes to be used in meeting the requirements for terminating the NRC license. BRP currently intends to restore the site to a "Greenfield" condition as defined below:

- The asphalt access road approaching the site terminates at a gravel parking area,
- No visible building structures remain in the vicinity of the former industrial area,
- All subsurface structures have been removed,
- The shoreline has been returned to its original contour by filling a portion of the discharge canal; the break wall remains in place,
- The lake water intake terminates at the former screen house and has been plugged with concrete,
- All subsurface piping has been removed with the exception of the septic drainfield,
- The asphalt ISFSI road is retained to the southern end of the former Radwaste building site and all other asphalt has been removed,
- The only site facilities in existence are those supporting dry fuel storage and are located on or near the ISFSI pad,
- Cleared areas are graded for proper drainage, and
- Topsoil, seed, and other plantings are utilized, where appropriate, to achieve the final Greenfield condition.

1.5.1 General Information

This LTP has been prepared for BRP in accordance with 10 CFR 50.82(a)(9). The LTP is being maintained as a supplement to the BRP UFHSR to support the application for a license amendment to meet 10 CFR 50.82(a)(9) and 10 CFR 50.90. Each of the chapters required by 10 CFR 50.82(a)(9) are outlined in the subsections below. Note all figures and references (listed in alphabetical order) are located at the end of the corresponding chapter.

1.5.2 Site Characterization

Chapter 2 of the LTP discusses site characterization as it applies to potential radiological and non-radiological material contamination onsite.

Site characterization identifies, quantifies, and documents any residual contaminants of plant origin present on the site. It classifies land areas as impacted or non-impacted and provides further, detailed classification of the site impacted property into areas of similar type (Class 1, 2, 3). The scope of the contamination evaluation at BRP is restricted to site soils and

groundwater as all systems, structures, and components will be dismantled and removed from site (with the exception of the ISFSI structures.) Characterization of the ISFSI area will be done as a revision to this LTP when the Department of Energy removes spent fuel from the site.

Site characterization is performed in accordance with the guidelines of NUREG-1575. The BRP site characterization is founded on the HSA and characterization surveys performed from 1997-2001.

The HSA is an investigation of historical events involving radioactive and non-radioactive materials either known to have impacted the environment or with the potential to impact the environment. The HSA consisted of an investigative review and compilation of the following information: health physics logs, corrective action documents, radiological incident files, operational survey records, and annual reports to the NRC. Personnel interviews were conducted with present and former plant employees and contractors to obtain additional information regarding operational events that may have impacted the environment.

As a result of the HSA information and process knowledge evaluation as described in Chapter 2, approximately 1.742 km^2 or 430.4 acres have been initially identified as "non-impacted" as defined in NUREG-1575. Final classification of impacted areas as Class 1, 2, or 3 will be completed prior to the FSS, in accordance with NUREG-1575 methodology.

Radiation surveys and additional characterization measurements and samples obtained during decommissioning activities will be used to confirm the area classification. Evaluation of survey equipment, processes, techniques, and data will support development of the FSS Plan.

The information obtained from the characterization process will be used as the basis for remediation activities. The characterization process also provides a foundation for the FSS that demonstrates compliance with criteria for release of the site for unrestricted use (10 CFR 20, Subpart E.)

1.5.3 Identification of Remaining Site Dismantlement Activities

Consumers Energy is conducting decontamination and dismantlement activities at the BRP site consistent with those discussed in the BRP PSDAR. Chapter 3 of the LTP describes those decontamination and dismantlement activities that remain at BRP as of December 2002. Also included in this chapter are estimates of radiation dose to workers from decommissioning activities and projected quantities of radioactive waste. Chapter 3, Table 3.1, Decommissioning Periods, contains descriptions of major decommissioning periods and activities.

Consumers Energy's primary goals are to decommission BRP safely, to monitor and control radiological hazards, and to maintain the safe storage of spent fuel. Demolition debris will be sent for disposal locally in accordance with alternate disposal approval under 10 CFR 20.2002. Materials that cannot be decontaminated will be sent to an offsite radioactive waste processor or directly to a licensed low-level radioactive waste disposal site. Completion of the decommissioning at the BRP site depends on the availability of a low-level waste disposal site. Currently, BRP has access to low-level waste disposal facilities in Barnwell, South Carolina, and Clive, Utah.

Major decommissioning activities completed as of December 2002 include:

- Decontamination of the primary system,
- Spent fuel pool clean-out (non-fuel irradiated reactor internal),
- Installation of site construction power,
- Establishment of a new spent fuel pool cooling system,
- Removal of the reactor feed pumps,
- Removal of the turbine and condenser,
- Relocation of the control room to a spent fuel pool monitoring station,
- Removal of the alternate shut-down (ASD) building,
- Construction of an ISFSI,
- Installation of a single-failure-proof containment building crane,
- Removal of the reactor internals,
- Poison tank removal,
- Emergency condenser removal, and
- Partial removal of fuel from the spent fuel pool to a dry fuel storage system.

1.5.3.1 Future Decommissioning Activities and Tasks

The remaining decommissioning activities include major component removal (e.g., steam drum and reactor vessel), contaminated systems removal, clean systems removal, decontamination and removal of site buildings, and cleanup of site land areas. Many of these activities will be performed concurrently. Decontamination and dismantlement activities are currently expected to continue until the Fall of 2004.

Decontamination of plant structures and equipment may be utilized to reduce dose rates or improve material shipping condition. Decontamination techniques may range from water washing to removal of a layer of building surface material. Contaminated equipment and structural material will be packaged and either shipped to a processing facility or shipped directly to a low-level radioactive waste disposal facility. Soil and groundwater remediation is discussed in Chapter 4, *Site Remediation Plan*, of the LTP.

Following decontamination, buildings will be demolished and the concrete and structural debris buried in a local landfill. On February 5, 2002, Consumers Energy received NRC approval for disposal of demolition debris in accordance with provisions of 10 CFR 20.2002 [Reference 1-8]. Letters from Consumers Energy on May 18 and June 20, 2001 serve as a description of the process used for ensuring decontaminated demolition debris meets the criteria for disposal in a local landfill [References 1-6 and 1-7]. The demolition debris would consist of flooring material, concrete, rebar, roofing materials, structural steel, incidental soil associated with digging up foundations, and concrete and/or asphalt pavement or other similar solid materials originating from decommissioning activities.

The NRC issued an environmental assessment and finding of no significant impact in the Federal Register on December 7, 2001 (Volume 66, Number 236), pages 63567-63568. This assessment concluded there are no significant radiological environmental impacts associated with Consumers' request to dispose of demolition debris in accordance with 10 CFR 20.2002. The NRC concluded the environmental impacts of processing the total waste projected for BRP approximately 18,000 cubic meters (635,100 cubic feet), which includes approximately 16,000 cubic meters (563,000 cubic feet) of demolition debris proposed to be sent to a State of Michigan licensed landfill, are bounded by NUREG-0586. The NRC further concluded the requested action did not involve any historic sites nor affect non-radiological plant effluents and has no other environmental impact.

A detailed description of the coordination of activities, requirements, permits, and licenses covered by other regulatory agencies is also included. These activities, requirements, permits and licenses include National Pollutant Discharge Elimination System (NPDES) permits, Great Lakes construction permits, mixed low-level waste storage permits, mixed low-level waste storage building closure certification, tank closure certification, storm water management plan, erosion and sediment control, asbestos and PCB characterization and remediation, noise regulations, air emissions, etc. These efforts involve coordination between Consumers Energy and other stakeholders, including the Michigan Department of Environmental Quality.

If Consumers Energy decides to operate the ISFSI as a site-specific license under 10 CFR Part 72 rather than a general license under 10 CFR Parts 50 and 72 as currently planned; a site-specific LTP will be developed. Currently, Consumers Energy intends to revise this LTP for the general license under 10 CFR Part 50 to include decommissioning of the ISFSI once the fuel is transferred to a permanent storage facility.

1.5.4 Site Remediation Plans

Chapter 4 of the LTP describes the various methods to be used during BRP decommissioning to reduce the levels of radioactivity to those which meet the NRC radiological release criteria in 10 CFR 20.1402, Radiological Criteria for Unrestricted Use. Big Rock Point intends to release the site for unrestricted use upon license termination. No post-remediation activities are anticipated except ISFSI operations. Activities for remediation initiated prior to license termination shall be completed in accordance with applicable State and Federal Regulations.

Remediation will be performed for all survey units that exhibit activity levels greater than the DCGL based upon 25 mrem/year for soil and drinking water.

1.5.5 Final Status Survey Plan

Chapter 5 of the LTP describes the methods to be used in planning, designing, conducting, and evaluating final status surveys at BRP to demonstrate the site meets the NRC's radiological criteria for unrestricted use as specified in 10 CFR 20.1402 (i.e., 25 mrem plus ALARA for all dose pathways.) The FSS Plan follows the guidelines developed in NUREG-1575 as they apply to the BRP site.

The primary objective of the FSS is to demonstrate the site meets the criteria for unrestricted release for termination of license. All site buildings and subsurface structures and equipment, with the exception of the facilities supporting ISFSI, will be demolished and removed from the site prior to the FSS. Chapter 5 addresses data quality objectives, final status survey design, survey methods and instrumentation, data collection, data reviews, reporting of survey results and quality assurance and quality control requirements. The BRP FSS Plan also includes measures to ensure FSS activities are planned and communicated to regulatory agencies to allow the scheduling of inspection activities by these agencies.

1.5.6 Compliance with the Radiological Criteria for License Termination

Chapter 6, together with Chapters 4 and 5, describes the process to demonstrate compliance with the radiological criteria of 10 CFR 20.1402 for unrestricted future use of the BRP site. The goal of the BRP Restoration Project is to release the site for unrestricted use in compliance with the NRC's dose limit of 25 mrem/year plus ALARA. The NRC dose limit applies to residual radioactivity that is distinguishable from background. This chapter of the LTP provides the methods for calculating the annual dose from residual radioactivity that may remain when the site is released for unrestricted use and the methods used to demonstrate compliance with the unrestricted use criteria.

Structures, foundations, paved surfaces and buried piping and utilities will have been removed prior to performance of the FSS for each specified survey area. Therefore, the scope of this chapter is limited to calculating annual dose resulting from surface and subsurface soil and groundwater contamination. This chapter provides a description of and the justification for source term assumptions, exposure scenarios considering the site environment, the mathematical model/computational method used, and the parameter values and a measure of their uncertainty.

Consumers Energy utilized accepted industry technical and computer codes to model dose from soils and groundwater and develop associated DCGLs. Derived Concentration Guideline Levels are the concentration radioactivity limits that will be the basis for evaluating the results of the FSS. The computer dose model is a modified resident farmer scenario for site soils and groundwater using RESRAD version 6.21.

1.5.7 Update of Site-Specific Decommissioning Costs

In accordance with 10 CFR 50.82(9)(ii)(f), Chapter 7, *Update of Site-Specific Decommissioning Costs*, provides an updated, site-specific estimate of the remaining decommissioning costs. Regulatory Guide 1.179 provides guidance with respect to the information to be presented. The LTP must provide an estimate of the remaining decommissioning costs, and compare the estimated costs with the present funds set aside for decommissioning. The financial assurance instrument required per 10 CFR 50.75 must be funded to the amount of the cost estimate [Reference 1-17]. If there is a deficit in present funding, the LTP must indicate the means for ensuring adequate funds to complete the decommissioning.

The cost estimate focuses on the remaining work, detailed by each activity associated with the decommissioning, including the costs of labor, materials, equipment, energy, and services. The decommissioning estimate includes a comparison of estimated costs with the present funds set aside for decommissioning and a description of the means to ensure there will be sufficient funds for completing decommissioning.

Consumers Energy owns a 100% undivided interest in the Big Rock Point (BRP) Nuclear Plant and provides financial assurance for decommissioning through the use of an external sinking fund, funded by rates that are established by cost of service ratemaking regulation. Following 35 years of electric power generation, BRP was voluntarily shut down by Consumers Energy on August 29, 1997 and immediately entered into decommissioning. In accordance with 10 CFR 50.82(a)(8)(iii), a detailed, site-specific cost estimate was prepared for Consumers Energy and docketed with the NRC in its submittal of the BRP PSDAR. Pursuant to State of Michigan requirements to prepare and file decommissioning cost estimate updates with the Michigan Public Service Commission (MPSC) at three-year intervals, a cost estimate

update was prepared in 2000 and filed in March 2001 as a follow up to the March 1998 filing. Consumers Energy will be preparing an estimate update in 2003 for filing in March 2004; the 2000 estimate, updated with actual costs incurred through 2002 and the latest forecast costs, serves as the cost basis for the LTP.

1.5.8 Supplement to the Environmental Report

Chapter 8, Supplement to the Environmental Report, satisfies the requirements stated in:

- 10 CFR 50.82(a)(9)(ii)(G)
  A supplement to the Environmental Report pursuant to 10 CFR 51.53 shall be submitted describing any new information or significant environmental change associated with the licensee's proposed termination activities.

- 10 CFR 51.53(d)
  Post operating license stage "... each applicant for a license amendment approving a license termination plan or decommissioning plan under paragraph 50.82 of this chapter either for unrestricted use or based on continuing use restrictions applicable to the site ... shall submit with its application the number of copies specified in paragraph 51.55, of a separate document, entitled "Supplement to Applicant's Environmental Report – Post Operating License Stage," which will update "Applicants Environmental Report – Operating License Stage," as appropriate, to reflect any new information or significant environmental change associated with the ... proposed activities with respect to the planned storage of spent fuel..."

Decommissioning activities will be accomplished with no significant adverse environmental impacts as described in Chapter 8. Decommissioning and license termination activities remain bounded by decommissioning activities described in:

- The PSDAR,
- NUREG-0586, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (FGEIS)*, and
- NUREG-1496, *Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination on NRC Licensed Facilities* [Reference 1-12].

The BRP PSDAR was submitted to the NRC in accordance with 10 CFR 50.82 (a)(4)(i). In the PSDAR, Consumers Energy performed an environmental review to evaluate actual or potential environmental impacts associated with proposed decommissioning activities. This site-specific evaluation used NUREG-0586 guidance and concluded environmental impacts were bounded by NUREG-0586 criterion.

Consumers Energy did not prepare an Environmental Report during original construction permitting. (An Environmental Report was not required under the Atomic Energy Commission regulations at the time of original BRP licensing.) In 1994, Consumers Energy prepared an Environmental Report for Decommissioning in conjunction with the Decommissioning Plan. This report was updated to reflect current plant conditions and parameters and was incorporated by reference into the UFHSR and submitted to the NRC on September 18, 2002.

The purpose of Chapter 8, *Supplement to the Environmental Report*, of the LTP is to revise the BRP Environmental Report with new information or significant environmental change associated with proposed license termination/partial release activities.

1.6 LICENSE TERMINATION PLAN CHANGE PROCESS

Consumers Energy is submitting this LTP as a supplement to the UFHSR. Accordingly, the LTP will be updated in accordance with 10 CFR 50.71(e). Once the LTP has been approved, the following change criteria will be used, in addition to those criteria specified in 10 CFR 50.59, 10 CFR 72.48, 10 CFR 50.82(a)(6), and 10 CFR 50.82(a)(7). Changes to the LTP that require NRC approval prior to implementation include:

- Increasing the radionuclide-specific DCGLs or area factors (as discussed in Chapters 5 and 6),
- Increasing the probability of making a Type I decision error above the level stated in the LTP (discussed in Chapter 5),
- Increasing the investigation level thresholds for a given survey unit classification (as given in Chapter 5),
- Reducing the coverage requirements for scan measurements (as discussed in Chapter 5), or
- Using statistical tests other than the Sign Test for data evaluation (as discussed in Chapter 5).

This change process will be reflected in the application for the proposed license amendment accompanying the LTP.

1.7 LICENSE TERMINATION PLAN INFORMATION CONTACT

For information or comments regarding the BRP LTP, please contact the following party:

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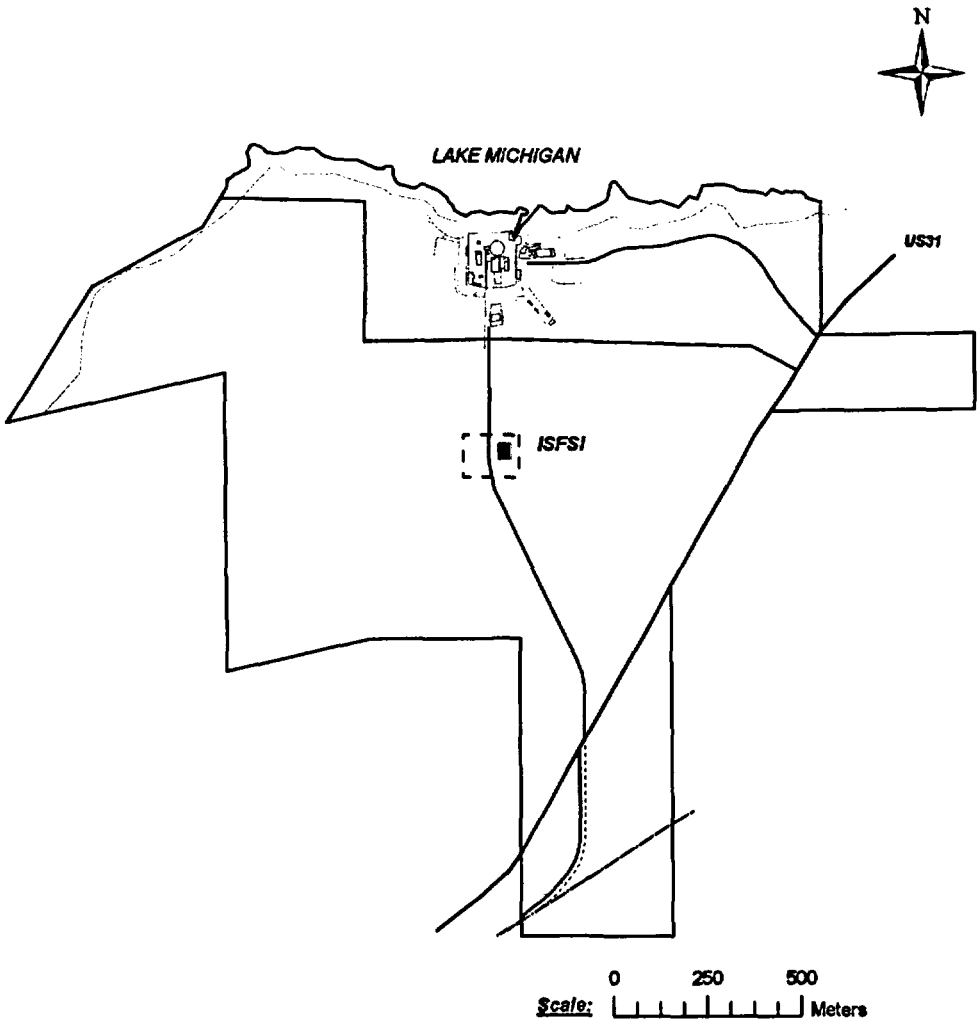

Figure 1-1. Big Rock Point Owner Controlled Area

1.8 REFERENCES

1-1 Big Rock Point Plant Facility Operating License (DPR-6) issued May 31, 1960 as amended January 13, 2000

1-2 Big Rock Point Plant Inter-Office Memorandum KEP 02-02. *Radiation Protection 2000 Program Review 10 CFR 20.1101*, from KEPallagi, RP&ES Manager to Self-Assessment File, February 19, 2002

1-3 Letter from Consumers Energy, Big Rock Point Plant to the U.S. Nuclear Regulatory Commission, *Decommissioning Plan and Environmental Report for the Decommissioning Plan for Big Rock Point Nuclear Plant*, February 27, 1995

1-4 Letter from Consumers Energy, Big Rock Point Plant to the U.S. Nuclear Regulatory Commission, *Documents Associated with Decommissioning (PSDAR, Rev. 1, ODCM, Defueled Technical Specifications, Defueled Emergency Plan, Emergency Plan Exemption)*, September 19, 1997

1-5 Letter from Consumers Energy, Big Rock Point Plant to the U.S. Nuclear Regulatory Commission, *Certification of Permanent Fuel Removal – Removed on September 20, 1997*, September 23, 1997

1-6 Letter from Consumers Energy, Big Rock Point Plant to the U.S. Nuclear Regulatory Commission, *Request for Approval of Proposed Disposal Procedures in Accordance with 10 CFR 20.2002*, May 18, 2001

1-7 Letter from Consumers Energy, Big Rock Point Plant to the U.S. Nuclear Regulatory Commission, *Request for Approval of Proposed Disposal Procedures in Accordance with 10 CFR 20.2002*, June 20, 2001

1-8 Letter from the USNRC to Consumers Energy, Big Rock Point Plant, *Proposed Disposal Procedures in Accordance With 10 CFR 20.2002*, February 5, 2002

1-9 Letter from Consumers Energy, Big Rock Point Plant to the U.S. Nuclear Regulatory Commission, *Documents Associated with Decommissioning (PSDAR, Rev. 1, ODCM, Defueled Technical Specifications, Defueled Emergency Plan, Emergency Plan Exemption)*, September 19, 1997

1-10 U.S. Federal Register, Volume 66, Number 236, Friday, December 7, 2001, page 63567 (66 FR 63567) Consumers Energy Company; Big Rock Point Plant; Environmental Assessment and Finding of No Significant Impact

1-11 U.S. Nuclear Regulatory Commission NUREG-0586, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, August 1988

1-12 U.S. Nuclear Regulatory Commission NUREG-1496, *Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination on NRC Licensed Facilities*, July 1997

1-13 U.S. Nuclear Regulatory Commission NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, December 1997

1-14 U.S. Nuclear Regulatory Commission NUREG-1700, *Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans*, April 2000

1-15 U.S. Nuclear Regulatory Commission NUREG-1727, *NMSS Decommissioning Standard Review Plan*, September 2000

1-16 U.S. Nuclear Regulatory Commission NUREG-1757, *Consolidate NMSS Decommissioning Guidance*, September 2002

1-17 U.S. Nuclear Regulatory Commission Regulatory Guide 1.179, *Standard Format and Content of License Termination Plans for Nuclear Power Reactors*, January 1999

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2.0 SITE CHARACTERIZATION

2.1 INTRODUCTION

The purpose of site characterization is to identify, quantify, and document residual radioactivity at the Big Rock Point (BRP) site. This effort includes the historical review and evaluation of all radiological and non-radiological materials that were either known or had the potential to impact the environment. The data quality objective (DQO) process is utilized to satisfy the following site characterization objectives:

1. Provide the information necessary for development of the site conceptual model used to demonstrate compliance with the radiological criteria for license termination;

2. Define the nuclide fractions for surrogate measurement of hard-to-detect (HTD) nuclides;

3. Identify the instrumentation, measurement performance criteria, and methods to be used for characterization survey and radioactivity analysis;

4. Establish the quality assurance requirements for sample collection, analysis, and record keeping;

5. Classify all areas of the BRP site property as impacted or non-impacted. Further define the initial classification of Impacted Areas as Class 1, 2, or 3; and

6. Provide information required to support the decision-making process necessary for potential environmental remediation and planning of the Final Status Survey (FSS).

The BRP site will have been returned to a Greenfield condition at the time of the FSS. All systems, components and buildings, with the exception of facilities supporting dry fuel storage, are scheduled for dismantlement and removal from the site. The scope of the characterization effort is therefore restricted to the residual radioactivity in site soils and groundwater. Evaluations of structures and components are included only as they pertain to known or potential environmental impacts.

Big Rock Point site characterization is a two-step process consisting of Historical Site Assessment (HSA) and Environmental Status Investigation (ESI). The HSA provides the foundation of the characterization effort. This study is a continuous chronological account and detailed evaluation of all historical events with the potential to have impacted the environment. Based on existing information, the HSA defines the Impacted and Non-Impacted Areas of the site and identifies known or potential sources of radioactivity in soils and groundwater.

The information established by the HSA provides the primary input for ESI planning. This step in the characterization process is the investigative survey, analysis, and evaluation of all soil and groundwater contamination within the site Impacted Area. ESI provides the planning and execution of all scoping, hydrogeological, characterization, and remediation surveys in support of license termination. The evaluation resulting from this effort serves to define the current status of environmental contaminants at the site and provides the required input for development of the dose model. Site characterization is an iterative process that provides the information necessary for continuing dismantlement, returning the site to a Greenfield condition, and planning of final status surveys.

2.2 HISTORICAL SITE ASSESSMENT SUMMARY

2.2.1 Overview

The purpose of the BRP HSA is to identify and document the current radiological status of the site. The HSA defines the Impacted and Non-Impacted Areas of the site, identifies potential sources of contamination, and assesses the likelihood of contaminant migration. This study forms the basis for initial site area classifications and the characterization survey process. The HSA is limited to events that resulted in known or potential residual radioactivity impacting site soils and groundwater. All structures, systems, and components, with the exception of those supporting Independent Spent Fuel Storage Installation (ISFSI), are scheduled for dismantlement and offsite removal prior to license termination. The HSA was completed in 1999 and forms the basis for initial Impacted and Non-Impacted Area classifications and subsequent site characterization surveys [References 2-6 and 2-7]. An evaluation of potential non-radiological site contaminants, completed in 2002, is also included in this assessment [Reference 2-8]. The HSA was developed through directives established in the DQOs and follows the guidance provided in NUREG-1575 [Reference 2-26].

2.2.2 Site Description

2.2.2.1 Property Identification:

Big Rock Point Restoration Project
10269 US 31 North
Charlevoix, Michigan 49720
Consumers Energy's License No. DPR-6

2.2.2.2 Geographic Description

The site topography can be divided into two categories: (1) a narrow band of property parallel to the lake that is characterized by swampy areas between low beach ridges, and (2) inland areas where the terrain rises on a till plain to upland drumlins. The site stratigraphy consists of glacial deposits that overlay limestone bedrock. These deposits range from sandy gravel and cobble to clay till. A significant portion of inland site property is considered wetlands.

2.2.2.3 Surface and Ground Water Hydrology

Big Rock Point is located within a three to four square mile watershed that originates south of the property. Surface water, shallow groundwater, and the drinking water aquifer located beneath the clay till all flow north through the site and into Lake Michigan. Stormwater runoff from high ground is diverted around the site-Protected Area. A drainage system consisting of catch basins and corrugated metal piping acts to remove stormwater away from buildings and parking areas toward Lake Michigan. An in-depth study of the site hydrogeology was conducted as an integral part of the ESI effort. This study is detailed in Section 2.4.3.

2.2.2.4 Industrial Area

The land area of potential radiological and non-radiological impact is that portion of the site where licensed activities took place. This location encompasses less than 0.1 km^2 (20 acres) and includes the Protected Area, the radwaste compound, and adjacent support structures and transport routes. Soils in these locations are coarse, of low fertility, and unsuitable for agricultural use. The upper 5 m (15 feet) of soil beneath this area is comprised of fill material and native soils ranging from coarse gravel and cobble to fine clayey sands. This upper soil strata is underlain by a thick and generally homogeneous layer of sandy clay that extends to bedrock. Two shallow groundwater bearing zones are typically encountered within 8.2 m (25 feet) of grade elevation. These water bearing zones are believed to originate from watershed hydraulic pressure resulting in the transportation of water above the clay layer and ultimately into Lake Michigan. Figure 2-1 shows the BRP Owner-Controlled Area. Figure 2-2 depicts the BRP Industrial Area.

2.2.3 Historical Site Assessment Methodology

The HSA is an extensive review of all historical plant documentation identifying events that were either known or had the potential to impact the environment. Investigation, physical inspection, and process knowledge were used to evaluate the event data and define site areas by radiological classification. Input information for this process included the following:

1. Review of Health Physics Logbook (1962 – 1999),
2. Response from employee/retiree questionnaires,
3. All corrective action records (1962 – 1999),
4. Personal interviews of past and present employees,
5. Decommissioning study performed in 1993 and 1994,
6. Radiological scoping surveys,
7. Investigations of historical anecdotes,
8. Physical walkdowns of site property,
9. Plant drawings,
10. Hazardous material assessments,

11. Records of polluting material spills, and
12. Waste shipment records (radiological, non-radiological and mixed waste).

The Health Physics Logbook is a 37-year account of continuous daily entries describing day-to-day radiological activities and site conditions. The corrective action records document those occurrences or events that recognized safety-related deficiencies, identified undesirable conditions adverse to quality, or were reportable to regulatory agencies. Corrective action documentation includes Deviation Reports, Event Reports, and Condition Reports. All supporting input documentation has been detailed in the HSA Supplemental Data.

Using the DQO process, an assessment of all input data was performed to define the current status of all contaminants in the BRP site environment. A Non-Impacted Area classification has been given to those areas with no evidence or reasonable potential for the presence of residual radioactivity. Areas that are known or suspected to contain residual radioactivity are classified as impacted. Where sufficient evidence exists, the classification of impacted was further profiled into the following sub-classifications: unlikely, potential, known, and potentially elevated. These initial area classifications were used as baseline data to aid in future ESI characterization survey planning.

2.2.4 Historical Review

2.2.4.1 Operation

The BRP Plant achieved initial criticality in September of 1962. The Nuclear Steam Supply System (NSSS) was a boiling water reactor designed by the General Electric Company. The turbine generator, also designed by General Electric, was rated to produce 75 MWe. The facility was originally operated as a research and development reactor, until commercial operations began in late 1962. The plant ceased operation on August 29, 1997. The BRP Plant has been permanently defueled and is currently undergoing dismantlement and return of the site to a Greenfield condition.

During BRP Plant operation, some events resulted in the contamination of structures and components inside buildings located in the Radiation Control Area. In addition, there were some occurrences that resulted in residual radioactivity outside of the buildings. Most occurrences were minor, resulting in minimal amounts of residual radioactivity. Upon discovery, events were documented and actions were taken to control and remove the contamination and to institute corrective actions to preclude future occurrences. These events are detailed in chronological order in Appendix 2-B.

2.2.4.2 Environmental Impact of Historical Fuel Failures

The review and evaluation of all HSA input data identified no occurrence of transuranic contamination beyond the containment building at the site. As with other nuclear plants of the era, BRP experienced significant fuel failures during the early years of operation. However, modifications to plant components and changes in reactor procedural operations minimized the potential for contamination resulting from failed fuel. The following factors are believed to have contributed to the minimization of fuel failures and absence of transuranics in the environment at the BRP site:

1. Big Rock Point was originally utilized as a research facility for reactor core performance testing and fuel irradiation evaluations. Early plant operation consisted of short criticality durations followed by test evaluations and subsequent core reconfiguration. This served to minimize the length of power operation associated with known fuel failures.
2. Fuel cladding design change from stainless steel to inconel early in the plant operational period (1960s).
3. Stainless steel replacements to the main condenser and primary system heat exchanger components reduced the scaling and subsequent fuel clad failures that result from poor heat transfer.
4. The pre-conditioning of fuel during start-up evolutions was procedurally established in the early 1970s. Fuel soaking prior to start-up removed oxygen from the coolant to maintain proper water chemistry and slower power escalations were found to reduce stress damage to fuel cladding.
5. Spent fuel was routinely shipped offsite for testing and reprocessing throughout the 1960s and early 1970s. Prior to completion of the stainless steel fuel pool liner project in 1974, all spent fuel had been removed from the BRP site.
6. The BRP Plant was constructed with the ability to maintain high purity reactor water chemistry. During operation, processed condensate was supplied to the reactor water feed pumps through high-capacity, deep-bed demineralizers. A primary system-processing loop also utilized deep bed demineralization to maintain ~3% cleanup flow through the reactor vessel. This large-capacity system maintained pure-water chemistry minimizing the presence of contaminants that potentially contribute to early fuel failure.
7. The NSSS steam drum was designed with cyclone separators to dry the steam supply to the turbine-generator and limit moisture and particulate carry-over. The off-gas system included a low velocity delay chamber for the removal of particulates and decay of short-lived nuclides prior to stack release. These system components remained intact and functional throughout the operational life of the plant and limited the ability of all particulate radionuclides, including transuranics to migrate into the environment.

8. The BRP Nuclear Plant is unique in design. The spent fuel pool is within the containment enclosure adjacent to the reactor vessel. Thus, fuel has never been routinely handled outside of the Containment Building. Additionally, reactor coolant piping did not exit the containment isolation boundary; only steam and liquid radioactive waste piping exit the Containment Building. This design significantly limits the areas that could have been exposed to transuranic contamination.

2.2.4.3 Initial Scoping Survey

In anticipation of decommissioning, a radiological scoping survey was performed in 1993 and early 1994. The initial scoping survey effort included the spectrographic analysis of grab samples taken in the Owner-Controlled Area, in-situ measurements of plant and background areas, and installation of nine groundwater monitoring wells. The scoping survey project was developed following the guidance of Draft NUREG/CR-5849[1]. Survey design, methodology, and findings are detailed in the BRP Decommissioning Plan [Reference 2-1]. Following this survey, Initial Derived Concentration Guideline Level (IDCGL) values were defined to provide conservative guidance for estimating remediation requirements. Initial Derived Concentration Guideline Levels were developed using the RESRAD v5.05 computer code based on the resident farmer scenario and the site release criteria of 25 mrem/yr[2]. The information resulting from the scoping survey contributed to development of the HSA. These data are summarized in Appendix 2-B, Data Event 49. The current radiological status of these survey areas is provided in Section 2.4.

2.2.5 Findings and Conclusions

2.2.5.1 Data Review

A review of 37 years of historical plant documentation resulted in the identification of 63 operational events that were either known or had the potential to radiologically impact the environment. These events are summarized and listed in chronological order in Appendix 2-B. Investigation, physical inspection, and process knowledge were used in the evaluation of event data to determine the present radiological condition of the site. An evaluation to determine the current posture of all non-radiological site contaminants was also performed in this manner. This process resulted in the identification of those areas meeting the requirements of NUREG-1575 for Impacted and Non-Impacted Area classification.

[1] NUREG-1575 (MARSSIM) had not been published when the initial scooping survey was performed.
[2] Finalized DCGL values to demonstrate compliance with the radiological criteria for license termination are detailed in Chapter 6.

Big Rock Point encompasses an area of 2.281 km^2 (563.6 acres) exclusive of the US Route 31 right-of-way. The Non-Impacted Area consists of 1.742 km^2 (430.4 acres) and is that portion of the Owner-Controlled property that has no evidence or reasonable potential for the presence of radioactivity resulting from plant operation. The remaining 0.450 km^2 (133.3 acres) of site property have been classified as impacted. These areas are known or have the potential to contain residual radioactivity. Figure 2-1 depicts the BRP site Impacted and Non-Impacted Areas.

2.2.5.2 Non-Impacted Area

The Non-Impacted Area of the BRP site ranges from low wetlands with standing water to mature forested uplands. Groundwater and surface water from the Lake Charlevoix watershed divide flow north into the Non-Impacted Area and then drain from this higher elevation through the Impacted Area into Lake Michigan. The property is generally inaccessible to motorized traffic and in most locations presents a challenge to foot travel. The Non-Impacted Area is mainly characterized by thick forest and uneven terrain. Dense vegetation is clearly visible in historical aerial photographs and indicates that the present terrain has remained relatively unchanged since plant construction.

The Non-Impacted Area served as a buffer zone for emergency planning purposes during power operations and was also used for the placement of dosimetry at site boundaries for environmental monitoring.

No other work activities have been conducted on this property and there is no historical data or process knowledge that would support classification of the area as impacted. The Non-Impacted property is part of a regional study that was conducted to establish the standard environmental radioactivity background value for soils similar in type to those found at BRP. No radioactivity other than the standard environmental background was identified within the Non-Impacted Area in the findings of this investigation. The Michigan Department of Environmental Quality (MDEQ) participated with BRP in this study. Michigan Department of Environmental Quality split sample results support the BRP findings of this investigation. See section 2.3.3. This region of the Owner-Controlled property meets the requirements of NUREG-1575 for Non-Impacted Area classification. The Non-Impacted Area is defined by the site legal description found in Appendix 2-A.

2.2.5.3 Impacted Area

The Impacted Property extends over a mile along the Lake Michigan shoreline and contains an area of 0.540 km^2 (133.3 acres). The majority of this property is remote from plant operational activities and has little probability to contain residual radioactivity. The locations of potential radiological concern are confined to the Industrial Area, an area of less than 0.1 km^2 (20 acres) that includes the Protected area, the Radwaste compound, and all material transport routes and storage locations. The following is a brief narrative of historical events that provide a description of the Impacted Area based upon location and the potential to contain residual radioactivity. Refer to Figure 2-2 for the area locations and buildings described below.

a. Areas Unlikely to Contain Residual Radioactivity

1. *Wooded Locations in Vicinity of the Protected Area*
Licensed activities are not known to have occurred in the wooded areas to the east and west of the protected area. Scoping surveys in these locations did not identify soil radioactivity above established environmental background levels. This area is classified Impacted only because of proximity to the Industrial Area.

2. *Area Along the Railroad Spur South of US Route 31*
Extensive surveys did not identify soil radioactivity above established environmental background levels in the soils of this area; however, concrete and asphalt construction debris were inadvertently moved to a small location within this region were found to have originated from a potentially contaminated area. A follow-up evaluation of this material identified a trace concentration of Co-60 fixed on a single olivine firebrick. The brick is believed to have originated from the former incinerator site. This brick and all other construction debris were removed from the property.

b. Areas of Potential Residual Radioactivity

1. *Septic System Drain Field*
The drainfield is a mound system of approximately 3000 m^2 that is located immediately west of the Protected Area. The septic tanks and pumping station that supply the drain field are within the Protected Area and located below grade about 20 meters south of the Screenhouse. In 1978, residual radioactivity was identified in the demineralized water system due to backflow through a check valve leading to the spent fuel pool. Demineriized water is the make-up supply for the heating boiler and heating boiler blowdown water was routinely released to the septic system. In 1982 it was discovered that a sink in the Chemistry Lab presented a drain path to the septic system. This sink was designated for non-contaminated analyses; however, the possibility exists that contaminated liquids were drained to the septic system from this location. All conditions were corrected and the Septic Tanks were placed on a routine sampling regimen. Septic Tank analyses have never identified residual radioactivity.
(Appendix 2-B, Radiological Events 21, 28, 34, 39)

2. *Incinerator Site*
An incinerator was used for the burning of radiologically clean trash between the years of 1965 and 1978. The incinerator was a simple enclosure constructed of cement blocks that was located in the Protected Area approximately 40 meters west of the Containment Building. On several occasions throughout its operational history, ash from the incinerator was found to contain radioactivity above established environmental background levels.
(Appendix 2-B, Radiological Events 11,15,16,18,19,23)

3. Transport Routes and Staging Locations
All paved and unpaved open areas that have been identified as staging locations or transport routes for the movement of radioactive materials prior to final packaging for shipment are considered to be potentially contaminated.

Roadway West of Turbine Building
Resin and filter material used in the primary system were routinely transferred from an area immediately west of the Turbine Building, through the south gate of the Protected Area, and into the Radwaste Compound for storage and shipment preparation. Low-level wastes to be packed in containers for shipment in the Radwaste Compound were also transported along this route.

Paved Areas in Vicinity of the Radwaste Compound
The current Radwaste Building, constructed in 1981-1982, houses the vault waste storage area. Prior to this, the vault area was exposed to the environment. During preparation for construction of this building, residual radioactivity was discovered in the concrete, asphalt, vegetation, and soil in this area. Remediation of the area was completed prior to building construction.
(Appendix 2-B, Radiological Events 20,25,26,29,32,33,48)

Power Line Easement
The power line right-of-way has been used as a staging area for large volumes of discarded construction materials. Bulk materials presently located in this area include asphalt and concrete rubble, structural steel, and other miscellaneous debris. Some of this material may have originated from areas of known residual radioactivity. All construction debris has been removed from the area. Residual radioactivity was not identified. Cleanup efforts are detailed in Appendix 2-C. Radiological surveys conducted in this area did not identify soil radioactivity above established environmental background levels.
(Appendix 2-B, Radiological Events 26,29,32,44,48,54,63)

Woods Road
The Woods Road is a narrow unimproved lane that extends approximately 300 meters from the western boundary of the Protected Area to the former weather station site. The station was constructed prior to plant operation and was used to collect weather data until January 1963. All that remains of the weather station are portions of the foundation. The Woods Road has been used as a materials transport route and several small locations along its length contain concrete rubble, wood pallets, paint chip refuse, and other miscellaneous debris; some of this material is known to have originated from inside the Protected Area. All debris of plant origin has been removed from this area [Sections 2.4.5.1(b), 2.4.5.1(c)]. Radiological surveys conducted in this area did not identify soil radioactivity above established environmental background levels.
(Appendix 2-B, Radiological Events 1,3,5,6)

Shoreline Near Screenhouse
An area of lake frontage extending from the Screenhouse toward the east parking lot has the potential to contain contaminated material. Cables, steel waste, and shards of asphalt and concrete have been identified in this area. In addition, dredgings from early Discharge Canal restoration work were stored in this area. These dredge spoils may have contained residual radioactivity from the Discharge Canal licensed release pathway. All construction debris has been removed from this area. No radioactivity above established environmental background levels was identified in conjunction with the construction debris removed from this area.
(Appendix 2-B, Radiological Events 4,9,10,12,14,38)

Construction Material Storage East of Protected Area
Physical inspection of an area 135 meters east of the Protected Area has identified two small locations that contain asphalt and concrete rubble. No radioactivity has been identified; however, a potential exists that this material may have originated from an area of known residual radioactivity.

4. Buildings
The HSA has been limited to site soils and groundwater; however, the occurrence of radiological events within or near site structures suggests the potential for residual radioactivity in soil.

Annex Building
A small quantity of the radioactive laboratory chemical, uranylacetate, was spilled inside the Annex Building in 1975. This chemical is not of plant origin and is commonly available from chemical suppliers. Materials of this type were commonly used at Public Affairs educational demonstrations. The spill was cleaned up. No evidence exists to indicate that this chemical has impacted the environment.

The original Annex drainfield was in use prior to connection with the main septic system. Workers sometimes showered in conjunction with wholebody counts taken at the Annex. Small amounts of radioactivity may have gone to the drainfield due to this activity. The drainfield is a small, fairly shallow cinder block lined trench that was in service prior to connection of the Annex sanitary system to the plant drainfield.
(Appendix 2-B, Radiological Event 17)

Contaminated Warehouse
The Contaminated Warehouse is located in the southwest corner of the Protected Area. This building has been used to store salvageable materials with fixed residual radioactivity.

Butler Building
The Butler Building was once part of the Radwaste Compound. Low-level radwaste was compacted into barrels in this building for offsite disposal. A 1985 radiation survey documents fixed residual radioactivity on this structure. The Butler Building was subsequently moved into the Protected Area for use as a storage shed. It is presently located east of the QA/QC Warehouse. (Appendix 2-B, Radiological Event 33)

QA/QC Warehouse
The QA/QC Warehouse is located in the southwest corner of the Protected Area. This building was a locked and controlled storage location for contaminated equipment. A 1986 radiation survey of the building describes fixed residual radioactivity on areas of the concrete floor. Cleanup was completed and the building was released for general use in accordance with site procedures.
(Appendix 2-B, Radiological Event 35)

Gas Bottle Storage Shed
A decontamination area known as 'Room 121' is located on the southeast end of the Turbine Building. This room contains a floor sink that was used for cleaning highly contaminated objects. Records indicate that the sink overflowed on several occasions and that the radioactive effluent leaked through a common wall with the Gas Bottle Storage Shed located outside the Radiologically Controlled Area (RCA). On each of these occasions the area was cleaned up and released for general use in accordance with plant procedures. The foundation and soils in this area may contain localized areas of residual radioactivity.
(Appendix 2-B, Radiological Events 40,41,43)

c. Areas of Soil and Groundwater that have been Known to Contain Residual Radioactivity

1. *Storm Water Drains*
Drains in the Protected Area divert stormwater run-off from building areas toward Lake Michigan. The north-south line along the railroad bed and the connecting east-west line to the west drainage ditch are known to have contained residual radioactivity at one time. The radioactivity is believed to originate from drainage of a contamination area west of the Turbine Building. The east-west drain line terminates in a collection barrel that holds sediment and allows supernatant to be released. The collection barrel is routinely sampled prior to release. Residual radioactivity has not been found in the liquid effluent; however, trace amounts of radioactivity have been found in the barrel sediment and in nearby ditch sediment originating from particulates deposited there prior to barrel installation.

Residual radioactivity was also found in the sediment of the east storm drain piping during investigation of the 1998 Service Water System event. The service water supplied sealing water to the condenser vacuum pumps and seal leak-off from the pumps was connected to the storm drain system. This

event provided a flow pathway to the storm drain and radioactivity was found in the sediment of the east storm drain piping. Analyses of the storm drain liquid effluent did not identify residual radioactivity. The east storm drain line sediment was removed at the time of the event.
(Appendix 2-B, Radiological Events 52,53,57,58)

2. *Canal Dredgings*
Scoping surveys identified residual radioactivity at small fractions of IDCGLs in an area north of the Protected Area fence. This area extends from the Discharge Canal to the west drainage ditch and also includes the small section of beach near the tree line immediately east of the canal. The Discharge Canal has been dredged on several occasions prior to 1989 and it has been reported that dredge spoils were placed in this area. These spoils may have contained residual radioactivity from the Discharge Canal licensed release pathway.
(Appendix 2-B, Radiological Events 9,10,12,14,38)

3. *Roof Gravel Storage*
Trace amounts of residual radioactivity (less than 10% of the IDCGL) were identified in the gravel removed during renovation work on the Turbine Building roof. The gravel is stored beneath a tarpaulin in a location near the northeast corner of the Containment Building. This location encompasses an area of approximately 10x10 meters.
(Appendix 2-B, Radiological Events 51,55)

4. *Turbine Building Track Alley*
A significant event involving a subsurface leak in a piping connection from the Condensate Storage Tank was recorded in 1984. An evaluation of this event concluded that approximately 20,000 gallons of radioactive condensate had been released to area soils beneath the Turbine Building. Shallow groundwater drains through this area towards the lake. Following extensive cleanup efforts, the NRC provided approval to allow the remaining contaminated soil to be left in place. This is the only onsite disposal utilized by BRP. Residual radioactivity was initially above IDCGLs, but has now decayed to less than the final site-specific DCGLs.
(Appendix 2-B, Radiological Events 24,30,42,46,47,56,60,61)

5. *Shallow Groundwater Monitoring Wells*
During decommissioning planning, nine shallow groundwater-monitoring wells were installed in 1994. These wells have been monitored by routine sampling and independent analysis. The two northern most wells have identified low levels of tritium. Tritium concentrations in non-potable water were initially above EPA drinking water guidelines for potable water, but decreased to below the guideline values over time. No other radionuclides have been detected. The tritium is believed to be the tail of a groundwater plume resulting from a Condensate Storage Tank leak that occurred in 1984. Other events within the potentially elevated area west of the Turbine Building may

also be a contributing factor for the identified tritium. Additional monitoring wells were installed during the Hydrogeological Assessment conducted in 2002. This study is summarized in Section 2.4.3.
(Appendix 2-B, Radiological Event 30)

d. Areas of Potentially Elevated Residual Radioactivity

Areas that have the potential to contain residual radioactivity levels above the IDCGLs are identified in Figure 2-2.

1. *Radwaste Vault Area*
Soil surrounding the vault in the Radwaste Compound may contain residual radioactivity. The classification of this area is based on recorded events, process knowledge of the methods used for the movement of radwaste, and previously identified residual radioactivity in this area.
(Appendix 2-B, Radiological Events20,26,29,32)

2. *Soils Below The Pipe Tunnel Floor*
The Pipe Tunnel is the location of the steam turbine exhaust and the main condenser. This location has been a known area of residual radioactivity throughout the history of the plant. A spent resin spill was recorded in this room. Standing water in the Pipe Tunnel resulting from steam and condensate leaks was common during the life of the plant. The open top expansion ring surrounding the sphere is known to contain contaminated soil in this area and the expansion joints in the concrete flooring are suspected to present a contamination pathway to the soil below grade Core samples through the Pipe Tunnel floor show several areas of residual radioactivity greater than IDCGLs within the first 15 cm of soil below the floor. One local area (beneath a floor penetration) was above IDCGL for Co-60 in a sample extending from 30 to 60 cm depth.
(Appendix 2-B, Radiological Events 7,24,61)

3. *Area Immediately West of the Turbine Building*
Three large surface-mounted tanks and piping associated with the Liquid Radwaste Processing System are located in this area. The Liquid Radwaste Processing System is contained in a subsurface concrete structure adjacent to the Turbine Building foundation wall. Off-gas piping and the spent resin sluice line are also located below grade in this vicinity. Several events resulting from tank overflows and piping leaks have been documented in this area. This area was also a transfer point for the movement of highly contaminated filters and spent resin. Resin spills have occurred and the soil in this area has been remediated on several occasions.
(Appendix 2-B, Radiological Events ,8,13,22,27,30,36,37,45,46,49,61,62)

2.2.6 Impacted Area - Non-Radiological Contamination

The Non-Radiological HSA reviewed the historical impact of site activities, including decommissioning waste management, involving hazardous and regulated materials that have the potential to impact the environment. This study was developed following the DQO process. Applicable guidelines for scoping and site characterization from the Environment Protection Agency's (EPA) Preliminary Assessment and Remedial Investigation/Feasibility Study (RI/FS) Processes and guidelines found in NUREG-1575 were used as a resource in the development of this document [Reference 2-23].

The Non-Radiological HSA is an indepth review of historical plant documentation that identified non-radiological events that were known or had the potential to impact the environment. Environmental impact is defined as adverse effect to site soil, water, plants and animals. Further information was then used as the basis to evaluate the presence and extent of non-radiological contamination at BRP. This information includes the following:

- Interviews of present employees,
- Corrective action records,
- Shift Supervisor Logbooks,
- Radiological HSA,
- Physical walkdowns of site property,
- Waste characterizations,
- Environmental assessments,
- Laboratory analysis reports,
- Hazardous waste review reports,
- Hazardous/regulated waste generation reports,
- BRP Environmental Logs,
- BRP Asbestos Abatement Sampling and Daily Logs, and
- BRP Lead Shielding Accountability Logbook.

An evaluation was performed to determine if any events required further investigation or action to allow final unrestricted release of the site. It was determined that there is no environmental contamination at BRP due to non-radiological activities involving hazardous and regulated substances [Reference 2-8]. Response and cleanup to those events that did, or had the potential, to impact the site were completed per applicable regulatory requirements. Further investigation and additional remediation efforts regarding these past incidents are not needed. As the decommissioning process continues and buildings are dismantled, scoping samples in the gravel and

soil beneath structures that pose the highest non-radiological risk to the environment may be considered to confirm no impact has occurred. These locations include the Screenhouse, Containment Building, Turbine Building, I & C Lab, Track Alley, and underground storage tank areas.

2.3 ANALYTICAL METHODS

2.3.1 Site Characterization Quality Assurance/Quality Control (QA/QC)

The site characterization process followed the applicable portions of the Consumers Energy Quality Program Description for Nuclear Power Plants [Reference 2-14]. This is the controlling document outlining quality assurance requirements for the BRP site. Decommissioning administrative procedures are designed to ensure compliance with applicable quality assurance requirements. Specific QA/QC requirements for site characterization are documented in the BRP Site Characterization Survey Plan [Reference 2-12]. These requirements are summarized below.

2.3.1.1 Sample Collection and Measurement Quality Control

a. Sample collection, preparation, and analyses are performed by qualified technicians. The process for sample collection and analysis, as defined by the BRP Site Characterization Survey Plan, includes the following tasks:

- Verification of survey unit grid identification number, date, and time of the survey on the survey unit plan,
- Collection techniques for samples,
- Completion of a Chain of Custody form for each sample group,
- Performance of daily instrument functional checks,
- Verification of spectroscopy input parameters including sample mass, location designation, geometry, date, etc., and
- Evaluation of spectroscopy output for the identification of all energy peaks.

b. Measurement Instrumentation
The quality control requirements for all site measurement instrumentation are specified by BRP administrative procedures [Reference 2-10]. In addition, instruments are controlled by procedures specific to their operation. QA/QC information concerning site characterization radiological measurement instrumentation is provided in Section 2.3.4.

Big Rock Point participates in a vendor Hot Cross Check Program to validate the operation and efficiency calibrations of laboratory spectroscopy instrumentation. The acceptance criterion for this program is specified by NRC Inspection Manual, Procedure 84750 [Reference 2-25]. All technicians using gamma spectroscopy at BRP are required to participate in this program to validate continued proficiency in the use of these instruments.

2.3.1.2 Survey Unit Data Validation

The data quality of analytical measurements of defined survey units was verified by one of two established methods. The first method requires an independent laboratory analysis and measurement comparison with BRP results on splits of randomly selected samples. The alternate method allows the comparison of independent laboratory analyses with BRP measurements of the same randomly selected sample to verify data quality. The acceptance criteria for measurement comparisons are established by evaluations performed using the two-tailed paired t-test at the 95% confidence level or by NRC Inspection Manual, Procedure 84750.

All data validation results are documented and maintained in accordance with quality requirements established by the BRP Site Characterization Survey Plan. Samples collected in support of the site characterization effort are documented and stored onsite in the event they are required for future evaluation.

2.3.1.3 Staff Training and Qualification Requirements

The Site Characterization Supervisor and technician workforce have, as a minimum, completed the following training courses: Review of Radiation Safety, Radiation Dose Control, Radiation Detection Instruments, and Survey Techniques.

Site characterization-specific tasks are defined in the RP&ES (Radiation Protection and Environmental Services) OJT (on-the-job training) Manual and listed in the Practical Factor Task Lists (PSTL) [Reference 2-11]. The operation of instrumentation used in performing characterization surveys is also included on the PSTL. Training and evaluation of specific tasks are required prior to independent performance of the task. Related work experience or equivalent training may be substituted for the above requirements at the discretion of the Site Characterization Supervisor. Training records and certifications are maintained by the BRP Training Department. Optional training certifications and records may be maintained by site characterization supervisory personnel.

2.3.1.4 Data Reviews

Site characterization utilizes the DQO process to establish quality requirements for the design of characterization surveys, development of HSA, performance of background studies, and various engineering analyses supporting instrument usage and the measurement of radioactivity. Following the BRP Site Characterization Survey Plan, reviews of survey unit files and other applicable data are conducted to ensure that all required information has been obtained and that DQOs have been met. Survey design and evaluation in accordance with stated DQOs is addressed in Section 2.4.4.1. As formal characterization survey results are received and processed, an individual file is created for each survey unit containing the following documents:

- Index of surveys performed,
- Survey design,
- Survey unit description, history brief, and summary findings,

- Master activity data sheet,
- Annotated survey area maps indicating sample data point locations,
- Sampling and analysis reports of in-situ gamma and/or laboratory spectroscopy data for each individual survey,
- NaI scan survey data where applicable,
- Identification of individuals performing surveys and laboratory measurements,
- Dose contributions, limit calculations, and statistical evaluations where applicable, and
- Documentation and results of investigations and unusual findings or conditions.

Surveys other than formal characterization surveys (such as surveys in support of remediation activities, or various readiness and turnover surveys, as applicable), may be filed separately with documentation that differs from the above, as directed by plant procedures.

Each laboratory and in-situ spectroscopy analysis receives a review for accuracy by a qualified technician and the Site Characterization Supervisor or his designate. This review verifies the correct date, time, sample number, sample mass, location, and detector geometry/efficiency. The review also ensures that the MDA requirements for specified radionuclides are verified and that all unidentified or anomalous peaks are accounted for. The reviewers document this evaluation by initialing and dating each printout.

2.3.1.5 Document and Records Control

Site characterization records include survey analysis data/computer printouts, completed procedures, log books, HSA records, supporting engineering analyses, and other pertinent information relating to site areas. Documents associated with site characterization are maintained and controlled by site characterization personnel until finalized. Finalized characterization records are then sent to BRP Document Control for storage in accordance with site procedures.

2.3.1.6 Program Review and Self-Assessment

The radiological site characterization program is reviewed annually, as a minimum, by the Site Characterization Supervisor or designate and documented as an RP&ES Department self assessment. Additional periodic reviews by independent subject matter experts are also performed as deemed necessary.

2.3.2 Initial Derived Concentration Guideline Level Values for Site Characterization Survey

Initial area classification, survey design, and requirements for remediation efforts in early phases of the decommissioning process have required a working knowledge of allowable activity concentration limits. The IDCGL values were developed to benchmark estimated guideline limits for radioactivity in soil and provide the information necessary to support characterization planning and the evaluation of survey findings.

A site conceptual model was established using default input values to the RESRAD modeling code. The IDCGL values resulting from this evaluation were based on the resident farmer scenario with the drinking water pathway excluded, and a release criterion of 25mrem/year [Reference 2-20]. Finally, preliminary nuclide fractions were determined for the surrogate measurement of HTD isotopes, and IDCGLs for the surrogates were adjusted downward to account for the assumed presence of the HTD radionuclides.

The IDCGLs have since been replaced with final site-specific DCGLs. Site-specific measurements resulting from radiological survey and hydrogeological assessment have provided the information necessary for development of finalized DCGL values and radionuclide fractions. The methods and findings for development of final DCGL values are detailed in Chapter 6, *Compliance with the Radiological Criteria for License Termination*. Finalized radionuclide fractions are provided in Section 2.4.5.7.

2.3.3 Background Radioactivity in Soil and Water for Radionuclides of Potential Plant Origin

A regional study was conducted to determine the standard background radioactivity concentration of gamma emitting radionuclides in soil [Reference 2-3]. A survey was conducted in the BRP Non-Impacted Area and at Fisherman's Island State Park, a coastal region approximately ten kilometers (six miles) south of the plant site. Split samples were shared with the MDEQ. Fisherman's Island has been determined to contain soils of similar type and range as those present at BRP. The Non-Impacted and Fisherman's Island Area surveys were designed in accordance with DQOs and followed the guidance of NUREG-1575. An evaluation of regional scoping data determined that 37 sample points were more than sufficient to satisfy the DQOs for the surveys conducted in this study. Cs-137 was the only radionuclide other than naturally occurring radionuclides identified in soil analyses. Data are summarized in the table below. Michigan Department of Environmental Quality results support the BRP findings.

Table 2-1. Local Area Soil Cs-137 Background Radioactivity (pCi/g)

Radionuclide	Mean	Median	Sigma	Range
Cs-137	0.52	0.48	0.79*	0.0 – 1.9

*Log transform of Standard Deviation for Non-impacted site sample set (log-normal distribution)

Background concentrations of radioactive materials in water are below the minimum detection limits for environmental samples in the vicinity of BRP. Residual radioactivity in groundwater and surfacewater has not been identified above MDA levels, achievable by commercial laboratory analysis [Reference 2-9]. Table 2-10 identifies observed minimum detection levels (designated by < signs) for groundwater.

2.3.4 Measurement Instrumentation

2.3.4.1 a. Survey Location Instrumentation

The site grid plan has been referenced to longitude/latitude coordinate locations by licensed survey and confirmed by Global Positioning System (GPS) measurement [Reference 2-17]. GPS was also used in the field to define random sample point locations in large outlying areas where intensive licensed land survey identifications were impractical. This method of data point location has only been applied in areas that did not identify residual radioactivity. Any areas identifying residual radioactivity have been directly tied to the site grid plan by licensed land survey to facilitate exact survey data point replication. Use of the GPS system requires functional and operational checks to meet the following acceptance criteria:

- Functional check comparisons to the site grid plan control point must be performed before and after each workday use. Acceptance criteria are ± 10 meters.
- Operational checks to determine triangulation accuracy are required prior to each field measurement. Acceptance criteria are ± 10 meters.

b. Gamma Spectroscopy

Gamma spectroscopy is the primary method of radionuclide identification for the characterization of soil and groundwater at the BRP site. Gamma spectroscopy is routinely performed in the field and in the laboratory for qualitative and quantitative radionuclide measurement.

1. Laboratory Spectroscopy

The BRP laboratory maintains two gamma spectrometers. Each counting system utilizes a one-liter Marinelli beaker geometry for soil analyses. Groundwater measurements are conducted using a volume of three liters in a four-liter Marinelli beaker geometry. Detector systems were calibrated for each measurement geometry using National Institute of Standards and Technology (NIST) mixed gamma sources. Both detectors are manufactured by Princeton Gamma-Tech Inc., and operate on the VMS Genie platform manufactured by Canberra Industries. Table 2-2 summarizes BRP laboratory instrument specifications.

2. In-Situ Spectroscopy

In-situ gamma spectroscopy is conducted using a p-type coaxial germanium detector manufactured by Canberra Industries. The unit is controlled by a separate electronics module and laptop computer interface. The system is calibrated by In-Situ Object Counting System (ISOCS) software. ISOCS uses a combination of Monte Carlo N-particle modeling calculations and discrete ordinate attenuation computations to derive a set of polynomial coefficients that describe the detector/source efficiency data. The user interfaces these coefficients through ISOCS to develop measurement efficiencies for the geometry selected.

The standard source geometry for open land survey is a truncated cone 15 cm in depth with a surface diameter of 14.14 meters. Other cone thicknesses (depth of activity) may be utilized if laboratory or down-hole analysis of soil corings indicate different thickness. The detector is collimated to 90° and secured in a fixed jig arrangement with 5 cm of lead shielding. Source to detector distance is 7.07 meters. Alternate geometry calibrations may be performed as required to provide radionuclide measurements of smaller survey areas. Accuracy of this counting system has been verified by empirical measurement [Reference 2-2].

Table 2-2. BRP Detector Performance and Specification Data

	Relative Efficiency *	Diameter	Length	End Window
Detector #1	9.7%	47mm	27mm	5mm
Detector #6	44.1%	67mm	60mm	5mm
In-Situ	40%	62mm	57.5mm	5mm

*Efficiency relative to the 1.33 MeV photopeak of Co-60 for a cylindrical NaI(Tl) detector 7.65 cm diameter by 7.65 cm in length, with a source-detector distance of 25 cm.

MDA determinations for both laboratory and portable counting systems have software controlled count times that maintain maximum environmental MDA values for all radionuclides of interest at fractional levels of the IDCGL release criteria. Algorithms used in MDA calculations for these two systems vary slightly in approach; however, both result in values equivalent to Currie MDA calculations at the 95% confidence level [Reference 2-15]:

$$MDA = Ld / KVT$$

where: Ld (limit of detection) = (3) + (4.65)$\sqrt{background}$

K = proportionality constant relating detector response to activity level

V = mass (or volume) of the sample

T = counting time

c. Surface Scanning

The evaluation of open land areas requires a detection methodology of sufficient sensitivity for the identification of small areas of potentially elevated activity. Big Rock Point scanning measurements are performed by passing a 2" x 2" NaI(Tl) (Sodium Iodide) gamma scintillation detector in gross count rate mode across the land surface under investigation [Reference 2-5]. The centerline of the detector is maintained at a source to detector distance of less than 10 cm above the surface and moved from side to side in a 1-meter wide pattern at a rate of 0.5 m/sec, while advancing forward approximately 0.125 m/sec. This serpentine scan pattern is designed to cross each survey cell (one square meter) four times in eight seconds with a maximum separation of less than 50 cm between any path. The audible signal is monitored for detectable increases in count rate. An observed count rate increase results in further investigation to verify findings and define the level and extent of residual radioactivity.

This method represents the Stage 1 and Stage 2 surface scanning process for land areas defined in NUREG-1507 and is the basis for calculation of the scanning detection sensitivity (scan MDC). The sensitivity of this counting system has been verified by empirical measurements. Alternate methods of sufficient sensitivity for the identification of small areas of elevated radioactivity may be used where appropriate. Survey methodology, counting geometry and Scan MDC calculations are detailed in Appendix 2-D.

2.4 ENVIRONMENTAL STATUS INVESTIGATION

2.4.1 Overview

The ESI builds on the foundational information developed in the HSA by physical inspection, measurement, and data analysis to further define the status of contaminants in the BRP Impacted Area. The result of this effort provides the information required for development of the site conceptual model, initial classification of Impacted Areas as Class 1, 2, or 3, and support of the decision-making process necessary for remediation and FSS planning. This task was accomplished through survey and investigation of soil and groundwater utilizing the following methods:

1. Legacy Materials Evaluation - to identify and define locations of abandoned or poorly documented underground piping and evaluate areas for the presence of subsurface legacy material,
2. Hydrogeological Study – to define the movement of water and migration of mobile contaminants through subsurface geology and provide the information necessary for development of the dose model, and
3. Radiological Survey and Spectroscopy Analysis - to characterize the location, concentration, and distribution of radionuclide contaminants in soil and groundwater.

To facilitate the ESI, licensed land surveyors have prepared the site plan by establishing a reference grid system. Based on HSA information and process knowledge, the site Impacted Area has been sectioned into preliminary survey units of similar residual radioactivity levels. These initial survey units are comprised of one or more 10 x 10 meter areas known as survey grids. Each survey grid is identified by a unique location code. Using a rectangular coordinate system with the southwest corner as origin, survey grids can be further defined in 1 x 1 meter areas known as survey cells. Permanent control points in the environment allow replication of the site grid system and verification of field locations during ESI surveys. Identification markers have been placed around the site at pre-determined intervals. These markers bear a numerical reference to provide survey point correlation with site map designations, United States Geological Survey (USGS) monuments, and latitude/longitude coordinates.

Survey units are identified by reference to the site grid plan. The southwest corner of each area represents the identifying origin of each survey unit. The nomenclature for identification of radiological surveys is described by the following:

NNT_iC (Example: $15A_i1$)

Where:
NN – Survey unit number (e.g., 15)
T– Survey type
(A-Characterization, B-Post Remediation, C-Final Status Survey)
i – Survey iteration (1,2,3 ...) or alternate identification as defined by survey package
C –Survey unit initial classification (1,2,3 ...)

The site grid plan coordinated with reproducible field locations facilitates survey management and design, ensures accurate location of survey measurements, and permits the replication of survey areas for remediation and measurement verification as necessary.

2.4.2 Legacy Materials Evaluation

Achieving a Greenfield condition at the time of the FSS requires the removal of all sub-surface structures and relevant materials of plant origin. Ground Penetrating Radar (GPR) was used to evaluate the presence of buried non-native objects around the site Industrial Area. The purpose of the GPR survey was to define abandoned or poorly documented subsurface piping and to locate underground legacy materials of plant origin. Areas of the Owner-Controlled property were selected for GPR investigation based on the information provided by HSA findings, plant process knowledge, and physical walkdowns of the site. All valid, positive indications of subsurface materials were evaluated by excavation, inspection, and radiological measurement during the performance of this survey [Reference 2-13].

2.4.2.1 Survey Instrumentation

A Geophysical Survey Systems, Sir System 2 test instrument was used to perform the GPR study. Instrument sensitivity under site-specific soil conditions was sufficient to define anomalies to depths up to 3 meters (10 feet). Items were detected on site at the following depths:

- Ceramic Tile – 1.63 meters.
- Concrete – 2.0 meters.
- Corrugated metal drain piping - > 5 meters.

2.4.2.2 Survey Methodology

Potential locations of subsurface legacy material were considered to be regions of poorly documented or abandoned piping systems and fringe areas that may have been used for material storage. Grid track lines were marked out with 1.5 meter (5-foot) spacings in the areas to be surveyed. Position markers were placed on the GPR data profiles at each grid crossing for location reference. The survey was

performed by passing the GPR antenna along the track lines at a slow walking speed. The GPR computer identified and recorded all subsurface anomalies and provided this information on a scale drawing of the survey area. Anomaly indications identified by the system were referenced to the site grid plan.

2.4.2.3 Survey Results

Construction debris consisting of concrete, asphalt, and miscellaneous scrap materials were identified and removed from survey areas along the shoreline and the former 138kV power line easement. In addition, two sections of drainage piping were recorded in Survey Unit 12, north of the Protected Area (see Figure 2-3). The piping locations have been documented and these systems are scheduled for excavation and removal prior to the FSS. Residual radioactivity was not identified in excavated materials or contact soils in any survey performed in this study.

The investigation of legacy materials around the BRP site is an ongoing process that will continue during the dismantlement and subsurface equipment removal activities. Detailed results of the GPR survey investigation are provided in Appendix 2-C.

2.4.3 Hydrogeological Study

A Hydrogeological Assessment of the BRP Industrial Area was completed in the spring of 2002. The project was conducted to evaluate existing documentation regarding the movement of groundwater in the Owner-Controlled Area and provide additional field investigations for detailed identification of the hydrogeological conditions within the Industrial Area. This study also resulted in the identification of soil and groundwater engineering properties required for input to the dose model (see Chapter 6) and provides the information necessary to define the movement of contaminants though the subsurface geology. Chapter 8, *Supplement to the Environmental Report,* contains additional information regarding BRP site hydrology.

2.4.3.1 Methods

The Hydrogeological Assessment was based on a review of existing site data, including the results of several previous site investigations, as well as a series of recent test borings and piezometer wells completed in the Industrial Area. The historical investigations utilized include those conducted by Zumberge (1959), The Traverse Group (1994) and Radian, Inc. (1999) [References 2-26, 2-22, and 2-19]. Additional test borings and piezometer well installations in the Industrial Area were conducted by Otwell Mawby, P.C. (2002) [Reference 2-18]. Individual geologic and groundwater bearing units were identified based primarily on visual examination of samples obtained during the drilling, while the engineering properties of several of the units were determined from laboratory testing of representative samples collected during field investigations. An analysis of the hydraulic heads in piezometer wells completed in different groundwater bearing units identified at the site was performed to assess the groundwater flow conditions at the site. A site plan drawing denoting the locations of the piezometer wells and soil borings is provided in Figure 2-4.

The physical (engineering) properties of the unsaturated and saturated soil materials were determined through laboratory testing of representative samples obtained from the individual layers. The laboratory methods used for the evaluation of physical properties were conducted following established ASTM procedures.

The horizontal groundwater flow directions in the groundwater bearing zones identified at the site were determined from the observed hydraulic heads measured in a minimum of three piezometer wells installed in each respective zone. Similarly, vertical groundwater flow direction(s) between the different groundwater bearing units (i.e., within the intervening aquitards) was determined from the observed hydraulic head differences measured in nested groups of piezometers installed at three locations. The horizontal groundwater flow velocity (v_H) for any given groundwater bearing zone and vertical groundwater flow velocity (V_v) within any given aquitard were determined from the following relationships:

$v_H = k^* i_H / n_E$,
where k = layer specific average hydraulic conductivity (cm/sec),
i_H = layer specific horizontal hydraulic gradient (dimensionless), and
n_E = layer specific effective porosity (dimensionless).

$v_V = k^* i_V / n_E$,
where k = layer specific average hydraulic conductivity (cm/sec),
i_V = layer specific vertical hydraulic gradient (dimensionless), and
n_E = layer specific effective porosity (dimensionless).

2.4.3.2 Site Geology and Hydrology

The results of the drilling and well installation work confirm that this portion of the site is underlain by recent unconsolidated deposits having a total thickness ranging from 12 to 24 meters (40 to 80 feet). This cover material is underlain by fractured limestone bedrock. While the surface elevation in the Industrial Area remains relatively constant at 130 to 131 meters (590 to 593 feet) msl, the variation in cover thickness results from a pronounced north to south decrease in the bedrock elevations at the site. A cross-section of the Industrial Area subsurface geology is provided in Figure 2-5.

The unconsolidated cover material consists of several units that are laterally continuous across the site. These units comprise a thin upper zone composed chiefly of granular sand and gravel (Units 6a, 6b; 2.4 to 3.7 meters [8-12 feet] thick), and a much thicker lower zone composed of a series of units containing a higher proportion of clay and silt (Units 2, 3, and 5; 10 to 25 meters [32-76 feet] thick). In addition, a thin sand layer (Unit 4; 2-5 feet thick) is also present in this lower zone at depths of 6 to 7.5 meters (20 to 25 feet). A similar sequence of units, including the intermediate depth sand layer, was reported in an earlier study conducted approximately 305 meters (1000 feet) west of the main power station area, indicating that the unconsolidated deposits found in the main power station area are continuous over a wide area.

The bedrock materials obtained from the north and south sides of the site reveal similar lithologies consisting of gray brown limestone with abundant natural fractures. Because the pronounced decrease in bedrock elevations from north to south across the site is greater than the regional bedrock tile (i.e., 40 feet per mile), the bedrock strata encountered on the south side of the site are inferred to be from a slightly lower stratigraphic zone than those encountered on the north side of the site.

2.4.3.3 Groundwater

A total of three groundwater bearing zones have been identified at the site. These include the lower portion of the near-surface sand and gravel layer (Unit 6a, 6b; e.g., bottom 1 to 1.5 meters [3-5 feet]), the intermediate depth sand layer (Unit 4) and the underlying fractured limestone bedrock (Unit 1). The uppermost groundwater bearing zone is unconfined, while the other two zones are confined. The inferred entry point for groundwater found in the uppermost zone is located south of the main power station area in the undeveloped portion of the BRP site. Much of this area is low, wetland type terrain and a significant portion of the precipitation falling in this area likely infiltrates into the soil and enters the shallow groundwater zone. The groundwater entry points for the other two units are also located to the south, at varying distances from the main power station area. The groundwater flow in all three of these units is northerly into Lake Michigan.

The lowermost bedrock aquifer (Unit 1) consists of separate upper and lower bedrock zones. The lower bedrock zone encountered on the south side of the site (piezometer well 1D) is characterized by primarily horizontal groundwater flow from the source area northward toward Lake Michigan. Due to the irregular bedrock topography, the upper bedrock zone encountered on the north side of the site (piezometer wells 2D and 3D) is apparently isolated from the groundwater source area, located to the south, by low permeability unconsolidated sediments and is assumed to receive groundwater vertically from the lower bedrock zone.

The near-surface location of the two upper groundwater bearing units would prevent their use as sources of drinking water. The limited thickness of these same two units would also prevent their use as sources of non-potable water for irrigation or other purposes. The fractured bedrock zone is considered to be the main drinking water aquifer at the site, as well as a potential source of non-potable water.

2.4.3.4 Groundwater Movement

Horizontal groundwater movement in all three water bearing zones moves northward though the main power station area and into Lake Michigan. Analysis of hydraulic head contour maps provides additional quantitative information regarding horizontal groundwater flow. The shallow aquifer yields a horizontal flow direction of N0°E to N9°E with a horizontal hydraulic gradient of 0.015. The intermediate aquifer flow direction is N20W with a horizontal gradient value of 0.028. It was not possible to construct a contour map for the lower bedrock aquifer due to the different completion

depths of the bedrock peizometers; however, horizontal hydraulic gradients for the upper and lower bedrock aquifer zones were estimated from the bedrock piezometer well data. Data indicates that the bedrock aquifer flows north into Lake Michigan with an estimated horizontal gradient value of 0.019.

Vertical groundwater movement was evaluated by investigation of hydraulic head differences using nested piezometer well pairs installed at three locations across the site (PZ-1, PZ-2, and PZ-3). Comparison of the hydraulic heads in the nested piezometer wells indicates that vertical head differences occur at all three locations. At the locations south of the Containment Building (PZ-1 and PZ-2), the head differences from nested wells indicate upward directed vertical components of flow above the intermediate sand unit and downward vertical flow components below the intermediate sand unit. At the location north of the Containment Building (PZ-3 location), the head differences from nested wells indicate downward vertical flow components both above and below the intermediate sand unit. Vertical hydraulic gradient data vary in magnitude both above and below the intermediate sand layer. The overall downward vertical gradient in the area north of the containment sphere indicates the potential for downward migration of mobile constituents from the surface or shallow aquifer zones to the bedrock groundwater bearing zone.

2.4.3.5 Effect of Building Foundations on Groundwater Flow

According to plant construction drawings, the foundations of several of the on-site buildings extend far enough below grade to intersect one or more of the aquifer units. Likely penetrations of the aquifer units occur at the Containment Building, Screenhouse Building, Liquid Radwaste Processing Vault, and Turbine Building. The concrete foundations of these buildings represent impermeable barriers that impede the normal (i.e., south to north) groundwater flow within the respective aquifer units. The presence of such barriers is expected to result in localized changes in the horizontal flow directions within the individual layers and in addition may provide opportunities for vertical movement between the different layers. The preferential migration of groundwater vertically or horizontally is also increased due to probable construction disturbance of the soils surrounding the building foundations.

Because of the large size of the containment structure, this building would likely have the greatest effect of the horizontal groundwater flow particularly within the shallow groundwater unit. The presence of additional foundation structures at upgradient locations of the Turbine Building and the Liquid Radwaste Vault structure present a complicated flow regime, which could result in groundwater flow stagnation zones in the area south of the Containment Building.

The Containment and Screenhouse Buildings intersect the upper shallow groundwater bearing zones. These penetrations, combined with the downward vertical gradients existing on the north side of the main power station, provide the potential for a vertical mixing of groundwater and a downward migration of mobile contaminants in this area.

Dewatering activities may require temporary barriers to groundwater flow prior to and during building demolition. Groundwater flow is not expected to be adversely influenced beyond the demolition interval.

2.4.4 Characterization Survey

Characterization surveys are the measurement process that identify, quantify, and document residual radioactivity in impacted areas of the BRP site. Over 1100 representative samples of soil and groundwater have been collected and analyzed from the 27 survey locations that form the Impacted Area. These surveys include:

- Primary survey – sample point locations selected by statistically based survey design,
- Supporting survey – knowledge-based judgmental data point locations to further investigate the radiological status of suspect areas,
- Deep core profiles – judgmental or systematic data point locations to define the vertical and lateral extent of subsurface residual radioactivity, and
- Groundwater survey – locations determined by hydrogeological study and the evaluation of subsurface contaminant migration.

2.4.4.1 Survey Design And Radiological Measurement

Initial survey units were developed for areas of analogous residual radioactivity through information established by HSA, process knowledge, and scoping survey data. Survey units follow the site grid plan and provide reproducible field point locations by reference correlation to local control points, USGS monuments, and latitude/longitude coordinates. Survey designs were performed in accordance with NUREG-1575 guidance; detailed survey design information is provided in Appendix 2-E for each survey unit. The DQO process was utilized to satisfy the following characterization survey design objectives:

1. Identify, quantify, and document residual radioactivity in soil, surface water, and groundwater at the BRP site,
2. Determine the extent of residual radioactivity within the survey unit; locate and define any areas of elevated activity,
3. Establish initial classification of site areas as Class 1, Class 2, or Class 3 in accordance NUREG-1575 guidance,
4. Provide the information necessary to define the nuclides of interest for evaluation and identify distribution fractions for surrogate measurement of HTD radionuclides, and
5. Provide the information required to support the decision-making process necessary for structural dismantlement, remediation, and planning of the FSS.

The primary method of survey unit evaluation utilizes laboratory gamma spectroscopy performed on soil samples collected at locations determined by survey design. The evaluation of HTD nuclides was performed by surrogate measurement, as defined in Section 2.3.2. All characterization surveys were conducted to include radionuclide-specific measurements without background reference area consideration. Although not excluded from gross count rate and dose rate measurements, naturally occurring radionuclides are excluded from nuclide-specific dose and DCGL analyses when identified on a nuclide-specific basis by gamma spectroscopy. The fallout radioisotope Cs-137 is not considered to be a naturally occurring radionuclide, and therefore was not excluded from dose or DCGL considerations.

In applicable locations of low background activity where soil sampling capabilities were limited by the presence of subsurface piping or electrical power hazards, in-situ gamma spectroscopy was used in combination with laboratory soil analyses to evaluate portions of the survey unit. In these cases, laboratory sample point locations follow the guidance of NUREG/CR-5849 and laboratory soil analyses were performed to support in-situ gamma evaluations [Reference 2-27]. Where personnel safety hazards exist and in-situ measurements are not feasible, survey designs were modified to permit sample collection at available locations. Survey unit sampling and measurements were conducted in the following method:

a. Primary Survey
   Primary surveys were performed to develop a comprehensive evaluation of the survey unit and provide input for follow-up survey investigations as required by survey design. Wherever practical, primary survey designs were based on the measurement requirements of the Sign Test with sample size defined by calculation of the relative shift. The relative shift was developed using IDCGL values (see Section 2.3.2) with Type I and Type II decision error limits of 0.05. The location and spacing of sample points for primary surveys were based on the following area designations identified by HSA.

   - Areas of 'Potential', 'Known', or 'Potentially Elevated' Radioactivity
     Random start systematic sample point locations - sample point spacing defined by square grid pattern requirements.
   - Areas Designated 'Unlikely' to Contain Residual Radioactivity
     Random number generated sample point locations - no spacing requirements.

b. Supporting Survey
Supporting surveys were conducted to further investigate suspect areas, identify trends, and define the concentration and boundary of existing area residual radioactivity. Sample point locations were judgmentally selected through information developed in the primary survey, HSA findings, process knowledge, and evaluation of contaminant migration pathways. Supporting investigations include surveys of increased intensity for the evaluation of surface and subsurface soils. Deep core profile sampling was performed in areas with the potential to contain residual radioactivity below grade. Deep core surveys were conducted to identify and quantify the vertical and lateral extent of subsurface residual radioactivity in the survey unit.

c. Post Remediation Survey
Post remediation surveys were conducted for specific survey units where radiological cleanup efforts have been performed. These surveys were radionuclide-specific evaluations designed and conducted in accordance with NUREG-1575 methodology. Post remediation surveys were performed with sufficient intensity to define the current radiological status of the remediated area and evaluate the effectiveness of the cleanup effort. These surveys excluded real-time measurements associated with remediation control efforts that were performed during the cleanup process.

d. Scan Survey
Scanning for the identification of areas of elevated activity was generally not performed during the characterization survey process. Scanning opportunities in and around the Industrial Area are greatly limited by accessibility, and elevated background activity originating from the Containment Building, Radwaste Processing Area, and the storage of radioactive materials around the site.

e. Surface and Groundwater Survey
Surface and subsurface waters are routinely monitored in accordance with the BRP Radiological Environmental Monitoring Program (REMP) (see Chapter 8). In addition, the Hydrogeological Assessment, conducted in 2002, provided an evaluation of groundwater movement through the site subsurface geology. This evaluation identified migration pathways of potential contaminants in groundwater within the Industrial Area. The Hydrogeological Assessment and associated radiological measurements performed in this study provide sufficient information to define the range, concentration, and migration of contaminants in subsurface hydrology. This evaluation is detailed in Sections 2.4.3, and 2.4.5.3.

2.4.5 Characterization Survey Findings

2.4.5.1 Radiological Status of Impacted Land Areas

A characterization of the BRP Impacted Area has been conducted. Survey findings are summarized by initial area classification. Additional information detailing the description, history, survey design, and sample point analyses of individual survey units is provided in Appendix 2-E.

For purposes of characterization, Cs-137 levels within the range identified in the background study discussed in Section 2.3.3 were not considered to indicate residual radioactivity. Any other radionuclide of potential plant origin, detected at any level, was considered indicative of residual radioactivity from plant sources.

a. Class 3 Areas
Class 3 areas considered unlikely to contain residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the IDCGL value. Survey Units 13, 14, 15(3), 15(4), 17, 18, and 59 are Class 3 areas. Table 2-3 summarizes survey data for Class 3 areas. Figure 2-6 identifies locations of Class 3 areas.

The Class 3 survey units are outlying areas that were remote from normal plant operational activities. Survey Units 13 and 14 are pristine sections of Lake Michigan shoreline that encompass the open area from the upland vegetation line (ordinary high water mark) to the waters edge. The remaining Class 3 survey units are generally heavily forested with occasional wetland areas. Exceptions to this are the open field areas of the power-line easement in Survey Unit 17 and the former rail supply connection in Survey Unit 59.

Survey Unit 13
Survey Unit 13 is a lakefront area approximately 100 meters east of the plant discharge release pathway. Due to recent near record lows in Lake Michigan water level, additional shoreline is exposed for surveys conducted in this area. Three samples taken in this area identified trace levels of Co-60 at concentrations of ≤0.1pCi/g. The location of this survey unit is near the plant Discharge Canal where licensed radioactive liquid releases occurred; the levels of radionuclides identified in these surveys are consistent with contaminant migration that would result from wind, current and wave action in this area.

Survey Unit 14
Survey Unit 14 is a narrow expanse of shoreline in the northwest section of the Owner-Controlled property. Radiological surveys conducted in Survey Unit 19 did not identify soil radioactivity above environmental background levels.

Survey Units 15(3), and 15(4)
These survey units are located along the Woods Road west of the Protected Area. A small location of construction debris identified by the HSA in both Survey Units 15(3) and 15(4) was investigated. Residual radioactivity was not identified in this material or in surrounding area soils. All waste material has been cleaned up and removed from the area.

Survey Unit 17
The power-line easement along the southern boundary of Survey Unit 17 was known to contain debris consisting of concrete, asphalt, and other miscellaneous construction materials. This area was investigated and all debris has been removed for offsite disposal. Radiological surveys conducted in Survey Unit 17 did not identify soil or construction material radioactivity above environmental background levels.

Survey Unit 18
Survey Unit 18 is a large wooded area in the southwest quadrant of the Impacted Area. Radiological surveys conducted in Survey Unit 18 did not identify soil radioactivity above environmental background levels.

Survey Unit 59
Survey Unit 59 is west of the former railroad spur in an extension of the Owner-Controlled property separated from the main site by US Route 31. Radiologically clean soil was stored on this survey unit. However, a small amount of construction debris from other areas also was moved inadvertently to this area. Upon investigation, all construction material was found to be radiologically clean with the exception of a single olivine firebrick containing a fixed concentration of 0.06 pCi/g of Co-60. All construction debris has been removed from the area. The primary survey and extensive follow-up investigations in Survey Unit 59 have not identified radioactivity in soil above environmental background levels.

Table 2-3. Summary of Class 3 Survey Unit Findings

Survey	Data Points	Radionuclides	Mean (pCi/g)	Max. (pCi/g)
$13A_1$	20	Cs-137	0.36	0.97
		Co-60	0.07	0.10
$14A_1$	20	Cs-137	0.16	0.40
$15(3)A_1$	2	Cs-137	0.12	0.12
$15(3)A_2$	25	Cs-137	0.38	1.05
$15(4)A_1$	9	Cs-137	0.16	0.64
$15(4)A_2$	25	Cs-137	0.23	0.43
$17A_1$	20	Cs-137	0.57	1.59
$17A_2$	5	Cs-137	0.38	0.48
$17A_3$	3	Cs-137	0.06	0.06
$17A_{pl}$	7	Cs-137	0.53	1.43
$18A_1$	20	Cs-137	0.60	1.00
$59A_1$	36	Cs-137	0.31	0.72
$59A_2$	6	Cs-137	0.37	0.49
$59A_3$	10	Cs-137	0.26	0.47
$59A_{sd}$	67	Cs-137	0.26	0.62

pl – power line
sd – supplemental data

b. Class 2 Areas

Class 2 areas have, or had prior to remediation, a potentially known residual radioactivity, but are not expected to exceed the IDCGL value. Survey Units 12, 15(1), 15(2), 16, and 19 are considered Class 2 areas. Table 2-4 summarizes survey data for the Class 2 areas. Figure 2-7 depicts the locations of Class 2 Survey Units.

Class 2 survey units at BRP are generally located within the plant Industrial Area. These locations serve as buffer regions to Class 1 areas and generally were used for the staging, transport, and storage of radioactive materials prior to final packaging for offsite shipment.

Survey Units 12 and 16

Survey Units 12 and 16 are located north and east of the Protected Area along the Lake Michigan shoreline. Residual radioactivity may be present in subsurface storm drain piping located in this area. Soils in contact with drain piping will obtain evaluation during drain pipe removal.

The Legacy Materials Evaluation identified subsurface construction debris and abandoned stormwater piping in Survey Unit 12. Construction debris was also identified in Survey Unit 16. All waste materials have been removed from the area and locations of abandoned piping are scheduled for excavation and removal. No residual radioactivity was detected in materials removed; however, radiological surveys have identified trace concentrations of residual radioactivity in the soils of both survey units (see Table 2-4). Residual radioactivity present above the high water line may be from the Discharge Canal dredging projects performed to maintain the lake water discharge release pathway. Residual radioactivity below the high water line is consistent with expectations for migration of permitted discharge radioactivity that would result from wind, current and wave action along the shoreline.

Survey Unit 15(1)

The plant septic drainfield is contained in Survey Unit 15(1). The drainfield is a mound-type pump back system that receives effluent from holding tanks located in the Protected Area. Radiological surveys conducted in Survey Unit 15(1) did not identify soil radioactivity above environmental background levels. Although the potential exists that residual radioactivity may be present in subsurface areas of the drainfield, radioactivity concentrations requiring remediation are considered very unlikely based on HSA findings. An evaluation for subsurface residual radioactivity will be performed when this system is removed from service.

Survey Unit 15(2)

Survey Unit 15(2) is a long, narrow region of property that parallels the shoreline south of Survey Unit 14. A small area of construction debris was identified along the Woods Road in this area. The material was cleaned up and removed from this area. Radiological surveys conducted in Survey Unit 15(2) did not identify soil radioactivity above environmental background levels.

Survey Unit 19

This area was used as a transport and staging location for the movement of radioactive materials to the Radwaste Building. A road improvement project was conducted in portions of this survey unit following final plant shutdown to pave areas north of the Radwaste Building and surface the roadway to the ISFSI. Primary surveys conducted in this area were performed in phases to investigate areas scheduled for construction (trenching, digging, road surfacing) prior to soil disturbance and road surfacing. Radiological surveys conducted in Survey Unit 19 did not identify soil radioactivity above environmental background levels.

Table 2-4. Summary of Class 2 Survey Unit Findings

Survey	Data Points	Radionuclide	Mean (pCi/g)	Max. (pCi/g)
$12A_1$	18	Cs-137	0.61	1.83
$12A_2$	25	Cs-137	0.26	1.48
		Co-60	0.16	0.18
$12A_{deepcore1}$	4	Cs-137	0.08	0.08
$12A_{deepcore2}$	4	Cs-137	0.52	1.56
$12A_{deepcore3}$	15	Cs-137	0.12	0.20
$12A_{gpr}$	4	Cs-137	0.25	0.29
$15(1)A_1$	25	Cs-137	0.22	1.20
$15(2)A_1$	44	Cs-137	0.18	1.06
$15(2)A_2$	25	Cs-137	0.22	0.53
$16A_1$	22	Cs-137	0.41	1.38
		Co-60	0.10	0.13
$19A_1$	79	Cs-137	0.18	0.45
$19A_2$	26	Cs-137	0.15	0.31
$19A_3$	25	Cs-137	0.61	1.10
		Co-60	0.12	0.12
$19A_{deepcore}$	4	Cs-137	0.22	0.35
$19A_{deepcore}$	2	nd	-	-
$19A_{td}$	15	nd	-	-

td - trenching & digging
nd - non-detect

c. Class 1 Areas

Class 1 areas are defined as locations that have, or had prior to remediation, a potential or known residual radioactivity above the IDCGL value. Big Rock Point Class 1 survey units have been assembled into subcategories of corresponding historical status and radioactivity concentration as discussed below. Table 2-5 summarizes survey data for the Class 1 areas. Figure 2-8 depicts the locations of Class 1 Survey Units.

1. Class 1, Group A

This group includes material transport and waste storage areas with radioactivity concentration levels less than 50% of IDCGL values. Survey Units 1, 2, 3, 4, 6, 7, 9, 10, 11, and 15(2R) are Class 1, Group A areas. These survey units meet one or more of the following criteria:

- Scan surveys precluded due to elevated background activity resulting from operational systems or material storage,
- Proximity to areas scheduled for soil remediation,
- Proximity to areas scheduled for excavation and removal of contaminated subsurface systems (including storm drain system), or
- Areas previously requiring soil remediation

Table 2-5 summarizes survey data for Class 1, Group A areas. Figure 2-8 indicates locations of Class 1, Group A Survey Units.

Survey Unit 15(2R)
Survey Unit 15(2R) is an area of 18 m^2 along the south edge of the Woods Road within the boundaries of Survey Unit 15(2). This location was a storage area for small quantities of miscellaneous refuse and construction debris. Surveys conducted during removal of this material identified residual radioactivity in approximately two crumbling red bricks. All refuse and construction debris have been removed from the area. A post-remediation survey was conducted and confirmatory measurements were performed by representatives of the MDEQ and the NRC.

Survey Units 1 and 2
These survey units are located near the southwest boundary of the protected area adjacent to the transport route used to move spent resin and filter material from the Protected Area to the Radwaste Building. Structures in this area include the QA/QC Warehouse and Butler Building located in Survey Unit 1, and the Maintenance Complex located in Survey Unit 2. Subsurface structures and equipment include building foundations, plumbing connections, storm drain and fire protection piping, fiber optics, and electrical conduit.

Remediation efforts have been conducted in the Butler Building and the QA/QC Warehouse to remove fixed residual radioactivity resulting from radioactive material storage. Subsurface residual radioactivity is not indicated by the HSA and was not identified by characterization surveys in these areas. Soils in contact with building foundations will receive further evaluation during structure removal.

Survey Units 3 and 4
Survey Units 3 and 4 are located along the northwest boundary of the Protected Area adjacent to the transport route used to move spent resin and filter material from the Protected Area to the Radwaste Building. Survey Unit 4 borders the Containment Building access at the Equipment Lock. No permanent buildings exist in these locations. Subsurface structures and equipment include storm drain piping, electrical conduit, Service Water and Fire Protection System piping. Survey Unit 4 borders the footing and foundations of the Containment Building and Equipment Lock. Subsurface soil residual radioactivity is not indicated by HSA and was not identified by characterization surveys conducted in this area.

Survey Unit 9
Survey Unit 9 is located in the northeast corner of the Protected Area and contains the Screenhouse. This area encompasses the water intake location for circulating water, service water, and fire water supply. Subsurface structures and equipment include the following:

- Intake structure and Screenhouse foundation,
- Diesel storage tanks (2) southeast of the Screenhouse (emergency generator and fire pump fuel supply),
- Diesel storage tank north of the Turbine Building (plant heating boiler fuel supply),
- Batch release pipe for radioactive liquid discharge,
- Transformer station and associated underground conduit, and
- Electrical power supply, instrumentation conduit, and condenser cooling water, service water, well water, fire protection, storm drain, and compressed air system piping.

The liquid batch release pipe used to release liquid radioactive waste effluent to the Discharge Canal passes through this survey unit. Soils in contact with the subsurface piping of this system will receive further evaluation during piping excavation and removal. Limited amounts of residual radioactivity have been identified in Survey Unit 9. Table 2-3 provides results of soil analyses from this area.

Survey Units 6, 7, and 10
Survey Units 6, 7, and 10 primarily consist of open paved areas that provide a transport pathway to the main gate at the east boundary of the Protected Area. The New Access Control Building is a temporary structure located in Survey Units 6 and 7 that is the access point for entry into the Turbine and Containment Buildings. The Security Building, located near the east gate in Survey Unit 7, is the security checkpoint for entrance into the Protected Area and also contains the Operations Monitoring Station and portal radiation monitors for exiting personnel. Subsurface systems and equipment include storm drain and fire protection piping, electrical conduit, the liquid radioactive release piping, and well water piping. In addition, Survey Unit 10 is the connecting point for circulating water and service water piping in the Turbine Building.

Trace levels of Co-60 (significantly less than the IDCGL) were identified in several surface samples taken along the former railroad grade in Survey Unit 6. Subsurface residual radioactivity is not indicated in these areas by HSA and was not identified in characterization surveys. Samples obtained in areas remote from the railroad bed did not identify soil radioactivity above established environmental background levels.

Survey Unit 11
Survey Unit 11 is located east of the former rail grade near the southern boundary of the Impacted Area and encompasses the Radwaste Building and the Mixed Low-Level Waste Storage Building.

Subsurface materials and equipment in this survey unit include the following:

- Radwaste storage vaults,
- Electrical supply conduit,
- Storm drain piping, and
- Remote security camera and motion sensor relay communication.

The Radwaste Building was used for the temporary storage and staging of contaminated material prior to offsite shipment as radioactive waste. The HSA has identified contamination events occurring in this location and documents a significant cleanup of the area conducted in 1981 prior to Radwaste Building construction. Supporting surveys included deep core soil sampling at locations encompassing the storage vaults. Residual radioactivity was identified only at levels well below the IDCGLs in this area.

Table 2-5. Summary of Class 1, Group A Survey Unit Findings

Survey	Data Points	Radionuclides*	Mean (pCi/g)	Max. Value (pCi/g)
$1A_1$	23	Cs-137	0.16	0.37
		Co-60**	0.11	0.11
$1A_{1\ deepcore1}$	4	nd	-	-
$2A_1$	20	Cs-137	0.24	0.92
$2A_{1\ deepcore1}$	11	nd	-	-
$3A_1$	17	Cs-137	0.34	2.13
		Co-60**	0.28	0.28
$3A_2$	2	nd	-	-
$3A_{deepcore1}$	9	Cs-137	-	0.17
$3A_{deepcore2}$	3	nd	-	-
$3A_{deepcore3}$	9	Cs-137	-	0.06
		Co-60	Nd	-
$4A_1$	22	Cs-137	0.22	0.74
$4A_2$	17	Cs-137	0.05	0.07
		Co-60**	0.27	0.27
$4A_3$	10	Cs-137	0.57	1.22
		Co-60	0.06	0.07
$4A_4$	4	Cs-137*	0.17	0.17
$4A_{deepcore1}$	22	Cs-137**	0.08	0.08
$4A_{deepcore2}$	12	Cs-137**	0.10	0.10
$6A_1$	18	Cs-137	0.09	0.20
		Co-60	0.08	0.16
$6A_2$	4	Cs-137	0.09	0.09
$6A_{deepcore1}$	5	nd	-	-
$6A_{deepcore2}$	2	nd	-	-
$7A_1$	15	Cs-137	0.10	0.20
$7A_{deepcore1}$	6	nd	-	-
$9A_1$	22	Cs-137	0.19	0.33
		Co-60**	0.04	0.04
$9A_{deepcore1}$	19	Cs-137	0.09	0.14
		Co-60	Nd	-
$10A_1$	21	Cs-137	0.22	0.52
$11A_1$	25	Cs-137	0.17	0.40
		Co-60**	0.48	0.64
$11A_{deepcore1}$	6	Co-137**	0.28	0.43
$11A_{deepcore2}$	33	Cs-137	0.09	0.93
		Co-60**	0.19	0.24
$15(2R)B_1$	19	Cs-137	0.75	2.03
$15(2R)B_{deepcore1}$	5	Cs-137	0.06	0.08

*nd – non-detect
**Radioactivity identified in a limited number of samples, details of survey analyses are provided in Appendix 2-E.

2. Class 1, Group B
Class 1, Group B, category includes survey units with identified residual radioactivity above IDCGL values. Survey Units 5(1), 5(2), and 8 are considered Class 1, Group B areas. Tables 2-7 and 2-8 summarize survey data for these areas. Survey unit locations are shown on Figure 2-9.

Survey Units 5(1), 5(2), and 8 represent connecting regions within the Protected Area that encompass the Containment Building, Turbine Building, and adjacent tank storage area to the west. These locations contain subsurface equipment, piping, and structures that currently remain operational and continue to support the spent fuel pool and ongoing decontamination and dismantlement activities. Primary surveys in these areas were limited due to worker safety requirements and plant systems still in use. The characterization of areas beneath buildings was conducted by coring through building structures and concrete foundations to obtain soil samples.

Survey Units 5(1) and 5 (2)
The Liquid Radwaste Vaults and Storage Tanks are located in Survey Units 5(1) and 5(2). These survey units are bisected by a remnant of the former Chesapeake and Ohio Railroad spur. The following structures are included in this area:

- Stack,
- Condensate storage tank,
- Demineralized water tank,
- Waste hold tanks, and
- Subsurface radwaste processing tanks, equipment, and interconnecting piping.

Residual radioactivity is present as the result of tank overfilling, piping leaks, and staging of radioactive waste that took place in this area. A narrow band of low topography that was formerly present along the railroad bed once provided a drainage pathway for the accumulation of contaminants in this location. The HSA details radiological events and subsequent soil remediation efforts that took place in this area. Later, rails and ties were removed at the western edge of these survey units. Following removal of contaminated soil and railroad ballast, clean fill was used to return excavated areas to proper grade. Samples taken from Survey Units 5(1) and 5(2) have identified elevated levels of residual radioactivity in surface and subsurface soils. Some of the subsurface samples contain residual radioactivity remaining below the clean fill.

Survey Unit 8 – Pipe Tunnel
The Pipe Tunnel is a defined area within the Turbine Building that annexes Containment at the NSSS piping penetration. This area is approximately 186 square meters in size and is the former location of the steam condenser. The soil beneath the condenser and inside the sphere expansion ring is

isolated within a vault structured with concrete walls and flooring. All remaining areas beneath the Pipe Tunnel are open to the environment. This area contains subsurface piping that currently remains in service to support continued operation of the spent fuel pool. Recent testing in 2001 validated the piping integrity of this system. The Pipe Tunnel was maintained as a contaminated area during plant power operations. Seal failures identified in flooring expansion joints and drain line connections have provided transport pathways to the soil immediately below the floor. All Pipe Tunnel floor seals were repaired following condenser removal in 2001. Surveys conducted in this area have identified elevated levels of Co-60, consistent with the primary system contamination events identified in the HSA. Survey results are summarized in Table 2-6.

Survey Unit 8 - Turbine Building
Samples collected in the eastern portion of the Turbine Building did not identify soil radioactivity above environmental background levels. This location was maintained as a radiologically clean area and contained the building heating and cooling unit, uninterruptible power supply (UPS) battery station, and the machine shop. Office space annexed to this region was outside the RCA.

Radioactivity concentrations at IDCGL values were identified in the western portion of the Turbine Building. The residual radioactivity was located in a narrow area adjacent to the west wall. This radioactivity results from the condensate piping leak that occurred in 1984. The depth of residual radioactivity identified in this area is consistent with the findings of the investigation conducted following this event.

Survey Unit 8 - Containment Building
The Containment Building is a steel sphere resting on a concrete base pad that extends approximately 10.5 meters below grade. The northward movement of groundwater through the Industrial Area provides a potential pathway for the migration of mobile contaminants in this area. Four sample locations were selected traversing the sphere at varying elevations to evaluate potential soil and groundwater residual radioactivity beneath the Containment Building. Samples were collected through subsurface steel and concrete to the maximum depth permitted by the soil media. With the exception of tritium, samples did not identify radioactivity above established environmental background levels in this area. Groundwater sampling is discussed in Section 2.4.5.3.

Table 2-6. Summary of Class 1, Group B Survey Unit Findings

Summary Findings for Survey Units 5(1) and 5(2)

Survey	Data Points	Radionuclides*	Mean (pCi/g)	Max. (pCi/g)
$5(1)A_1$	33	Cs-137	3.26	12.74
		Co-60	0.54	0.73
$5(1)A_2$	13	Cs-137	0.45	1.09
		Co-60	nd	-
$5(1)A_3$	7	Cs-137	0.06	0.07
		Co-60	nd	-
$5(1)B_1$	23	Cs-137	1.81	16.59
		Co-60	0.16	0.76
$5(1)_{deepcore1}$	21	Cs-137	0.06	0.09
		Co-60	nd	-
$5(1)_{deepcore2}$	25	Cs-137	1.21	12.94 (15-30 cm)
		Co-60	0.19	0.47
$5(1)_{deepcore3}$	1	nd	-	-
$5(1)_{deepcore4}$	5	Cs-137	0.30	0.79
		Co-60	0.17	0.17
$5(1)_{deepcore5}$	8	Cs-137	2.22	6.41
		Co-60	0.36	0.66
$5(2)A_1$	26	Cs-137	0.28	1.39
		Co-60	0.20	0.42
$5(2)A_2$	7	Cs-137	0.04	0.04
$5(2)B_1$	6	Cs-137	2.29	5.25
		Co-60	0.07	0.09
$5(2)_{deepcore1}$	16	Cs-137	1.15	2.73
		Co-60	nd	-
$5(2)_{deepcore2}$	12	Cs-137	0.79	2.72
		Co-60	0.31	0.98
$5(2)_{deepcore3}$	19	Cs-137	2.87	30.70
		Co-60	1.96	7.50
$5(2)_{deepcore4}$	19	Cs-137	0.25	0.67
		Co-60	0.54	1.45
$5(2)_{deepcore5}$	3	Cs-137	nd	-
		Co-60	nd	-

*nd – non-detect

Table 2-7. Summary Of Findings For Survey Unit 8

Survey	Data Points	Radionuclides*	Mean (pCi/g)	Max. (pCi/g)
Turbine Bldg. $A_{Deepcore\ 1}$	14	nd	-	-
Pipe Tunnel $A_{Deepcore\ 2}$	33	Cs-137	1.27	12.60
		Co-60	4.84	105.90[D]
		Mn-54**	1.77	8.68
Turbine Bldg. $A_{Deepcore\ 3}$	58	Cs-137	1.22	5.29
		Co-60	0.15	0.17
Sphere $A_{Deepcore\ 4}$	9	H-3	Liquid Only See Table 2-8	-

*nd - non-detect
**Mn-54 identified in 6 samples only; decayed to ~81 pCi/g as of October, 2002

2.4.5.2 Radiological Status of Surface Water

Surface water flows northward and is directed by stormwater convey areas on both the east and west sides of the Industrial Area. Surface water enters Lake Michigan at the west drainage ditch and at the plant Discharge Canal in the Impacted Area of the BRP site.

a. Drainage Ditch
The Drainage Ditch is located just west of the Protected Area (see Figure 2-10). It is a seasonal stream approximately a meter wide that extends approximately 370 meters from the northern boundary of the Non-Impacted Area. Surface waters from wetland elevations to the south accumulate in low areas along the railroad grade and flow north into the Industrial Area. Runoff is diverted around the Protected Area to the Drainage Ditch and discharges directly into Lake Michigan at the east boundary of Survey Unit 14. The Drainage Ditch also receives water from a series of catch basins and corrugated metal piping that act to remove stormwater away from buildings and parking lots in the Industrial Area.

Routine sampling has not identified radioactivity in the liquid effluents of storm water piping or Drainage Ditch water. A primary survey has been conducted of the Drainage Ditch Area. Trace levels of residual radioactivity have been identified in the sediment of stormwater piping in the Protected Area and in Drainage Ditch soils near where the storm pipe discharges to the ditch. Further information detailing survey design and sample point analysis is provided in Appendix 2-E. Table 2-8 summarizes survey data for the Drainage Ditch.

Table 2-8. Summary of Drainage Ditch Survey Unit Findings

Survey	Data Points	Radionuclides	Mean (pCi/g)	Max. Value (pCi/g)
$Stream_1$	19	Cs-137	0.13	0.32
		Co-60*	0.11	0.17

*Co-60 detected in 2 samples only

b. Discharge Canal

The plant Discharge Canal enters Lake Michigan north of the Owner-Controlled Area and extends from the Screenhouse to the normal beach contour line. This area is approximately 600 m^2 in size and includes the submerged area from the Discharge Canal bottom to the water's edge. Normal water depths in the Discharge Canal range from 1.2 to 2.4 meters (4 to 7 feet); however, current near-record lows in Lake Michigan water levels have greatly reduced this depth. Figure 2-11 indicates the Discharge Canal location.

The Discharge Canal bottom consists of a layer of dense cobble resting on a base of hard clay. The cobble is estimated to be between 15 and 90 cm thick. Variations in surface water depth and movement have resulted in minor locations of sediment build-up in backwater eddies and areas of low flow. Structures and equipment in this area include the following:

- Liquid batch release pipe located next to the Screenhouse weir at the point of effluent discharge,
- Stormwater discharge piping approximately ten meters north of the Screenhouse,
- Liquid process monitor intake piping that traverses the Discharge Canal approximately eight meters from the Screenhouse, and
- The concrete floor and foundation footings of the Screenhouse.

The Discharge Canal is the licensed release pathway for liquid effluents. Environmental monitoring of effluents, surface waters and sediment is performed in accordance with site procedures. Radioactivity originating from licensed liquid release is present in this area. Characterization surveys have identified elevated levels of radioactivity concentrated in areas of sediment located below the water's surface. Table 2-9 summarizes survey data for the Discharge Canal.

Additional information detailing survey design and sample point analyses is provided in Appendix 2-E.

Table 2-9. Summary of Discharge Canal Survey Unit Findings

Survey	Data Points	Radionuclides	Mean (pCi/g)	Max. Value (pCi/g)
CanalA_1	18	Cs-137	0.61	1.90
		Co-60	0.38	2.68
		Mn-54*	0.12	0.23
CanalA_2	17	Cs-137	1.39	3.31
		Co-60	2.87	17.74
		Mn-54	0.32	1.04

*Mn-54 detected in 3 samples only.

2.4.5.3 Radiological Status of Groundwater

a. Historical Investigation

As part of decommissioning studies, a scoping survey was performed in 1994 that included the installation of nine groundwater monitoring wells. Well installations were screened between 6.5 and 8 meters (20 and 25 feet) below grade and placed at locations selected to encompass all areas with the potential for groundwater contamination. Well water sampling is performed in accordance with the BRP REMP and applicable procedures. Monitoring well analyses have provided baseline information on waterborne radioactivity levels (undetectable for all radionuclides but tritium) and tritium migration.

Investigations conducted in 1999 involved a series of 28 additional test borings around the Industrial Area. This investigation was conducted to identify areas of subsurface soil residual radioactivity and provide additional geological information. Test boring sites were selected to bound locations in the Industrial Area with the potential to contain subsurface soil radioactivity. Additional data point locations were selected in observed contaminant migration pathways. The test borings were performed by continuous sampling using the split-spoon, hollow-stem auger method. Boring depths in many cases approached 16.4 meters (50 feet) below grade or until soil media refusal. The test borings did not penetrate the bedrock aquifer and were carefully sealed and grouted upon completion to prevent introducing a mechanism for vertical transport. Samples from the test borings analyzed for radioactivity and soil properties were evaluated and documented during this study.

b. Survey Design

In 2001 a hydrogeologic study was initiated for the BRP site. This project was conducted to satisfy the following objectives:

1. Identify, define, and document existing geologic and hydrogeologic conditions in the Industrial Area,
2. Review and evaluate historical hydrogeological data,
3. Determine the direction and rate of groundwater flow (vertical and horizontal) in the Industrial Area,

4. Assess the potential for groundwater migration between aquifer zones,
5. Collect samples of soil and groundwater representative of varying conditions in all defined geologic strata,
6. Identify radioactivity concentrations in subsurface soil and groundwater,
7. Acquire the information necessary to identify radioactivity trends and contaminant migration pathways, and
8. Establish the information necessary for development of the site conceptual model, including engineering properties of soil and groundwater within the Industrial Area.

A sample collection plan was developed to establish drilling methods, sampling technique, and data point locations for piezometer test wells. Locations representative of hydrogeological conditions within the Industrial Area were chosen based on regional knowledge, historical documentation, and the techniques required for gradient measurements. Big Rock Radiation Protection personnel then reviewed these regions and well sites were selected to span locations of the Industrial Area with the potential to contain radioactivity. Input to the well site selection process included the following:

- Historical Site Assessment event data,
- Environmental scoping surveys,
- Radioactivity identified in monitoring well analyses, and
- Observed contaminant migration pathways.

Samples were collected by hollow-stem, split-spoon auger. Shallow groundwater elevations were cased and grouted in place, where identified, to prevent seepage communication between geological strata. Drilling was then continued by advancing the auger through the casing for the investigation of lower elevations. This process resulted in the successfully installation of 13 test wells screened in three groundwater zones. Sample point locations are provided in Figure 2-4.

Additional groundwater samples for this study were collected beneath the Containment Building structure in Survey Unit 8. Data point locations were selected to bisect the building at four sites perpendicular to groundwater flow. Samples were collected by coring through the steel Containment Building shell and concrete base pad at elevations between 185 and 189 meters (565 and 575 feet) msl. Sample point locations are provided in Appendix 2-E, Survey Unit 8.

The results of the hydrogeological assessment provided the following information:

- Two shallow water bearing zones were identified above the potable aquifer,
- Flow direction of all groundwater is northward into Lake Michigan,

- The intermediate water-bearing zone is under artesian conditions. Vertical groundwater flow is directed upward above the intermediate zone in all areas south of the Turbine Building,
- Downward gradients exist in shallow water bearing zones north of containment,
- Building foundations present a barrier to shallow groundwater flow, and
- Shallow water bearing zones do not have sufficient depth and yield for potable water usage.

c. Radiological Status

Well water samples were analyzed for gamma emitting radionuclides and the presence of tritium. Samples identifying elevated tritium concentrations were further investigated by independent laboratory analysis for other HTD radionuclides with the potential to originate from plant activities. All water samples were collected and sent for analysis without preservation; sample preservation was performed at the vendor laboratory facilities as required by accepted industry methods. Vendor laboratories contracted for BRP radionuclide measurements are HASL-300 compliant [References 2-16, 2-24, and 2-21].

Sample analyses identified tritium as the only radionuclide present in groundwater at BRP. Tritium concentrations were found in all three groundwater zones north of the Turbine Building in a narrow corridor less than 100 meters wide. This corridor extends approximately 140 meters to the site boundary at Lake Michigan. The location of highest contaminant concentration within these three zones is near the centerline of the Containment Building in the vicinity of the concrete base pad. Tritium concentrations decrease at test well locations north of the Containment Building when compared with shallow well analyses south of containment, validating a transport pathway in the direction of groundwater flow as discussed below.

The source of groundwater contamination is believed to have originated from the condensate leak beneath the Turbine Building that occurred in 1984 (see Section 2.2.5.3). Shallow groundwater below the Turbine Building is held in place above a dense layer of thick clay and the deep foundation walls of this building provide a mechanism for confinement. It is postulated that contaminated water from this event has been contained in this area and is slowly migrating north, via pathways around Turbine and Containment Building foundations and footings. Further investigations of shallow groundwater contaminant migration are ongoing; additional information/data for groundwater survey results will be maintained in accordance with Site Characterization Plan requirements.

Table 2-10. Groundwater Test Well Results

	PZ-1S pCi/l	PZ-2S PCi/l	PZ-3S pCi/l	PZ-4S pCi/l	PZ-5S pCi/l	PZ-6S pCi/l	PZ-1M pCi/L	PZ-2M pC/l	PZ-3Ma pCi/l	PZ-3Mb pCi/l
BRP Gamma	nd	Nd	nd	nd	nd	nd	nd	nd	nd	nd
Independent Lab										
H-3	< 177	< 177	< 177	< 177	2650	< 177	< 177	< 177	2060	808
Mn-54					< 3.54				< 3.13	
Co-60					< 3.51				< 3.72	
Zn-65					< 6.98				< 7.49	
Ag-110m					< 3.5				< 3.08	
Cs-137					< 3.02				< 2.9	
Cs-134					< 3.4				< 3.57	
Eu-152					< 9.05				< 8.66	
Eu-154					< 9.9				< 8.7	
Eu-155					< 9.94				< 10	
Am-241										
Hard to detect										
C-14	< 5.8	< 5.8	< 5.8	< 5.8	< 5.8	< 5.8			<47	
Fe-55					< 140				<132	
Ni-59					< 46.3				<92.6	
Ni-63					< 170				<146	
Sr-90	< 0.5	< 0.5	< 0.5	< 0.5	<0.6	< 0.6			<0.67	
Tc-99	< 1.9	< 2	< 1.9	< 2.4	<1.9	< 2.1			<7.58	
I-129	< 0.6	< 0.6	< 0.6	< 0.5	<0.6	< 0.6			<6.68	
Am-241					<0.22				<0.43	
Cm-243/244					<0.22				<0.18	
Pu-238					<0.22				<0.20	
Pu-239/240					<0.38				<0.35	
Pu-241					<12.4				<13.7	

nd – non-detect
< indicates less than MDA value
Blank entries indicate no analysis performed

Table 2-10. Groundwater Test Well Results (continued)

	MW-1 pCi/l	MW-2 pCi/l	MW-3 pCi/l	MW-4 pCi/l	MW-5 pCi/l	MW-6 pCi/l	MW-7 pCi/l	MW-8 pCi/l	MW-9 pCi/l
BRP gamma	nd	nd	nd	nd	nd	nd	nd	nd	nd
Independent Lab									
H-3	< 141	< 141	< 164	< 164	2860	5150	< 164	< 706	357
Mn-54									
Co-60									
Zn-65									
Ag-110m									
Cs-137									
Cs-134									
Eu-152									
Eu-154									
Eu-155									
Am-241									
Hard to detect									
C-14					< 5.8	< 5.8			
Fe-55									
Ni-59									
Ni-63									
Sr-90					< 0.65	< 0.4			
Tc-99					< 2.3	< 1.9			
I-129					< 0.6	< 0.6			
Am-241									
Cm-243/244									
Pu-238									
Pu-239/240									
Pu-241									

nd – non-detect
< indicates less than MDA value
Blank entries indicate no analysis performed

Table 2-10. Groundwater Test Well Results (continued)

	PZ-1D pCi/l	PZ-2D pCi/l	PZ-3D pCi/l	Sphere 1 pCi/l	Sphere 2 pCi/l	Sphere 3 pCi/l	Sphere 5 pCi/L
BRP gamma	nd	nd	nd	nd	nd	nd	nd
Independent Lab							
H-3	< 177	< 177	1560	12692	3290	32000	23725
Mn-54			< 1.8	< 1.1	< 1.9	< 4.8	< 2.1
Co-60			< 2.1	< 1.6	< 2.2	< 3.9	< 2.9
Zn-65			< 6.7	< 3.9	< 5.1	< 5.3	< 7.2
Ag-110m			< 2.5	< 1.8	< 3	< 3.5	< 3.2
Cs-137			< 4	< 1.5	< 2.8	< 2.7	< 1.6
Cs-134			< 3.4	< 2.1	< 3.6	< 4.7	< 3.7
Eu-152			< 11	< 5.2	< 10	< 12	< 12
Eu-154			< 10	< 3.2	< 8.2	< 8.4	< 7.9
Eu-155			< 13.4	< 9.1	< 15	< 21	< 12
Am-241			<48	<9.9	< 11	< 21.2	< 18
Hard to detect							
C-14	< 5.8	<5.8	< 5.9	< 7.5	< 8.9	< 5.8	< 7
Fe-55			< 27	< 103	< 99	< 106	< 108
Ni-59			< 185	< 96	< 123	< 203	< 184
Ni-63			< 18	< 11.8	< 15.1	< 19.4	< 17.6
Sr-90	< 0.6	< 0.5	< 0.5	< 0.4	< 0.5	< 0.4	< 0.4
Tc-99	< 4.3	< 4.3	< 3	< 3	< 3.4	< 3.8	< 3.5
I-129	< 0.6	< 0.5	< 0.7	< 0.6	< 0.6	< 0.6	< 0.7
Am-241			< 0.4	< 0.5	< 0.8	< 0.1	< 0.6
Cm-243/244			< 0.3	< 0.2	< 0.2	< 0.1	< 0.3
Pu-238			< 0.06	< 0.1	< 0.1	< 0.2	< 0.1
Pu-239/240			< 0.03	< 0.1	< 0.1	< 0.2	< 0.1
Pu-241			< 12	< 67	< 29	<96	< 42

nd – non-detect
< indicates less than MDA value
Blank entries indicate no analysis performed

2.4.5.4 Radionuclide Fractions for Surrogate Measurement of HTD Contaminants in Soil

An investigation was conducted for the identification of all radionuclides potentially present in BRP soils and groundwater. This study resulted in development of the 24 radionuclide suite presented in Table 2-11 below. Further details of this evaluation are provided in Chapter 6, Section 6.4.1.

Table 2-11. Radionuclides Potentially Present in BRP Soil

H-3*	Ni-63	Cs-134	Pu-239
C-14	Zn-65	Cs-137	Pu-240
Mn-54	Sr-90	Eu-152	Pu-241
Fe-55	Tc-99	Eu-154	Am-241
Ni-59	Ag-110m	Eu-155	Cm-243
Co-60	I-129	Pu-238	Cm-244

*Radioactivity measurements were performed on dry samples; H^3 analyses of soil samples were not conducted in this study.

This suite of potential BRP radionuclides was the basis used for the analyses of characterization soil samples to define the actual radionuclides present in BRP soils and develop nuclide ratio's for the surrogate measurement of HTD contaminants. Areas representative of the highest activity set of survey units were used for this study. These survey units were represented by 389 soil samples encompassing an area of 6,500 m^2 (Figure 2-12). All survey data from these areas were evaluated with no samples excluded. Selected soil samples from the most highly contaminated areas in this data set were selected for further evaluation in order to provide the most probable identification of HTD nuclides. This selection resulted in the independent laboratory analysis of 21 soil samples for the presence of the radionuclides defined in Table 2-11. These samples included surface samples, deep core samples, and activity profiles to depths up to 1.8 m.

Vendor laboratories contracted for BRP radionuclide measurements are HASL-300 compliant. Radionuclide analyses were conducted by accepted industry methods to the lowest MDA values achievable by standard commercial laboratory. Laboratory results are provided in Table 2-12. The HTD radionuclides identified in this study are Fe-55 and Sr-90. The ratio of Fe-55 to Co-60 (surrogate) is 0.47 and the Sr-90 ratio to Cs-137 (surrogate) is 0.020 [Reference 2-4].

Table 2-12. Soil Sample Analyses for Hard-to-Detect Radionuclides

Grid Location	318	318	318	269	269	250	250	250	266	266
Sample Depth	0–15cm	0–15cm	0–15cm	0–15cm	0–15cm	0–30cm	30-60 cm	60-90 cm	0–15 cm	30-60 cm
Gamma:	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g
Mn-54	< 0.010	< 0.010	< 0.020	0.110	0.030	1.140	0.236	0.028	< 0.040	< 0.19
Co-60	0.03	0.02	< 0.02	6.43	1.91	80.7	15.6	< 0.1	5.17	0.12
Zn-65	< 0.03	< 0.01	< 0.04	< 0.09	< 0.07	0.33*	< 0.238	< 0.073	< 0.09	< 0.047
Ag-110m	< 0.02	< 0.01	< 0.05	< 0.02	< 0.02	< 0.04	< 0.073	< 0.026	< 0.05	< 0.022
Cs-134	< 0.01	0.01*	< 0.02	< 0.04	< 0.02	< 0.06	< 0.064	< 0.024	< 0.04	< 0.02
Cs-137	3.56	4.01	4.18	0.2	0.26	3.8	0.77	< 0.03	21.7	0.97
Eu-152	< 0.05	< 0.01	< 0.05	< 0.03	< 0.05	< 0.08	< 0.16	< 0.058	< 0.06	< 0.056
Eu-154	< 0.03	< 0.01	< 0.04	< 0.02	< 0.03	< 0.06	< 0.18	< 0.091	< 0.05	< 0.063
Eu-155	< 0.07	< 0.02	< 0.07	< 0.04	< 0.06	< 0.1	< 0.13	< 0.052	< 0.09	< 0.06
Am-241	< 0.08	< 0.02	< 0.07	< 0.05	< 0.07	< 0.22	< 0.416	< 0.031	< 0.14	< 0.058
Non Gamma:	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g
C-14	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 1.54	< 1.48	< 0.47	< 1.68
Fe-55	< 51	< 49	< 31	< 48	< 45	38	< 3.66	< 3.75	< 36	< 3.34
Ni-59	< 2	< 1.9	< 2	< 2	< 2.4	< 2.4	< 1.65	< 4.29	< 2.3	< 1.53
Ni-63	< 0.25	< 0.24	< 0.24	< 0.37	< 0.25	< 0.39	< 2.98	< 2.62	< 0.4	< 1.97
Sr-90	< 0.02	< 0.04	< 0.04	< 0.02	< 0.02	0.13	< 0.095	< 0.11	< 0.06	< 0.11
Tc-99	< 0.26	< 0.16	< 0.34	< 0.23	< 0.18	< 0.33	< 1.94	< 2.8	< 0.2	< 2.53
I-129	< 0.26	< 0.24	< 0.25	< 0.24	< 0.28	< 0.24	< 0.28	< 0.26	< 0.25	< 0.33
Pu-238	< 0.02	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01	< 0.17	< 0.15	< 0.02	< 0.154
Pu-239/240	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01	< 0.32	< 0.19	< 0.02	< 0.20
Pu-241	< 8.9	< 9.4	< 7.6	< 8.4	< 7.3	< 7.2	< 5.4	< 6.03	< 8.9	< 7
Cm-243/244	< 0.04	< 0.08	< 0.03	< 0.05	< 0.02	< 0.06	< 0.06	< 0.06	< 0.15	< 0.0189
Am-241	< 0.04	< 0.08	< 0.08	< 0.07	< 0.09	< 0.03	< 0.024	< 0.019	< 0.08	< 0.019

< indicates less than MDA values. *Excluded due to short half-life

Table 2-12. Soil Sample Analyses for Hard-to-Detect Radionuclides (continued)

Grid Location	266	266	266	266	211	248	248	247	247	228	Canal sediment
Sample Depth	60-90 cm	0-15cm	0-15cm	0-15cm	0-15cm	0-15cm	0-15cm	0-15cm	0-15cm	0-15cm	0-15cm
Gamma:	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g
Mn-54	<0.026	< 0.031	< 0.045	<0.041	<0.010	<0.010	< 0.010	< 0.010	< 0.020	< 0.010	0.203
Co-60	<0.1	< 0.042	< 0.046	<0.034	<0.02	0.56	0.3	0.5	0.58	0.51	8.27
Zn-65	<0.067	< 0.072	< 0.108	<0.084	<0.05	<0.03	< 0.03	< 0.03	< 0.05	< 0.03	< 0.173
Ag-110m	<0.029	< 0.028	< 0.049	<0.033	<0.01	<0.04	< 0.03	< 0.03	< 0.04	< 0.03	< 0.0586
Cs-134	<0.029	< 0.028	< 0.039	<0.029	<0.02	<0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.0494
Cs-137	<0.309	< 0.032	0.111	<0.1	<0.01	14.0	10.2	25.7	13.36	8.14	2.19
Eu-152	<0.068	< 0.083	< 0.127	<0.082	<0.03	<0.07	< 0.04	< 0.06	< 0.07	< 0.06	< 0.126
Eu-154	<0.091	< 0.095	< 0.148	<0.107	<0.02	<0.05	< 0.03	< 0.05	< 0.05	< 0.04	< 0.136
Eu-155	<0.092	< 0.100	< 0.116	<0.089	<0.04	<0.08	< 0.07	< 0.1	< 0.11	< 0.08	< 0.0934
Am-241	<0.160	< 0.165	< 0.061	<0.186	<0.07	<0.19	< 0.07	< 0.12	< 0.08	< 0.14	< 0.0518
Non-gamma:	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g
C-14	<1.44	< 1.68	< 1.55	<3.81	<0.47	<0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 1.12
Fe-55	<3.24	< 3.78	< 3.77	<3.99	<38	<37	< 35	< 41	< 37	< 31	< 1.70
Ni-59	<2.64	< 2.13	< 4.28	<1.38	<2	<2.8	< 2.1	< 2.4	< 2.5	< 2.4	< 14.2
Ni-63	<2.05	< 2.47	< 2.18	<2.55	<0.25	<0.4	< 0.39	< 0.9	< 0.39	< 0.42	< 3.14
Sr-90	<0.103	< 0.0994	< 0.118	<0.117	<0.3	<0.6	< 0.06	< 0.04	< 0.1	0.04	< 0.592
Tc-99	<2.05	< 1.92	< 2.63	<1.97	<0.14	<0.23	< 0.11	< 0.29	< 0.24	< 0.13	< 3.31
I-129	<0.282	< 0.033	< 0.297	<0.361	<0.23	<0.24	< 0.24	< 0.25	< 0.26	< 0.27	< 0.332
Pu-238	<0.149	< 0.144	< 0.121	<0.125	<0.04	<0.02	< 0.03	< 0.04	< 0.05	< 0.06	< 0.0737
Pu-239/240	<0.366	< 0.187	< 0.25	<0.147	<0.03	<0.03	< 0.03	< 0.04	< 0.05	< 0.04	< 0.165
Pu-241	<0.229	< 5.43	< 6.03	<4.82	<8.6	<8.4	< 6.7	< 5.2	< 7.1	< 9.6	< 0.324
Am-241	<0.020	< 0.051	< 0.023	<0.019	<0.03	<0.04	< 0.13	< 0.2	< 0.07	< 0.29	< 9.65
Cm-243/244	<0.063	< 0.075	< 0.057	<0.061	<0.06	<0.04	< 0.06	< 0.13	< 0.08	< 0.64	< 0.185

< indicates less than MDA values

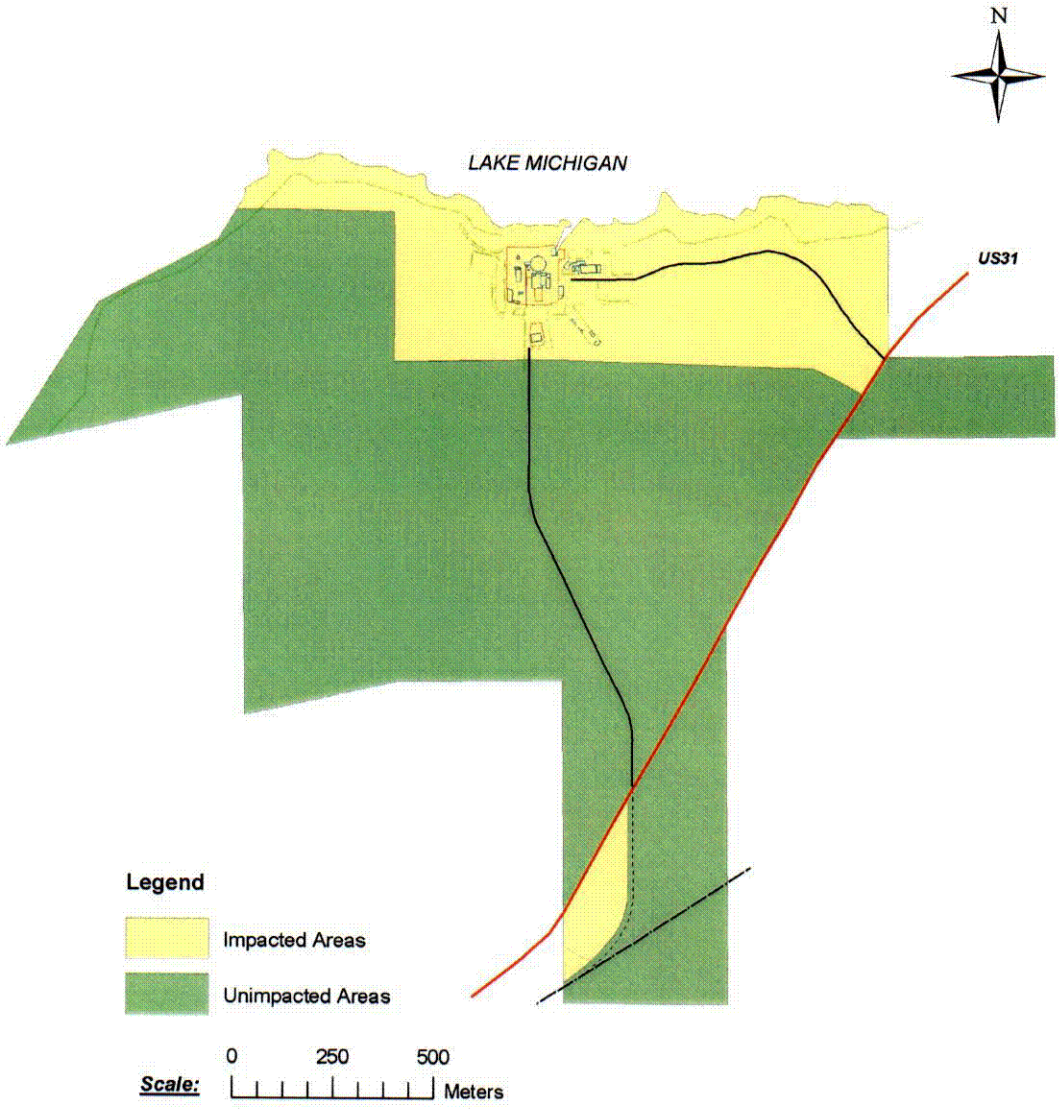
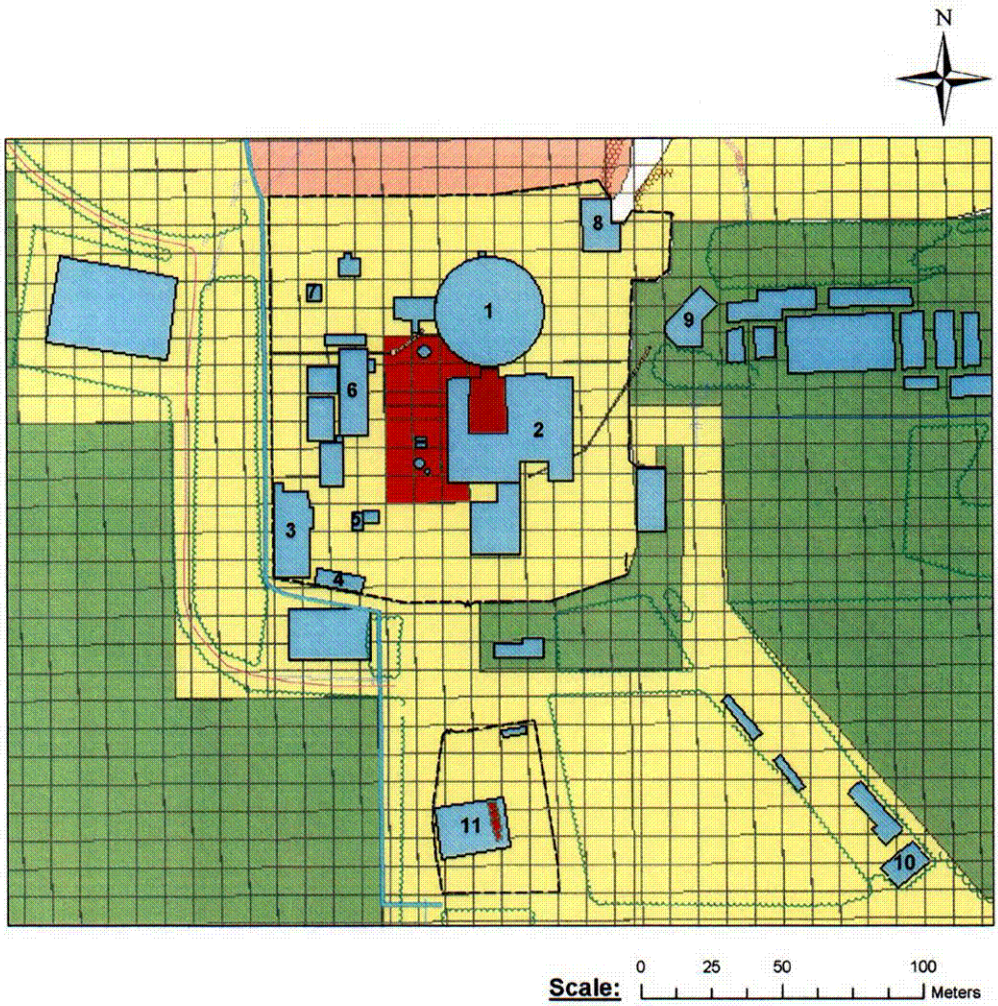


Figure 2-1. Big Rock Point Owner-Controlled Area

C-01



1. CONTAINMENT BUILDING (SPHERE)
2. TURBINE/SERVICE BUILDING
3. QA/QC BUILDING (WAREHOUSE)
4. CONTAMINATED WAREHOUSE
5. BUTLER BUILDING (FORMER BALER HOUSE)
6. MAINTENANCE BUILDING (FORMER SITE OF NEWKIRK WAREHOUSE)
7. FORMER SITE OF PLANT INCINERATOR
8. SCREENHOUSE
9. ANNEX BUILDING
10. SWAMP WAREHOUSE
11. RADIOACTIVE WASTE BUILDING

Figure 2-2. Big Rock Point Industrial Area

C-02

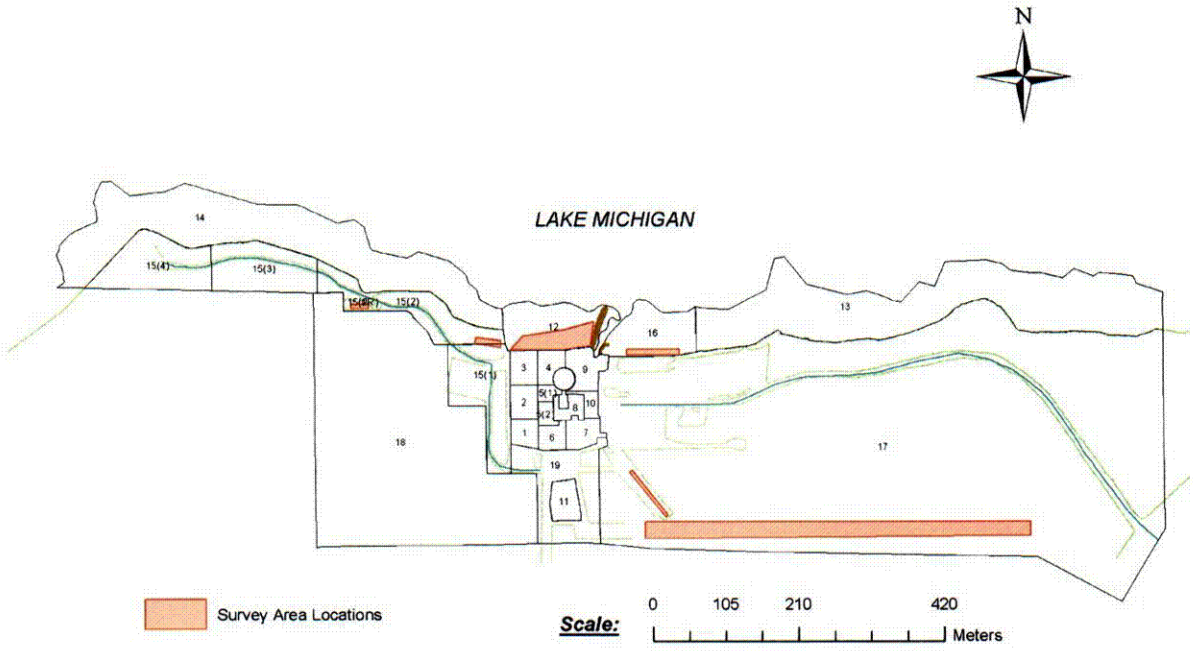


Figure 2-3. Legacy Materials Evaluation Survey Areas

C-03

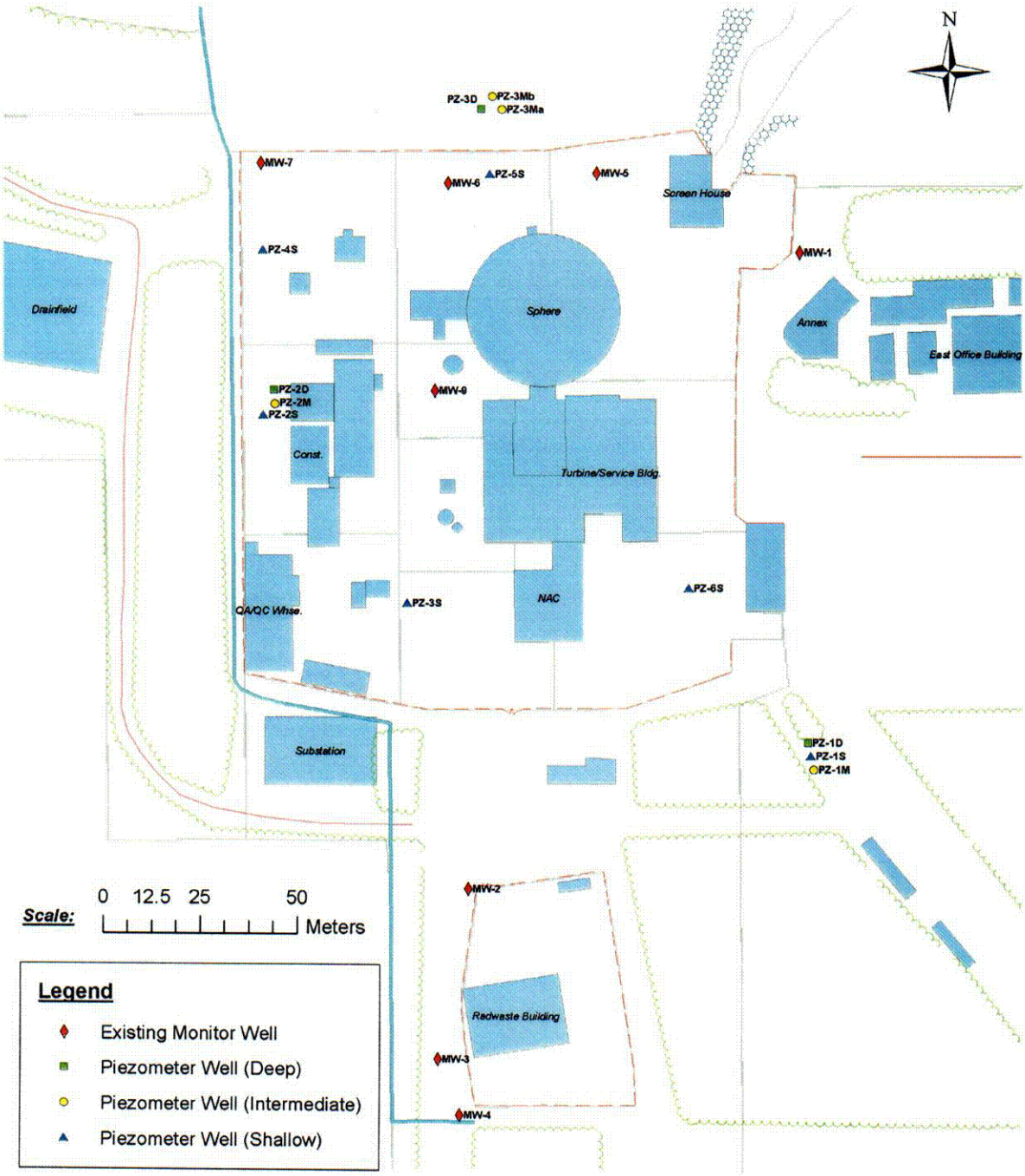
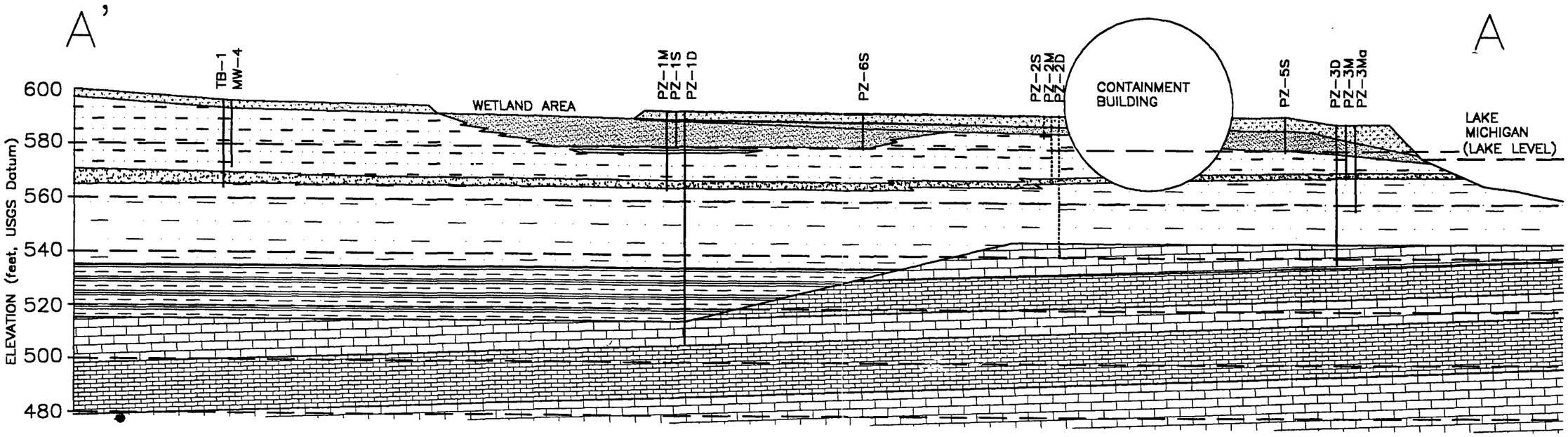


Figure 2-4. Big Rock Point Groundwater Monitoring Wells

C-04



UNITS

- SAND & GRAVEL FILL (6a)
- NATIVE SAND,W/GRAVEL, OCCASIONAL CLAY LAYERS, WET AT BOTTOM (6b)
- UNSORTED SAND, CLAY, GRAVEL (5)
- SAND,FINE GRAINED, SATURATED (4)
- SANDY CLAY W/SAND SEAMS, WET (3)
- SILTY CLAY, DRY (2)
- LIMESTONE BEDROCK (1)

NOTES:

1. BOUNDARIES BETWEEN GEOLOGICAL UNITS ARE INFERRED BASED ON LIMITED SUBSURFACE DATA.

2. WELLS SHOWN WITH DASHED LINES ARE PROJECTED ONTO VERTICAL PROFILE.

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 40'

BIG ROCK POINT RESTORATION PROJECT CHARLEVOIX CO., MICHIGAN	**Figure 2-5.** VERTICAL PROFILE A–A'		
OTWELL MAWBY, P.C. Traverse City, Michigan	Date: 07/23/02	Job No.:	Scale: 1"=100'

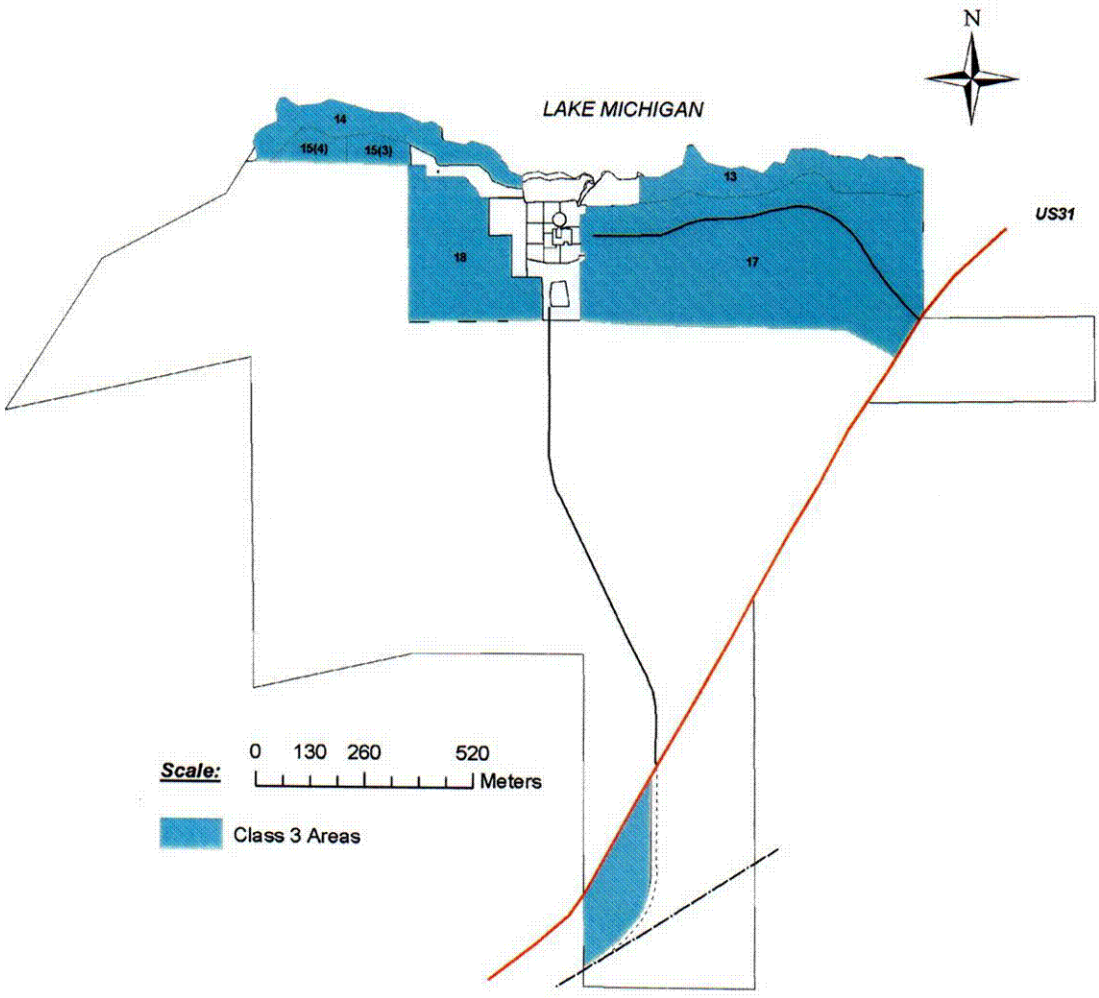


Figure 2-6. Class 3 Survey Units

C-05

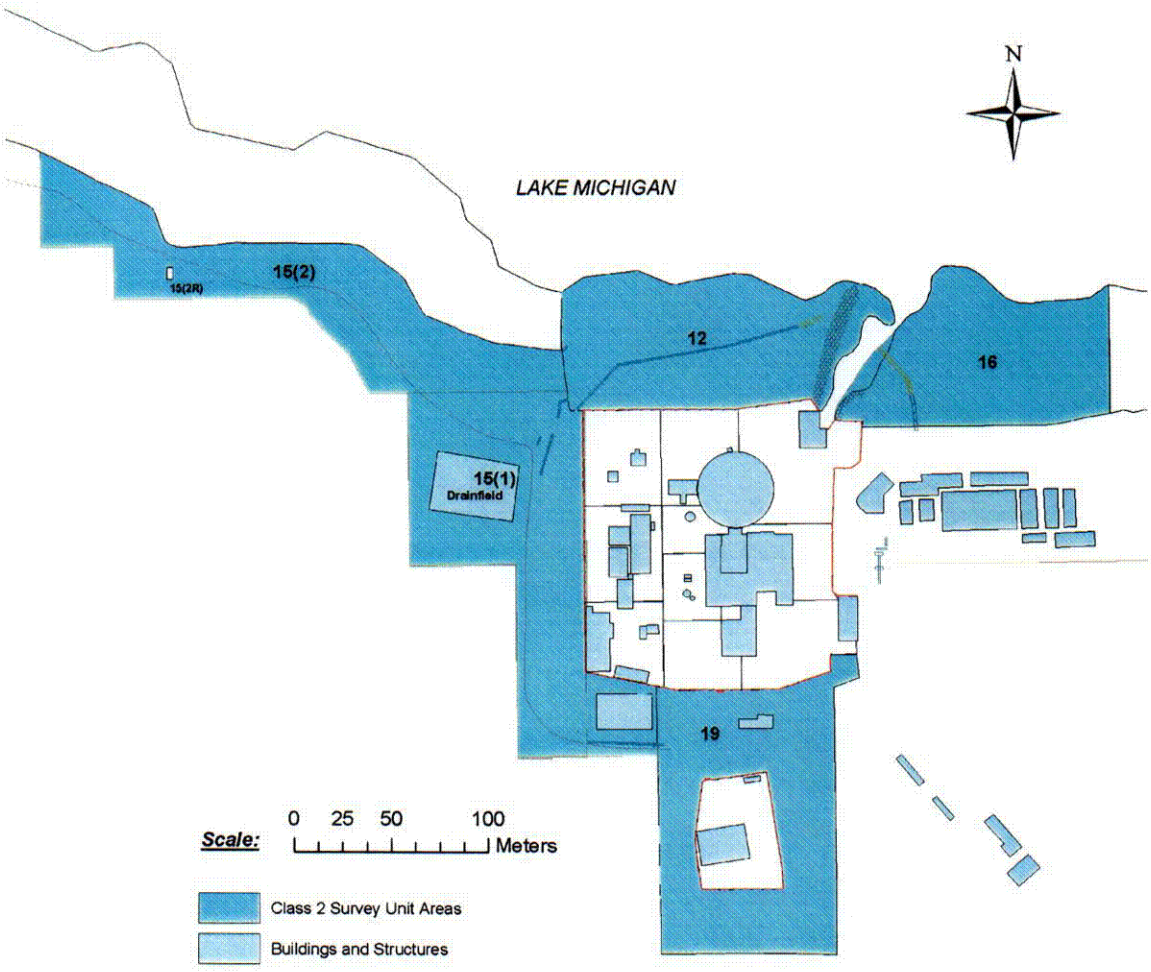


Figure 2-7. Class 2 Survey Units

C-06

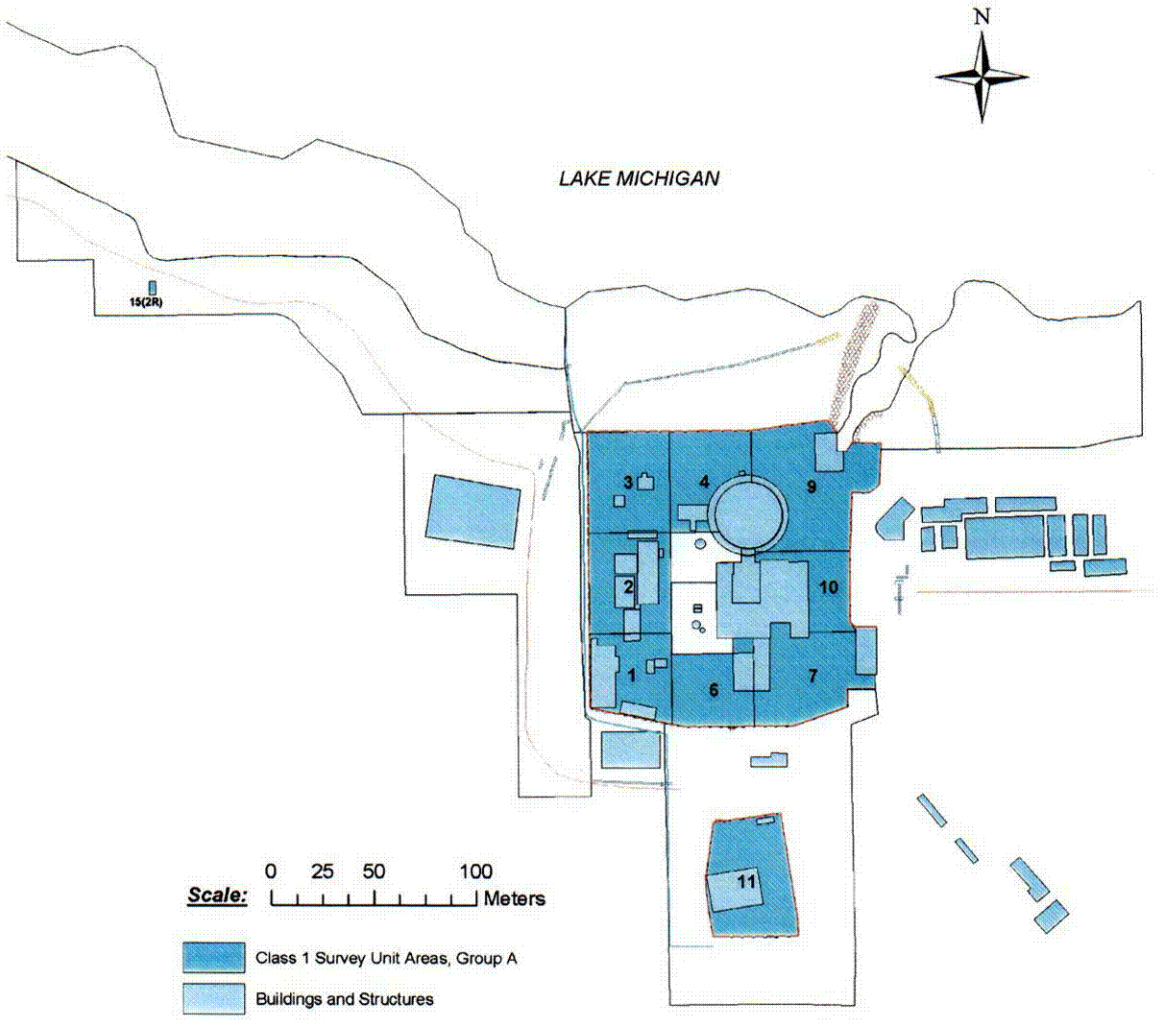


Figure 2-8. Class 1, Group A Survey Units

C-07

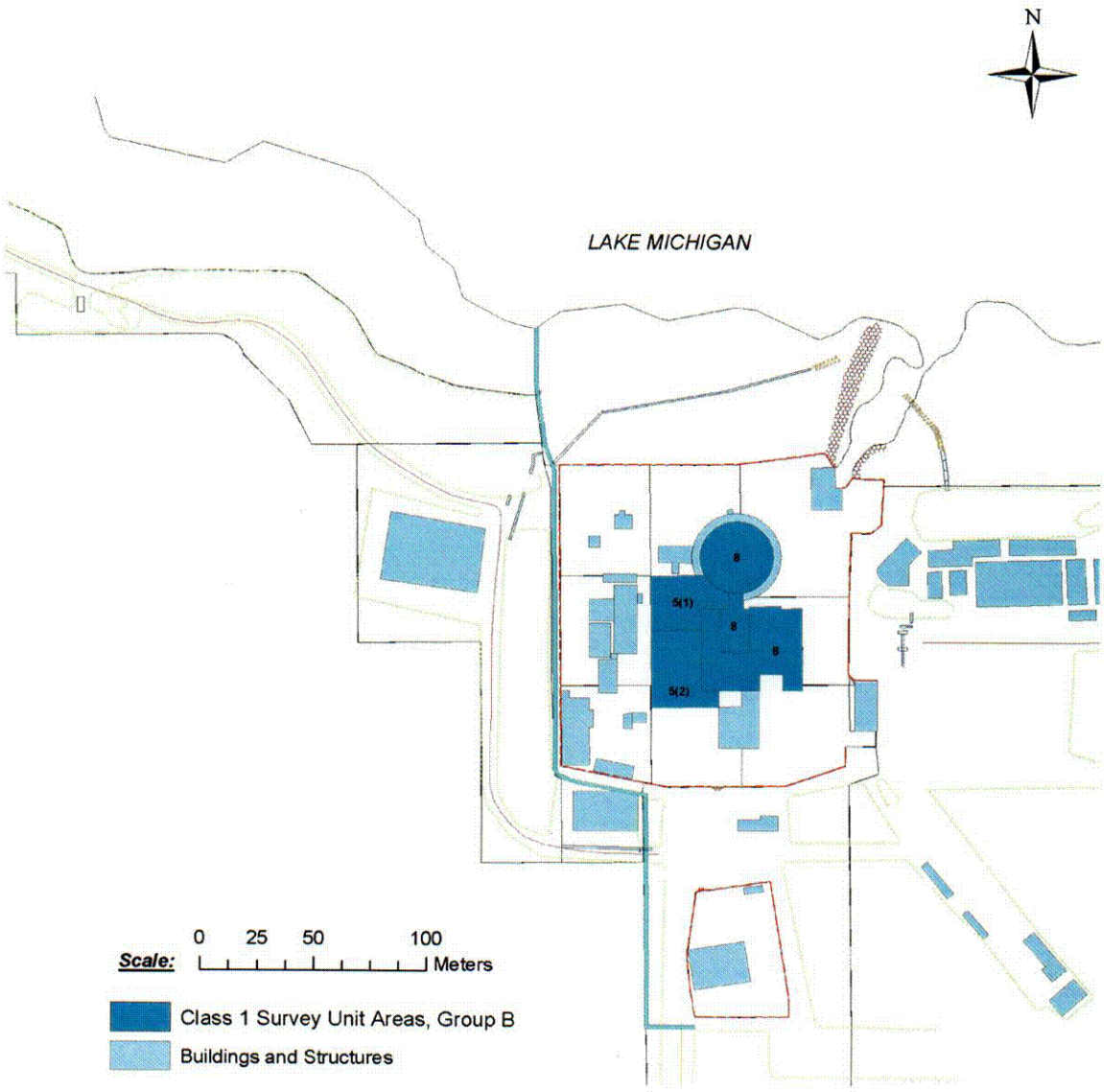
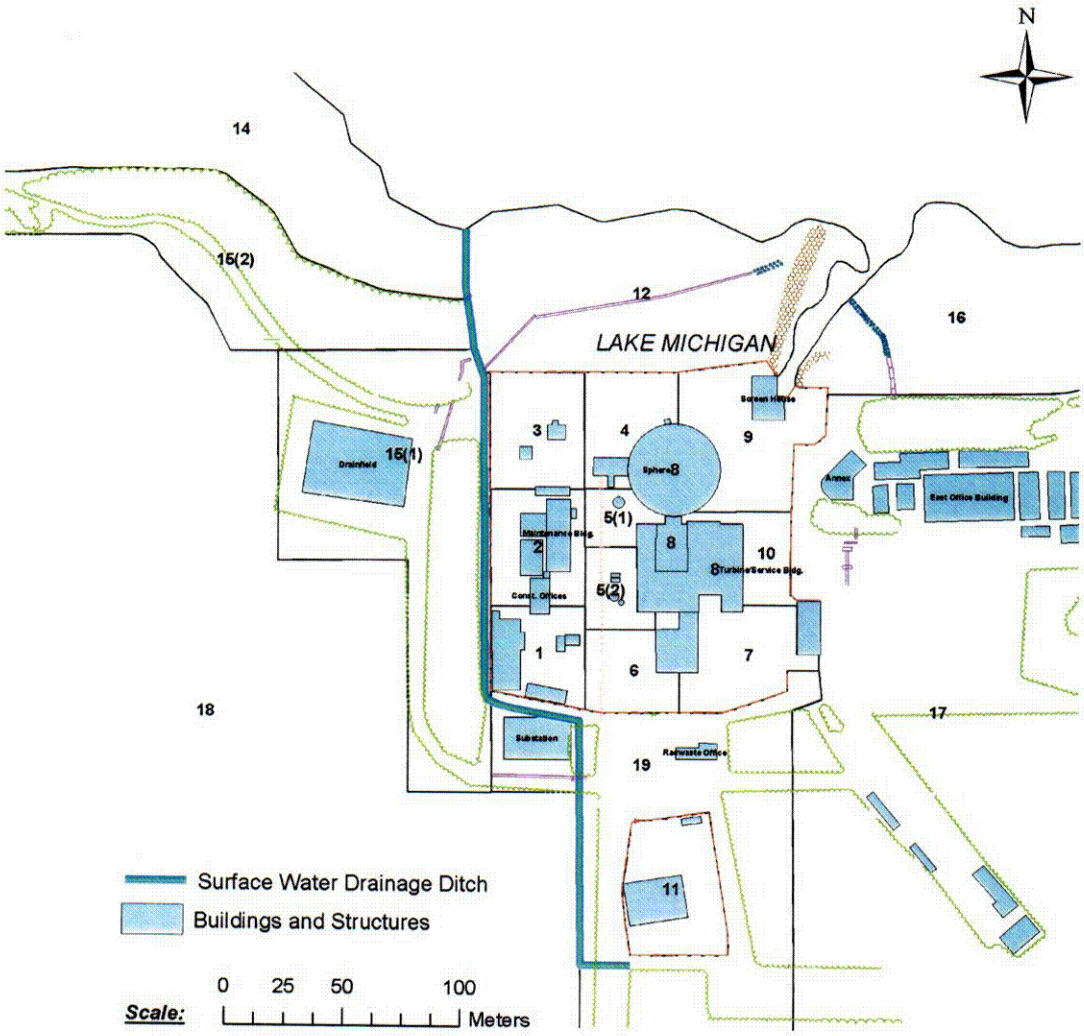


Figure 2-9. Class 1, Group B Survey Units

C-08



Note: Survey points were collected in shaded area for surface water drainage ditch.

Figure 2-10. Drainage Ditch Survey Unit

C-09

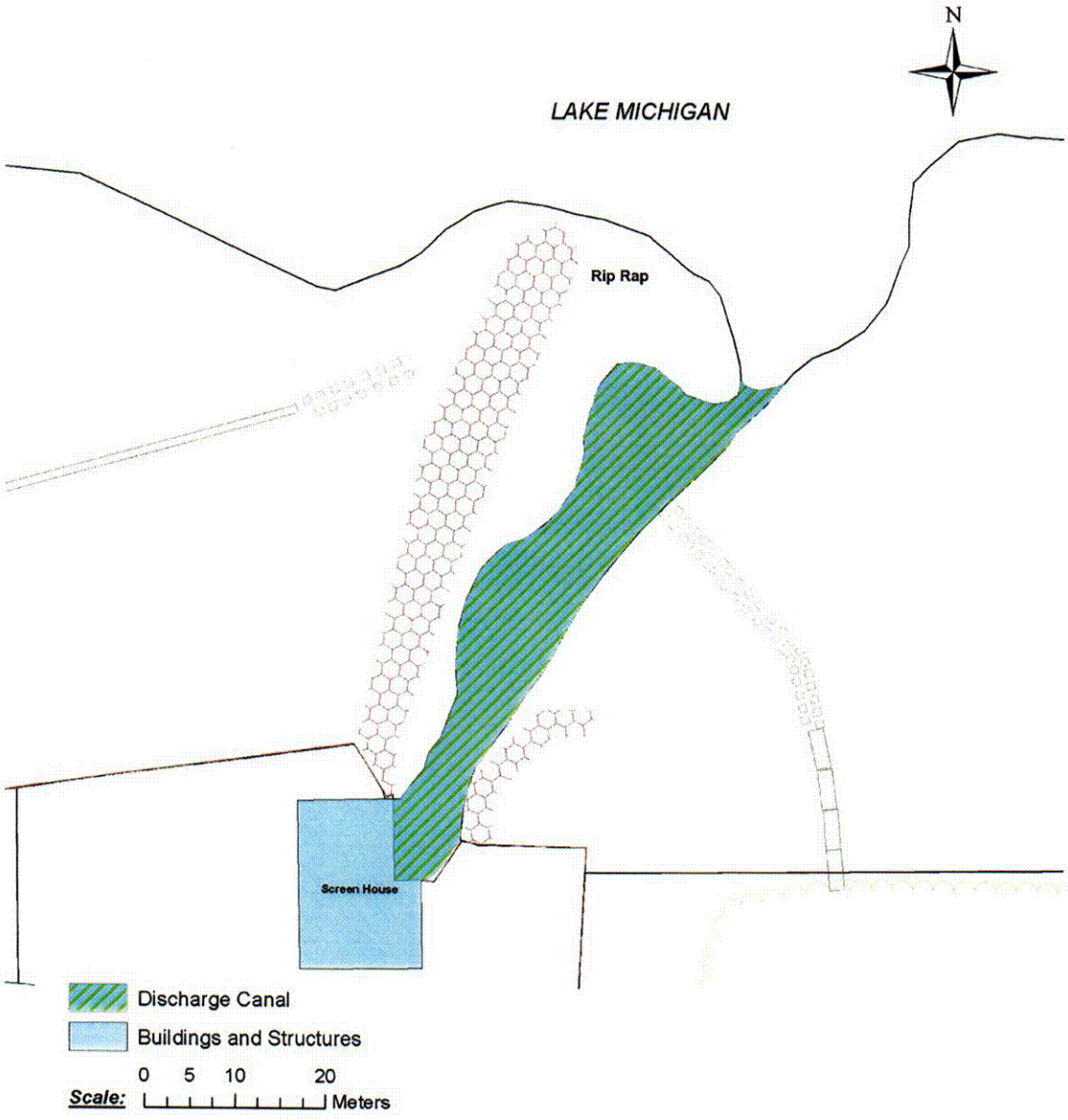


Figure 2-11. Discharge Canal Survey Unit

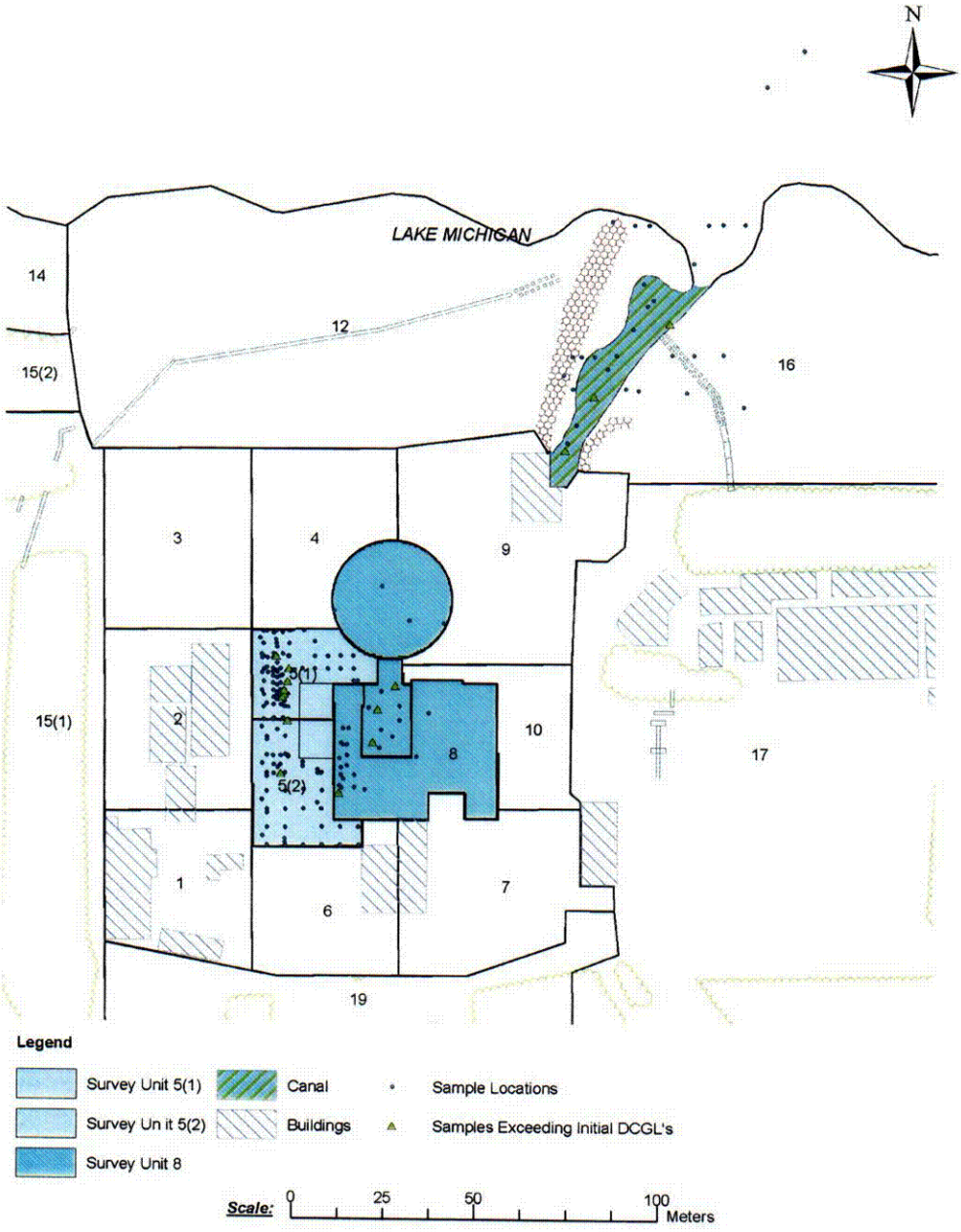


Figure 2-12. Data Point Locations for Determination of Radionuclide Fractions

C-11

2.5 REFERENCES

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2-2 Big Rock Point Engineering Analysis EA-BRP-DW-98-01, *Efficiency Confirmation of the Portable Gamma Spectrometer*, December 1998

2-3 Big Rock Point Engineering Analysis EA-BRP-SC-01-00, *Background Radioactivity in Soil*, June 2000

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2-6 Big Rock Point Historical Site Assessment, 1962-1999, May 2001

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2-28 Zumberge, J.H., *Geology and Hydrology of the Proposed Reactor Site at Big Rock Point, near Charlevoix, Michigan*, 1959

PROPERTY DESCRIPTIONS: Sheet 1 of 3

For: Consumers Energy (Big Rock Point): Date: January 15, 2003

Impacted Area #1: (Parcel includes Plant Facilities & Beachfront)
In the Township of Hayes, Charlevoix County, Michigan, COMMENCING at the corner common to Sections 7, 8, 17 & 18, Township 34 North, Range 7 West; thence along the line common to said Sections 7 & 8 North 0°05'57" West 2627.58 feet to the 1/4 corner common to said Sections 7 & 8, being the POINT OF BEGINNING of this description; thence along the East & West 1/4 line of said Section 7, (as monumented) South 77°55'17" West East 20.45 feet; thence North 0°00'33" West 1226.88 feet; thence North 88°13' 00" West 1268.76 feet to the shore of Lake Michigan; thence along said shore the following seven (7) courses: North 32°01'00" East 506.91 feet, South 77°00'20" East 1046.15 feet, South 78°06'52" East 1318.53 feet, South 90°00'00" East 1320.00 feet, North 70°00'00" East 660.00 feet, South 69°00'00" East 792.00, and North 71°00'00" East 35.53 feet; thence leaving said shore along the East 1/8 line, also being the East line of Government Lot 2, of said Section 8, South 0°04'35" East 1122.78 feet to the East & West 1/4 line of said Section 8; thence along said 1/4 line South 89°46'27" West 4004.74 feet to the POINT OF BEGINNING, being part of Government Lots 1 & 2 in Section 7 and Government Lots 2, 3 & 4 in Section 8, all in Township 34 North, Range 7 West and containing 125.006 acres within the perimeter of the courses herein described. Property includes all land to the water's edge of Lake Michigan lying Northwesterly and Northerly of the courses described as being along said shore. Subject to the rights of the public and of any governmental unit in any part thereof taken, used or deeded for street, road or highway purposes.

Impacted Area #2 (Parcel Lying South of Highway U.S.-31):
In the Township of Hayes, Charlevoix County, Michigan, COMMENCING at the 1/4 corner common to Sections 8 & 17, Township 34 North, Range 7 West; thence along the North & South 1/4 line of said section 17 South 0°00'29" East 2655.11 feet to the center 1/4 corner of said Section 17; thence along the East & West 1/4 line of said section North 89°19'18" West 1338.35 feet to the West 1/8 line of said section; thence along said 1/8 line North 0°02'04" East 176.36 feet to the POINT OF BEGINNING of this description; thence continuing along said 1/8 line North 0°02'04" East 526.92 feet to the Southeasterly line of Highway U.S.-31; thence along said highway line on a curve to the left 773.41 feet, (the radius of said curve being 5804.63, the central angle being 7°38'03" and the chord bears North 33°33'14" East 772.84 feet); thence continuing along said highway line North 29°44'13" East 207.80 feet; thence South 0°05'06" East 626.63 feet; thence along a curve to the right 477.88 feet, (the radius of said curve being 585.54 feet, the central angle being 46°45'40" and the chord bears South 23°17'44" West 464.73 feet); thence South 46°40'34" West 344.33 feet; thence South 57°35'47" West 115.13 feet to the POINT OF BEGINNING, being a part of the East 1/2 of the Northwest 1/4 of Section 17, Township 34 North, Range 7 West and containing 8.266 acres

PROPERTY DESCRIPTIONS: Sheet 2 of 3

For: Consumers Energy (Big Rock Point):
Date: January 15, 2003

Non-Impacted Area Lying North & East of Highway U.S.-31:
In the Township of Hayes, Charlevoix County, Michigan, BEGINNING at the corner common to Sections 7, 8, 17 & 18, Township 34 North, Range 7 West; thence along the line common to said Sections 7 & 18 South 77°40'53" West 1282.91 feet to the East 1/8 line of said Section 7; thence along said 1/8 line North 0°07'19" West 2632.85 feet to the East & West 1/4 line of said Section 7, (as monumented); thence along said 1/4 line, also being the South line of Government Lots 2 & 3 of said Section 7, South 77°44'18" West 1969.87 feet to the shore of Lake Michigan; thence along said shore the following three (3) courses: North 32°42'00" East 1411.30 feet, North 62°13'00" East 1100.00 feet, and North 32°01'00" East 293.09 feet; thence leaving said shore South 88°13'00" East 1268.76 feet; thence South 0°00'33" East 1226.88 feet to the East & West 1/4 line of said Section 7; thence along said 1/4 line North 77°55'17" East 20.45 feet to the 1/4 corner common to said Sections 7 & 8; thence along the East & West 1/4 line of said Section 8, North 89°46'27" East 4004.74 feet to the Southeast corner of Government Lot 2 of said section; thence continuing along said 1/4 line North 89°46'27" East 1334.91 feet to the East 1/4 corner of said Section 8; thence along the East line of said section South 0°13'00" East 665.64 feet to the South line of the North 1/2 of the North 1/2 of the Southeast 1/4 of said Section 8; thence along the aforementioned line South 89°54'06" West 1932.81 feet to the Northwesterly line of Highway U.S.-31; thence along said highway line South 29°44'13" West 3661.53 feet; thence continuing along said highway line on a curve to the right 475.89 feet, (the radius of said curve being 5604.63, the central angle being 4°51'54" and the chord bears South 32°10'10" West 475.75 feet) to the West 1/8 line of said Section 17; thence along said 1/8 line North 0°02'04" East 1598.21 feet to the line common to said Sections 8 & 17; thence along said section line North 89°49'18" West 1336.25 feet to the POINT OF BEGINNING, being the East 1/2 of the Southeast 1/4, Part of Government Lots 1 & 2, all of Government Lot 3 in Section 7, the Southwest 1/4, Part of the Southeast 1/4 in Section 8, and part of the East 1/2 of the Northwest 1/4 of Section 17, all in Township 34 North, Range 7 West and containing 383.664 acres within the perimeter of the courses herein described. Property includes all land to the water's edge of Lake Michigan lying Northwesterly and Northerly of the courses described as being along said shore. Subject to the rights of the public and of any governmental unit in any part thereof taken, used or deeded for street, road or highway purposes.

John E. Ferguson, P.S. No.24595

PROPERTY DESCRIPTIONS: Sheet 3 of 3

For: Consumers Energy (Big Rock Point):
Date: January 15, 2003

Non-Impacted Area Lying South of Highway U.S.-31:
In the Township of Hayes, Charlevoix County, Michigan, BEGINNING at the 1/4 corner common to Sections 8 & 17, Township 34 North, Range 7 West; thence along the North & South 1/4 line of said Section 17 South 0°00'29" East 2655.11 feet to the center 1/4 corner of said Section 17; thence along the East & West 1/4 line of said section North 89°19'18" West 1338.35 feet to the West 1/8 line of said section; thence along said 1/8 line North 0°02'04" East 176.36 feet; thence North 57°35'47" East 115.13 feet; thence North 46°40'34" East 344.33 feet; thence along a curve to the left 477.88 feet, (the radius of said curve being 585.54 feet, the central angle being 46°45'40" and the chord bears North 23°17'44" East 464.73 feet); thence North 00°05'06" West 626.63 feet to the Southeasterly line of Highway U.S.-31; thence along said highway line North 29°44'13" East 1280.47 feet to the line common to said Sections 8 & 17; thence continuing along said highway line North 29°44'13" East 345.30 feet to the North & South 1/4 line of said Section 8; thence along said 1/4 line South 0°09'18" East 300.19 feet to the POINT OF BEGINNING, being part of Part of the Southeast 1/4, Southwest 1/4 in Section 8, and part of the East 1/2 of the Northwest 1/4 of Section 17, all in Township 34 North, Range 7 West and containing 46.699 acres. Subject to the rights of the public and of any governmental unit in any part thereof taken, used or deeded for street, road or highway purposes.

John E. Ferguson, P.S. No.24595

Radiological Event History

The following list is a summary of historical events that were either known, or had the potential, to impact the environment. Many of these events were evaluated and resolved through the corrective action process at the time of each occurrence. Documentation and further details surrounding these events can be found in the Historical Site Assessment (HSA) Supplemental Data.

1960's 1. A Bechtel construction crew reportedly buried non-contaminated welding equipment on the beach after the plant was completed. No location given.
Data from Historical Site Assessment Questionnaire.

1960's 2. Radwaste Tanks and Resin Disposal Tanks were overfilled on many occasions, often with water standing on the floor. The Valve Pit at the back northwest door of the Turbine Building had resin spills in it.
Historical Site Assessment Questionnaire.

1960's 3. Construction waste may have been buried west of the Discharge Canal near the beach in the construction staging area.
Historical Site Assessment Questionnaire.

1960's 4. Old steel cables and solid steel waste were buried or dumped along the east side of the Discharge Canal.
Historical Site Assessment Questionnaire.

1960's 5. Construction debris has been identified in areas along the Woods Road. These locations contain wooden pallets and paint chips that are suspected to originate from the Protected Area.
Historical Site Assessment Questionnaire.

1960's 6. Construction materials were stored in a temporary lay down areas near the Big Rock and the old weather tower.
Historical Site Assessment Questionnaire.

12-1-62 7. The Pipe Tunnel was flooded with approximately 2 inches of water. It is suspected that this water was from the Condensate System. Leaks of this type have occurred throughout the operational life of the plant. Some of this contaminated water may have entered the gravel filled expansion cavity that surrounds the Containment Building or through floor expansion joints into the sand below the building.
HP logbook entry 12-1-62

8-8-63 8. A water leak was identified at a flange of the Waste Hold Tank. These outdoor tanks are a part of the Radwaste Clean-up System and are located west of the Turbine Building. It is likely that contaminated water may have entered the ground below the tanks.
HP logbook entry dated 8-8-63.
Historical Site Assessment Questionnaire.

8-6-64 9. Discharge Canal dredging was completed 8-18-64. The discharge canal is the effluent pathway for the radwaste batch release of contaminated water. Based upon employee interviews and the results of scoping surveys, it is suspected that dredging spoils may have been stored on the narrow strip of land north of the protected area and on the beach northeast of the Discharge Canal.
HP logbook entries dated 8-6-64, 8-18-64.
Historical Site Assessment Questionnaires.
Safety Evaluation for renewal of dredging permit 5-11-87.
Evaluation of Radiological Impact of Discharge Canal Dredging 4-13-89.

11-13-64 10. Contamination was identified on top of the Canal Process Monitor intake piping during a maintenance work evolution. The source of contamination is believed to have originated from this licensed release pathway.
HP logbook entry dated 11-13-64.

6-8-65 11. Twelve logbook entries reference the incinerator and identify contamination in the ash. Used for burning clean trash, the incinerator was a simple enclosure constructed of cement block. Some of the ashes that were removed from the incinerator have contained low levels of contamination. The incinerator was in operation between 1965 and 1978. In December of 1978 it was dismantled, surveyed for contamination and released as clean trash. There is a potential that contamination may be present in the soil at this location.
HP logbook dated: 6-8-65, 9-10-70, 9-11-70, 6-12-73, 10-23-73, 4-29-74, 3-23-76, 7-1-76, 5-16-77, 4-17-78, 12-8-78, 12-21-78.
Historical Site Assessment Questionnaires.

10-3-72 12. Canal dredging is in process.
HP logbook entry 10-3-72.

7-25-73 13. Contaminated material is discovered in a temporary shelter near the stack base. No further entries refer to this storage location and it is probable that this temporary storage area was cleaned up shortly after discovery. The potential exists for soil and pavement in this area to be contaminated as a result of this event.
HP logbook entry 7-25-73.

10-3-73 14. Canal dredging is in progress.
HP logbook entry 10-3-73.

10-23-73 15. Ash removed from the incinerator was found to be contaminated. The ashes were disposed of as radwaste.
HP logbook entry 10-23-73.

4-29-74 16. Ten barrels of contaminated ashes were removed from the incinerator as radwaste.
HP logbook entry 4-29-74.

8-18-75 17. Uranylacetate was spilled in the Annex Building. The Public Affairs Department likely used this radioactive chemical during presentations. The area was cleaned up following the spill.
HP logbook entry 8-18-75.

3-23-76 18. Contamination was found in 8 barrels of ashes from the incinerator. The barrels were taken to the radwaste area for shipment.
HP logbook entry 3-23-76.

7-1-76 19. Contamination was identified in 8 barrels of incinerator ash. The ash was released as radwaste.
HP logbook entry 7-1-76.

2-21-77 20. The radwaste transfer cask liner was banged against the cask during the transfer of spent filters. Contaminated debris was spilled on the ground by the open air Radwaste Vault in the Radwaste Compound. The liner read 2.3 Rem/hr. Clean up efforts included the removal of contaminated snow. It is likely that contamination remained on the ground in this area.
HP logbook entry 2-21-77.

8-20-78 21. Contamination was found in demineralized water collected at the chemistry lab and Machine Shop sample location. The source of contamination is suspected to have originated from a remote piping cross connection that established demineralized water as an alternate source for spent fuel pool make-up. The cross connect was removed, and in later years this contamination was reduced to trace levels found only in sample locations at lower elevations in the sphere. Many plant systems that are connected to the demineralized water supply have drain connections that may have provided a contamination release pathway. The investigation following this event could not identify a radioactivity release to the environment. This system is now surveyed on a routine basis.
HP logbook entry 8-20-78.

9-28-78 22. The Waste Hold Tank was found overflowing to the asphalt below the tanks.
HP logbook entries 9-28-78 and 9-29-78.

12-8-78 23. The Incinerator was in the process of being dismantled by contractors. No contamination was identified during removal.
HP logbook entries 12-8-78 and 12-21-78

11-20-81 24. Approximately 10 cubic feet of contaminated resin were spilled at the north end of the Pipe Tunnel in the Turbine Building. The spill was an operational error resulting from improper valve line up. Clean up efforts included the removal of the top 3-5 inches of gravel from the expansion joint area between the Pipe Tunnel and the Sphere. Over the course of the next several days the area was decontaminated and resurveyed several times. Fields of 2-3 Rem/hr were recorded at contact with the floor. It is suspected that contamination remains in the sphere expansion area and may have also migrated through the floor expansion joints to the environment below.

HP logbook entries 11-20-80(2 log entries), 11-23-80(2 log entries), 11-24-80 (two log entries), Table 3.1-2 Big Rock Point Nuclear Plant Decommissioning Plan. Deviation Report D-BRP-80-60.

4-22-81 25. Loose contamination was found in a normally clean area of the Baler House (Butler Building). The baling area at this time was a 12 by 22 foot building located in the Radwaste Compound. This building was the location for the compaction and barreling of low level waste. Soils in this area are potentially contaminated.
HP logbook (2 log entries) 4-22-81.

8-17-81 26. Elevated contamination levels were identified while preparing for construction of the new Radwaste Building. Asphalt, dirt and vegetation with significant contamination levels were removed and placed in barrels for shipment. Large slabs of concrete were taken inside the turbine building and decontaminated. These blocks were then moved to their current storage location at the power line south and east of the Swamp Warehouse. This was a long-term project that continued on until November 9, 1981. A total of 90 drums of sand, cement, and blacktop were shipped offsite as radioactive waste.
HP logbook entries 8-17-81, 8-22-81, 8-25-81, 8-30-81, 8-31-81, 9-1-81, 9-2-81, 9-3-81, 9-4-81, 9-11-81, 9-15-81, 9-16-81, 10-8-81, 10-9-81, 10-12-81, 10-30-81, 11-2-81, 11-3-81, 11-4-81,11-5-81, 11-6-81, 11-9-81.
Table 3.1-2 Big Rock Point Nuclear Plant Decommissioning Plan.
Internal Correspondence GLF-81-27.
Historical Site Assessment Questionnaire.

11-5-82 27. Contamination was identified in asphalt rubble located near the Stack Base. The following events have occurred in the vicinity of the Stack Base that could have resulted in the contamination of this area: temporary contaminated material storage area, resin sluicing and pumping, numerous Waste Hold Tank leaks and overflows, Condensate Storage Tank leaks. This area was also the transfer point for the movement of radwaste filters casks to the Radwaste Building.
HP logbook entries11-5-82 and 7-25-73.

11-16-82 28. A transport pathway was identified between the Chemistry Lab sink and the septic system. This sink was used for the disposal of non-contaminated water samples. Modifications were made to correct this situation in December 1982. There is a potential that this sink may have been used for the disposal of contaminated waste. The septic tanks and drain field (liquid, sludge and soil) were sampled for suspected contamination. This and subsequent investigations and analyses have never identified radioactive contamination. The septic tanks are presently sampled and analyzed three times per year.
HP logbook 11-16-82, Specification field change SFC 82-050.

11-24-82 29. Contaminated blocks of cement from the radwaste vaults were moved to the northeast corner of the Contaminated Materials Warehouse. The cement had fixed contamination levels of 100 to 800 cpm. These blocks may have been stored along the power line at the time the contamination was discovered.
HP logbook entry 1-24-82.

5-31-84 30. Water was found weeping through the wall of the Radwaste Pump Room. The water originated from a leak in a two-inch aluminum line below the Turbine Building floor. It was calculated that approximately 20,000 gallons of condensate system water had leaked into the soil. A section of the floor in the southwestern corner of the turbine building was cut out and eight barrels of contaminated soil were removed and shipped as low-level radwaste. On August 16, 1985, Consumers Power requested NRC approval to retain the remaining contaminated soil. Total activity estimated at 1.4E-7 μCi/g; nuclides present in 1984 included Mn-54, Cs-137, Co-60 and Ag-110m. The NRC granted approval on May 8, 1986. Voids were replaced by clean fill and the concrete floor was repaired. It is estimated that 5300 cubic feet of contaminated soil remained at this location The summary section of this engineering study made the following conclusion: "Retaining the contaminated soil on-site with approximately 8 inches of concrete covering (turbine building floor) would result in no discernable impact on either the environment or on occupational and public health. The total activity is expected to be undetectable within seven years."
HP logbook entries 5-31-84, 7-10-84 (2 log entries), 7-11-84 (two log entries), 7-12-84, 7-18-84, and 7-25-84.
Engineering Analysis performed in August of 1985 "Justification for Retaining Contaminated Soil On-Site" E-BRP-84-05
Big Rock Point Nuclear Plant Decommissioning Plan Table 3.1-2.
Historical Site Assessment Questionnaire.
Event Report E-BRP-84-05.
Action Item Record A-BRP-84-20.

9-5-84 31. Contamination is discovered in a small quantity of soil during a free release evaluation of equipment from the temporary resin shed south of the Stack Base. This contamination was likely the result of a spill during spent resin pumping activities.
HP logbook entry 9-5-84.
Historical Site Assessment Questionnaire.

11-9-84 32. Concrete blocks from the radwaste vault were found with activity levels of 100 to 500cpm. These are likely from the storage location along the power line. (Related events 26 and 29.)
HP logbook entry 11-9-84.

7-29-85 33. In July of 1985 the "Butler Building" (formerly the Baler House) was evaluated for radioactivity. Fixed contamination of 300 cpm was found on the north window of this 12 by 22 foot metal building. The building was moved to a location directly east of the QA/QC warehouse inside the protected area and is now used for materials storage.
HP logbook entry dated 7-29-85.
Historical Site Assessment Questionnaire

9-30-86 34. Contaminated sludge was found in the heating boiler during a maintenance evolution. The source of this activity is believed to have originated from contaminated demineralized water make-up. (Related event 21). Frisking performed on samples of the sludge detected 160 cpm over background and

gamma analysis identified measurable levels of Co-60, Cs-134 and Cs-137. The sludge was removed and the area was decontaminated. A pathway existed for liquid drains from this system to have reached the environment. A new heating boiler was installed in 1990 and system drains are now batched by licensed effluent release.
HP logbook entries 9-30-86, 10-1-86, 10-2-86, 10-3-86, 10-6-86, 10-10-86, 10-11-86.

10-25-86 35. Contamination was found on the concrete floor under the pipe rack in the QA/QC warehouse. The contamination was limited to the locked storage area in the south quarter of the building. Fixed activity levels greater than 50,000 cpm were identified. A major clean-up effort was undertaken that involved chipping out contaminated sections of the floor. The room was then released as a radiologically clean area.
HP logbook entries dated 10-25-86, 10-27-86, 10-28-86, 10-29-86, 10-30-86, 12-22-86, 12-23-86, 3-27-87, 10-2-87, 10-5-87, 10-7-87, 10-14-87, 10-15-87, and 10-19-87.

2-13-87 36. Approximately 25 gallons of water is estimated to have leaked from the #1 Waste Hold Tank vent line due to overfilling. Less than one gallon was estimated to have reached the environment. Soil samples taken after this event identified 1.2E-5 Ci/gm of Co-60, 3.4E-5 Ci/gm of Cs-137, and 2.0E-6 Ci/gm of Mn-54. Two and a half fifty-five gallon drums of soil were removed from the area below the tank. The pit was approximately 3 feet long and 2 ½ feet deep when soil levels reached <100 cpm above background and the clean-up effort was terminated.
HP logbook entries 2-13-87 (2 log entries), 2-14-87,
Table 3.1-2 Big Rock Point Nuclear Plant Decommissioning Plan.
Deviation Report D-BRP-87-56.
Historical Site Assessment Questionnaire.
Internal Correspondence JLB 87-64.

3-11-87 37. A decontamination of the Waste Hold Tank was performed. This may be the result of the overflow recorded in event 36.
HP logbook entry dated 3-11-87 (2 log entries).

3-17-87 38. The Discharge Canal was dredged. A direct frisk of dredge spoils identified only background activity levels. The refuse was likely placed on the elevated stretch of property between the beach and the protected area fence that is north of the Containment Building. (Related events 9, 12, 14)
HP logbook entry dated 3-17-87.

6-30-87 39. Maintenance removes sludge from the heating boiler water-box. Gamma isotopic analysis identified a Cs-137 activity of 1.60E-6 Ci/cc of sludge. During the process of clean-out approximately 500 gallons of heating boiler water was inadvertently released to the septic system.
HP logbook entry 6-30-87.
Table 3.1-2 Big Rock Point Nuclear Plant Decommissioning Plan.
Internal Correspondence WMH-01 & WDB 87-05.
Historical Site Assessment Questionnaire.

6-29-88 40. Contaminated water leached through a cement wall on the west side of the Room 121 into the compressed gas bottle storage area. Water analysis identified an activity level of 3.59E-5 Ci/ml. The area was decontaminated and released as radiologically clean.
HP logbook entry 6-29-88.
Internal Correspondence RLB 88-12.

7-8-88 41. Moisture was again found at the seam of the wall in the gas bottle storage area. Smears of the area did not identify radioactive contamination.
HP logbook entry 7-8-88.

2-24-89 42. Drain line integrity is questioned in the floor drain of the Condensate Demineralizer Room (between cation and anion tanks). Maintenance personnel may have punctured the drain while attempting to unplug the line. Soil contamination is suspected below the concrete flooring.
*Internal Correspondence TAM 89-04, JLB 89*23.*

9-21-89 43. The floor sink inside the Room 121 decontamination area was found flooded up to the curb and water leaked out into the gas bottle storage area (related events 40 & 41). The area was cleaned up and released as radiologically clean.
HP logbook entries 9-21-89, 9-25-89, 9-26-89.

9-19-91 44. A truckload of rip/rap and a concrete pad were frisked and released for storage along the power line behind the Swamp Warehouse. This material was likely from the canal dredging area.
HP logbook (two entries) 9-19-91.

8-13-93 45. The #1 Waste Hold Tank was overfilled and leaked to the ground. The area was boundaried off and decontaminated. (Related events 8, 22, 36, 37).
HP logbook (two entries) 8-13-93.
Deviation Report D-BRP-93-048.

11-27-93 46. The overhead supply line to the Condensate Storage Tank was found leaking near the Turbine Building. A temporary cover was constructed to keep out rain and snow. Two 55-gallon barrels of low activity soil were removed from the leak area. On June 6, 1994 further clean up resulted in the removal of an additional barrel of soil.
HP logbook 11-27-93 (two logbook entries), 11-29-93 (two logbook entries), 12-1-93, Table 3.1-2 Big Rock Point Nuclear Plant Decommissioning Plan.
Deviation Report D-BRP-93-065.
Historical Site Assessment Questionnaire.

1-6-94 47. A leaking union was discovered on a section of the demineralized water transfer line located immediately west of the southern end of the Turbine Building. Snow and ice in the area below the piping leak was collected. The logbook entry gave no activity results for the samples. The leak was repaired on the same day as it occurred.
HP logbook (two entries) 1-6-94
Historical Site Assessment Questionnaire.

6-27-94 48. Contractors removed asphalt and dirt from the Radwaste Compound in preparation for pouring a new cement slab in front of the loading bay. This asphalt and dirt were released to the power line storage area behind the Swamp Warehouse. This location from which these materials came was once a contamination area.
HP logbook entries 6-27-94, 6-30-94

8-18-94 49. In August of 1994 the Decommissioning Planning Team had nine groundwater- monitoring wells installed. Gamma isotopic analyses of water samples collected from these wells showed no detectable reactor generated activity, however, an analysis for Tritium identified low level contamination in the two wells (wells 5 & 6) closest to the lake. The Tritium is believed to have originated from the Condensate Storage Tank leak (event 30) that occurred in May of 1984. The Tritium concentration is a factor of 500 lower than the level of the original leak and it is likely that this represents the tail of the groundwater plume moving toward Lake Michigan. Routine activity monitoring of groundwater has been added to the plant's Radiological Environmental Monitoring Program.

As part of Decommissioning Planning, an initial site Scoping Survey was also performed. This survey identified contaminated soil in the following two locations:

Area 1 - The edge of the asphalt directly west of the resin disposal tank plugs. Approximately 5-10 square meters. Nuclide activity levels in this area ranged from 4.7 to 13 pCi/gm of Co-60, and 2.8 to 100 pCi/gm of Cs-137. This is believed to have originated from the 1990 resin transfer work and the numerous spills and overflows of the Waste Hold Tanks that occurred over the years.

Area 2 - Approximately 5-10 square meters of soil west of the acid tank containment wall contained contamination levels up to 48 pCi/gm of Co-60 and 70 pCi/gm of Cs-137. This activity suspected to have originated from the 1984 Condensate Storage Tank leak and other spills and overflows of the Waste Hold Tanks.

Clean up efforts were conducted at the completion of the Scoping Survey.
Deviation Report D-BRP-94-073 & D-BRP-94-073B.

11-12-94 50. An activity analysis was performed on the storm drain effluent that empties into the west drainage ditch. Samples were taken from the eroded area near the drain and from nearby sediment and vegetation. The results of these analyses could not be located. However, it is known that radioactivity was limited to sediment passing through the drain and not to liquid effluent, and that a barrel was installed to collect sediment at the outfall of the drain.
HP logbook entry 11-12-94

6-6-95 51. Gravel containing Cs-137 was identified during repair of the Turbine Building roof. The gravel contained Cs-137 at soil background levels. The gravel is being stored under a tarp northwest of the sphere.
HP logbook (two entries) 6-6-95.
Internal Correspondence RAE HP97-008.

9-14-95 52. Heavy rains flooded an area below the stack base. The storm drain at this location had been sealed due to ongoing resin transfer work and the seal was removed to allow flow to the west drainage ditch. A gamma analysis of the drain discharge to the drainage ditch identified radioactive contamination. No activity could be identified in additional samples taken of the sediment collection barrel and creek discharge to the lake.
HP logbook entry dated 9-14-95

8-23-96 53. Contamination was found (15 pCi/gm) in the collection barrel sediment of the storm drain discharge at the west drainage ditch. Samples were taken after a spent resin transfer evolution west of the Turbine Building. This location is the storm water collection source for the storm drain. An investigation identified the following known sources of contamination in this area:

- Spills or the migration of contamination during spent resin and filter cask transfer
- Waste Hold Tank overfills
- Contamination resulting from past leaks in area piping

Condition Report C-BRP-96-778.

9-16-96 54. Two loads of blacktop were removed from an area near the stack base. Both loads were frisked and identified no activity above background levels. These two loads were released to the storage area along the power line behind the Swamp Warehouse. An additional load evaluated on the following day contained numerous areas of surface contamination ranging from 1,000 to 10,000 cpm. The contaminated pieces were segregated and taken to the Radwaste Building. The remaining asphalt was released to the power line storage area.
HP logbook entries 9-16-96, 9-17-96.

11-18-96 55. Roof repair was performed on the Turbine Building (Related event 51). Gravel from this location was removed and placed in the storage location northwest of the Containment Building. The average activity of the gravel stored in this area is 0.72 pCi/gm Cs-137, and 0.07 pCi/gm Co-60.
HP logbook entry 11-18-96.
Internal Correspondence RAE HP97-008.

3-13-97 56. Contamination was found in the soil below a cracked floor drain near the caustic tank in the Condensate Pump Room. This room is located in the Turbine Building north of Track Alley. Samples collected identified Cs-137, Mn-54, Sb-124, and Cs-134. Area clean up efforts were performed and the drain has been plugged to prevent further use. Soils in this location are expected to contain low levels of contamination.
HP logbook entry 3-13-97.
Condition Report C-BRP-97-0174.

3-98 57. An investigation of a system process monitor alarm event identified contamination (Co-60 and Mn-54) in the sediment of the east storm drain. For a brief period, radioactive contaminants were introduced into the Service Water System that provides supply water to many radiologically clean systems. The contaminants entered through an improperly seated condenser warming line and were the result of wave-suspended radioactivity that was previously discharged to the lake in permitted releases. The sediment radioactivity is likely to have originated from the condenser vacuum pump which uses sealing water from the Service Water System and discharges to the storm drain. Sediment activity levels in the drain piping were approximately 0.8 pCi/gm. No activity was identified in the samples taken from other connecting sections of drain system. The entire length of this drain line has been decontaminated and is now monitored on a routine basis by the Operational Health Physics Department. Any potential piping leaks in this system would have presented a release pathway to the environment.
Condition Report C-BRP-98-056 and WR 117526

5-99 58. Trace levels of contamination were found in the east storm drain piping during a follow-up survey to CR-BRP-98-056 (Related event 57). This activity is likely to be wash out from the earlier event of March of 1998. An effort has been made to seal plant outflow piping to the storm drains and this system is now monitored in the Annual Survey. The Planning and Scheduling Department has been notified that removal of storm drains will be a requirement for license termination.
Condition Report C-BRP-99-0183

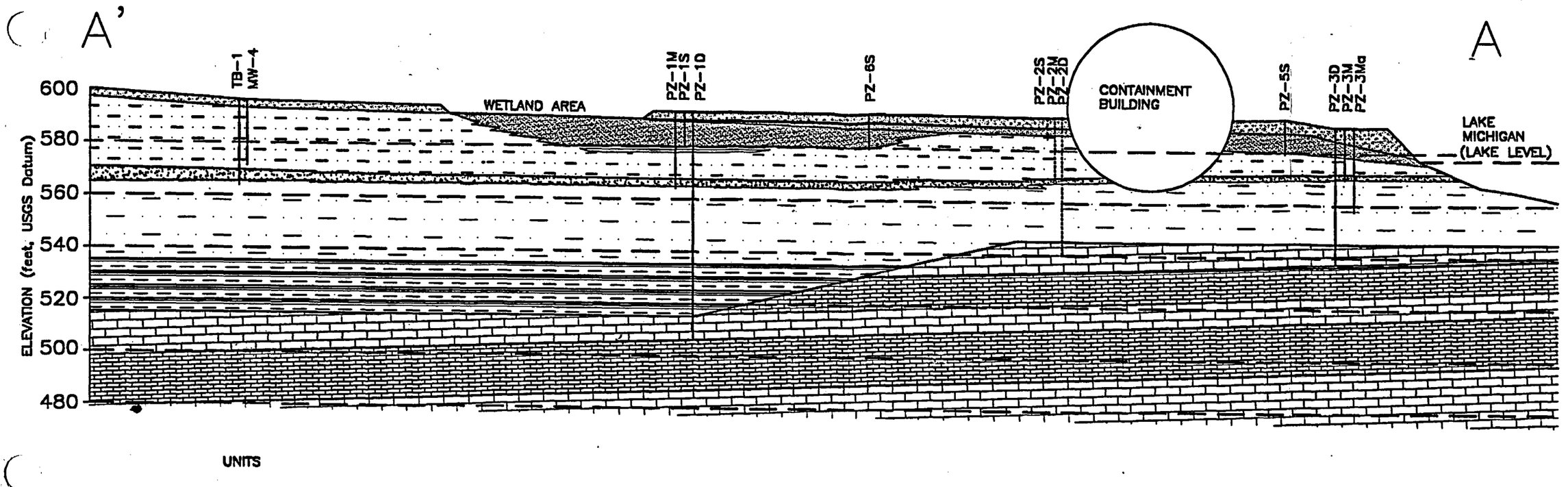
No Date 59. Anti-Contamination clothing in a yellow radwaste disposal bag was found in a void under the asphalt near the Equipment Lock Area. No contaminated materials were present in the bag. This void may be the result of wash out that was caused by modifications that were made to the Alternate Shutdown Building drainage. No further information is known concerning the origin of the radwaste disposal bag.
Historical Site Assessment Questionnaire

No Date 60. Floor drain in shop had activity.
Historical Site Assessment Questionnaire

No Date 61. The integrity of all under ground piping is suspect due to inadequate cathodic protection. There is a potential of soil contamination in areas near underground piping carrying radioactive fluids.
Historical Site Assessment Questionnaire

No Date 62. There was a spill during a resin shipment that occurred prior to sealing the storm drains at the Stack Base.
Historical Site Assessment Questionnaire

No Date 63. Old steel from inside the sphere was stored in the area where the Swamp Warehouse is presently located. The steel was from plant modifications that were made over the years and is believed to contain low levels of contamination.
Historical Site Assessment Questionnaire



UNITS

- SAND & GRAVEL FILL (6a)
- NATIVE SAND,W/GRAVEL, OCCASIONAL CLAY LAYERS, WET AT BOTTOM (6b)
- UNSORTED SAND, CLAY, GRAVEL (5)
- SAND,FINE GRAINED, SATURATED (4)
- SANDY CLAY W/SAND SEAMS, WET (3)
- SILTY CLAY, DRY (2)
- LIMESTONE BEDROCK (1)

NOTES:

1. BOUNDARIES BETWEEN GEOLOGICAL UNITS ARE INFERRED BASED ON LIMITED SUBSURFACE DATA.

2. WELLS SHOWN WITH DASHED LINES ARE PROJECTED ONTO VERTICAL PROFILE.

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 40'

BIG ROCK POINT RESTORATION PROJECT CHARLEVOIX CO., MICHIGAN	**Figure 2-5.** VERTICAL PROFILE A–A'		
OTWELL MAWBY, P.C. Traverse City, Michigan	Date: 07/23/02	Job No.:	Scale: 1"=100'