# EVALUATION

## 1.0 DESCRIPTION

Humboldt Bay Power Plant (HBPP), Unit 3, is currently undergoing active decommissioning, and spent fuel has been transferred to the onsite Humboldt Bay Independent Spent Fuel Storage Installation (ISFSI). As a result, Pacific Gas and Electric Company (PG&E) proposes to amend Facility Operating License DPR-7 for HBPP, Unit 3, to add License Condition 2.C.5, "License Termination Plan (LTP)."

## 2.0 PROPOSED CHANGE

PG&E proposes to add License Condition 2.C.5, which describes NRC approval of the LTP and provides criteria for making future changes to the LTP that require prior NRC approval. The proposed wording for License Condition 2.C.5 is contained in Enclosure 2 of this letter.

## 3.0 BACKGROUND

On July 2, 1976, HBPP, Unit 3, was shut down for refueling. During the shutdown, PG&E had to upgrade the seismic design basis for the plant based on new seismic information. In December 1980 it became apparent that the cost of completing the required upgrades would make it uneconomical to restart the unit. PG&E ultimately concluded that the seismic modifications and other modifications required (i.e., in response to the Three Mile Island accident in 1979) were not economical, and in June 1983 announced its intention to decommission Unit 3.

PG&E permanently defueled the Unit 3 reactor in 1984, and on July 30, 1984, PG&E submitted a license amendment request (LAR) to possess fuel for up to 30 years, but no longer operate, and to decommission using the SAFSTOR method. On July 16, 1985, the NRC issued License Amendment (LA) 19 to place Unit 3 in a possess-but-not-operate status. On July 19, 1988, the NRC issued LA 23 approving the Decommissioning Plan and authorizing the decommissioning of HBPP, Unit 3.

PG&E submitted the HBPP, Unit 3, Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC on February 27, 1998, in accordance with 10 CFR 50.82(a)(4)(i). The PSDAR and the Defueled Safety Analysis Report (DSAR) superseded the original Decommissioning Plan and provided the information required by 10 CFR 50.82(a)(4). By December 2008, all spent fuel had been removed from the spent fuel pool and transferred to the 10 CFR 72 licensed ISFSI.

PG&E is currently conducting decontamination and decommissioning (D&D) activities at the HBPP site in accordance with HBPP procedures and approved work packages. This will complete the last phase of SAFSTOR. Final decommissioning activities are being coordinated with the appropriate Federal and State regulatory agencies. This will allow for the performance of activities to prepare the site for license termination.

## 4.0 REGULATORY ANALYSIS

Pursuant to 10 CFR 50.82(a)(9), nuclear power reactor licensees are required to submit an LTP prior to, or along with, their application for termination of a license. This LTP will become a supplement to the HBPP, Unit 3, DSAR. The LTP is required to be submitted at least 2 years before termination of the license.

PG&E is submitting a proposed amendment to the HBPP, Unit 3, license to satisfy the requirements of 10 CFR 50.82(a)(10) for approval of the HBPP LTP by license amendment. The change to the license will authorize the implementation of the LTP, allows the implementation of the method outlined in Chapter 5 of the LTP for site compliance with dose-based release criteria, and provides appropriate and necessary conditions for when changes can be made without prior NRC review and approval.

PG&E prepared the LTP using the guidance in:

- Regulatory Guide 1.179 "Standard Format and Contents for 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," and
- NUREG-1757 "Consolidated NMSS Decommissioning Guidance"

## 5.0 TECHNICAL ANALYSIS

The LTP includes a discussion on the following topics:

- Site Characterization to ensure that Final Status Surveys (FSS) cover all areas where contamination existed, remains, or has the potential to exist or remain,
- Identification of remaining dismantlement activities,
- Plans for site remediation,

- A description of the FSS plan to confirm that HBPP will meet the release criteria in 10 CFR 20, Subpart E,
- Dose-modeling scenarios that ensure compliance with the radiological criteria for license termination,
- An estimate of the remaining site-specific decommissioning costs, and
- A supplement to the DSAR and the Final Generic Environmental Impact Statement describing any new information or significant environmental change associated with proposed license termination activities.

This proposal gives the NRC the opportunity to review the HBPP LTP to ensure HBPP's planned activities and processes meet the criteria in 10 CFR 50.82(a)(9) and NUREG-1700. Additionally, in accordance with NUREG-1700, Revision 1, Appendix 2, the license condition requires NRC approval for changes to the methodology that could result in increasing the amount of plant-related activity remaining at the time of license termination compared to the methodology the NRC reviewed in the proposed LTP.

Since the LTP is based on NRC guidance and establishes the methodology PG&E will use to meet license termination criteria, this proposed license amendment is appropriate to allow completion of the HBPP decommissioning project and license termination.

## 6.0 ENVIRONMENTAL CONSIDERATION

### No Significant Hazards Consideration

PG&E has reviewed the proposed license amendment against each of the criteria in 10 CFR 50.92, "Issuance of amendment," and has concluded that the amendment request does not involve a significant hazards consideration. The following provides PG&E's analysis of the issue of no significant hazards consideration:

**1. Does the proposed license amendment involve a significant increase in the probability or consequences of an accident previously evaluated?**

No. The change allows for the approval of the LTP and provides the criteria for when changes to the LTP require prior NRC approval. This change does not affect possible initiating events for the decommissioning accidents previously evaluated in the HBPP DSAR, as updated, Appendix A, "Implications of Decommissioning Accidents with Potential for Radiological Impacts to the Environment," or alter the configuration or operation of the facility. Safety limits,

limiting safety system settings, and limiting control systems are no longer applicable to HBPP in the permanently defueled mode, and are therefore not relevant.

The proposed change does not affect the boundaries used to evaluate compliance with liquid or gaseous effluent limits, and has no impact on plant operations. Therefore, the proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

**2. Does the proposed license amendment create the possibility of a new or different kind of accident from any accident previously evaluated?**

No. The safety analysis for the facility remains accurate as described in the HBPP DSAR, as updated, Appendix A. There are sections of the LTP that refer to the decommissioning activities still remaining (e.g. removal of large components, decontamination, etc.). However, these activities are performed in accordance with approved HBPP work packages/steps and undergo 10 CFR 50.59 screening prior to initiation. The proposed amendment merely makes mention of these processes and does not bring about physical changes to the facility. Therefore, the facility conditions for which the postulated accidents have been evaluated are still valid and no new accident scenarios, failure mechanisms, or single failures are introduced by this amendment. The system operating procedures are not affected. Therefore, the proposed changes will not create the possibility of a new or different kind of accident from any accident previously evaluated.

**3. Does the proposed license amendment involve a significant reduction in a margin of safety?**

No. There are no changes to the design or operation of the facility resulting from this amendment. The proposed change does not affect the boundaries used to evaluate compliance with liquid or gaseous effluent limits, and has no impact on plant shutdown operations. Accordingly, neither the postulated accident assumptions in the DSAR, as updated, Appendix A, nor the Technical Specifications are affected. Therefore, the proposed change does not involve a significant reduction in a margin of safety.

**Environmental Impact Consideration**

This amendment request satisfies the criteria specified in 10 CFR 51.22(c)(9) for a categorical exclusion from the requirements to perform an environmental assessment or to prepare an environmental impact statement. The criteria of 10 CFR 51.22(c)(9) are addressed as follows:

**(i) The amendment involves no significant hazards consideration.**

As discussed in the No Significant Hazards Consideration section above, the proposed license amendment 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 the plant activities described in the DSAR. No changes in effluent system requirements or controls are proposed in this change. The environmental impacts associated with radiation dose 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," NUREG-0586, Supplement 1, and NUREG-1496, "Generic Environmental Impact Statement in Support of the Rulemaking on Radiological Criteria for License Termination."

NUREG-0586 provides a generic environmental assessment of decommissioning a reference nuclear facility. Based on the findings in NUREG-0586, the NRC concluded a generic finding of "no significant (environmental) impact." The NRC further concluded that no additional Environmental Impact Statement would need to be prepared in connection with decommissioning a particular nuclear site unless the impacts of a particular plant have site-specific considerations significantly different from those studied generically. LTP Chapter 8 provides an updated assessment of the environmental effects of decommissioning HBPP. The updated assessment also determined that the environmental effects from decommissioning HBPP are minimal and there are no adverse effects outside the bounds of NUREG-0586, Supplement 1. Based on the above, there will not be a significant change in the types or increase in the amounts of effluents released offsite for the remaining decommissioning activities. The release of effluents from the facility will continue to be controlled by site procedures throughout the remaining decommissioning, and the activities at HBPP will continue to be performed in accordance with the HBPP Offsite Dose Calculation Manual, as applicable.

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

The attributes identified in NUREG-0586, Supplement 1 were compared with the remaining activities for HBPP and the following conclusions were made:

- PG&E will maintain annual occupational radiation exposure to individuals as low as reasonably achievable. These exposures will be at, or below, the estimated values in Table 4-1 of NUREG-0586, Supplement 1. LTP Section 3.4 provides a dose estimate for HBPP decommissioning.

- PG&E will maintain exposure to onsite workers and the offsite public as a result of waste transportation well below the levels projected by NUREG-0586.

LTP Chapter 8 provides an updated assessment of the environmental effects of decommissioning HBPP. The updated assessment also determined that the environmental effects from decommissioning HBPP are minimal and there are no adverse effects outside the bounds of NUREG-0586, Supplement 1.

Based on the above, there is no significant increase in individual or cumulative occupational exposure due to decommissioning HBPP.

**Conclusion**

Based on the evaluations above: (1) there is reasonable assurance that the health and safety of the public will not be endangered by the conduct of activities in the proposed manner, and (2) such activities will be conducted in compliance with the NRC's regulations, and the proposed amendment will not be inimical to the common defense and security or the health and safety of the public.

## 7.0 REFERENCES

7.1 Regulatory Guide 1.179, "Standard Format and Contents for License Termination Plans for Nuclear Power Reactors"

7.2 NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)"

7.3 NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans"

7.4 NUREG-1757, "Consolidated NMSS Decommissioning Guidance"

7.5 NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities"

7.6 NUREG-0586 Supplement 1, "Regarding the Decommissioning of Nuclear Power Reactors"

7.7 NUREG-1496, "Generic Environmental Impact Statement in Support of the Rulemaking on Radiological Criteria for License Termination"

7.8 10 CFR 50.82, "Termination of License"

## PROPOSED LICENSE CHANGE

New License Condition 2.C.5 is proposed as follows:

5. License Termination Plan (LTP)

NRC License Amendment No. 45 approves the LTP. In addition to the criteria specified in 10 CFR 50.59 and 10 CFR 50.82(a)(6), a change to the LTP requires prior NRC approval if the change:

(a) Increases the probability of making a Type 1 decision error above the level stated in the LTP

(b) Increases the radionuclide-specific derived concentration guideline levels (DCGL) and related minimum detectable concentrations

(c) Increases the radioactivity level, relative to the applicable DCGL, at which investigation occurs

(d) Changes the statistical test applied other than the Sign Test or Wilcoxon Rank Sum Test.

(e) Results in significant environmental impacts not previously reviewed.

Reclassification of survey areas from a less to a more restrictive classification (e.g., from a Class 3 to a Class 2 area) may be done without prior NRC notification; however, reclassification to a less restrictive classification (Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.

# HUMBOLDT BAY POWER PLANT, UNIT 3

# LICENSE TERMINATION PLAN

## TERMS AND ACRONYMS

**Action Level**—The numerical value that will cause the decision maker to choose one of the alternative actions. It may be a regulatory threshold standard (*e.g.*, Maximum Contaminant Level for drinking water), a dose- or risk-based concentration level (*e.g.*, *DCGL*), or a reference-based standard.

**AEC**—Atomic Energy Commission

**AF**—Area Factor

**AL**—ALARA action level

**ALARA**—"as low as reasonably achievable," which means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical.

**alpha ($\alpha$)**—The specified maximum probability of a Type I error. This means the maximum probability of rejecting the null hypothesis when it is true. Alpha also is referred to as the size of the test. Alpha reflects the amount of evidence the decision maker would like to see before abandoning the null hypothesis.

**ANL**—Argonne National Laboratory

**Area of elevated activity**—An area over which residual radioactivity exceeds a specified value $DCGL_{EMC}$.

**beta ($\beta$)**—The probability of a Type II error, i.e., the probability of accepting the null hypothesis when it is false. The complement of beta ($1-\beta$) is referred to as the power of the test.

**bgs**—below ground surface

**BMP**—Best Management Practice

**BWR**—Boiling Water Reactor

**CAB**—Citizens Advisory Board

**Caisson**—An underground concrete structure at HBPP that houses the underground nuclear reactor.

**CCC**—California Coastal Commission

**CDP**—Coastal Development Permit

**CEC**—California Energy Commission

**CFR**—Code of Federal Regulations

**CIRP**—Caisson In leakage Repair Project

**COC**—Chain of Custody refers to an unbroken trail of accountability to ensure the physical security of samples, data, and records.

**Conceptual site model**—A description of a site and its environs and presentation of hypotheses regarding the contaminants present, their routes of migration, and their potential impact on sensitive receptors.

**Control charts**—A plot of the results of a quality control action that demonstrates control is being maintained within expected statistical variation or to indicate when control is or may be lost unless intervention occurs.

**CPUC**— California Public Utilities Commission

**Critical Group**—The average group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

**CWT**—Concentrated Waste Tank

**D&D**—Decontamination and Decommissioning

**Data Quality Assessment (DQA)**—The scientific and statistical evaluation of data used to determine if the data are of the right type, quality, and quantity to support their intended use.

**Data Quality Objective (DQO)**—Qualitative and quantitative statements derived from the DQO process that clarify technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

**DAW**—Dry Active Waste

**DCF**—Dose Conversion Factor

**DCGL**—Derived Concentration Guideline Level

**$DCGL_{EMC}$**—A DCGL scaled, through the use of area factors, to obtain a DCGL that represents the same dose to an individual for residual radioactivity in a smaller area within a survey unit.

**$DCGL_W$**—A DCGL for the average residual radioactivity in a survey unit.

**delta ($\delta$)**—The amount that the distribution of measurements for a survey unit is shifted to the right of the distribution of measurements of the reference area. This term is used in the evaluation of elevated areas.

**delta ($\Delta$)**—The width of the gray region. $\Delta$ divided by $\sigma$, the arithmetic standard deviation of the measurements, is the relative shift expressed in multiples of standard deviations.

**Derived Concentration Guideline Levels (DCGLs)**—Derived radionuclide-specific activity concentration that corresponds to the release criterion (25 mrem/y) within a survey unit.

**DOE**—U.S. Department of Energy

**DP**—Decommissioning Plan

**DPM**— disintegrations per minute

**DPR**—Decommissioning Project Report

**DQO**—Data Quality Objective

**DSAR**—Defueled Safety Analysis Report

**DTSC**—Department of Toxic Substances Control

**Elevated Measurement Comparison (EMC)**—This comparison is used to determine if there are any measurements that exceed a specified value $DCGL_{EMC}$.

**EPA**—U.S. Environmental Protection Agency

**ETD**—Easy to detect (for this purpose, nuclides that are detectable by gamma analysis)

**Exposure Scenario**—A description of the future land uses, human activities, and behavior of the natural system as related to a future human receptor's interaction with (and therefore exposure to) residual radioactivity. In particular, the exposure scenario describes where humans may be exposed to residual radioactivity in the environment, what exposure group habits determine exposure, and how residual radioactivity moves through the environment.

**$ft^3$**—cubic foot

**FGEIS**—Final Generic Environmental Impact Statement

**FGR**—Federal Guidance Report

**FSS**—Final Status Survey

**GEIS**—Generic Environmental Impact Statement

**Gross Activity DCGLs**—DCGLs established, based on the representative radionuclide mix, for gross (non-radionuclide-specific) alpha/beta surface radioactivity measurements. Field assessments will typically consist of these gross radioactivity measurements.

**GTCC**—Greater than Class C

**HABS**—Historic American Building Survey

**HAER**—Historic American Engineering Record

**HBGS**—Humboldt Bay Generating Station

**HBPP**—Humboldt Bay Power Plant

**HEPA**—High Efficiency Particulate Air filter

**Historical Site Assessment (HSA)**—The identification of potential, likely, or known sources of radioactive material and radioactive contamination based on existing or

derived information for the purpose of classifying a facility or site, or parts thereof, as impacted or non-impacted.

**HPGe**—High Purity Germanium

**HSE**—Health, Safety, and Environment

**HTD**—Hard to detect (for this purpose, nuclides that are not detectable by gamma analysis).

**Investigation level**—A derived media-specific, radionuclide-specific concentration or activity level of radioactivity that: 1) is based on the release criterion, and 2) triggers a response, such as further investigation or cleanup, if exceeded.

**ISFSI**—Independent Spent Fuel Storage Installation

**ISOCS**—In Situ Object Counting System

**Judgmental measurement/biased measurement**—A measurement performed at locations selected using professional judgment based on unusual appearance, location relative to known contaminated areas, high potential for residual radioactivity, general supplemental information, etc. Judgmental measurements are not included in the statistical evaluation of the survey unit data because they violate the assumption of randomly selected, independent measurements. Instead, judgmental measurements are individually compared to the DCGL.

**LA**—License Amendment

**LAR**—License Amendment Request

**LHS**—Latin Hypercube Sampling

**LLRW**—Low-level Radioactive Waste

**LLW**—Low-level Waste

**Lower Bound of the Gray Region (LBGR)**—Refers to the minimum value of the gray region. The width of the gray region (*DCGL-LBGR*) is also referred to as the shift, $\Delta$.

**LPG**—Liquid Propane Gas

**LRW**—Liquid Radwaste

**LTP**—License Termination Plan

**$m^2$**—square meter

**$m^3$**—cubic meter

**MARSSIM**—The *Multi-Agency Radiation Site Survey and Investigation Manual (NUREG–1575)* is a multi-agency consensus manual that provides information on planning, conducting, evaluating, and documenting building surface and surface soil final

status radiological surveys for demonstrating compliance with dose- or risk-based regulations or standards.

**MDC**—Minimum Detectable Concentration

**MDCR**—Minimum Detectable Count Rate

**Measurement**—For the purpose of MARSSIM, the term is used interchangeably to mean: 1) the act of using a detector to determine the level or quantity of radioactivity on a surface or in a sample of material removed from a media being evaluated or, 2) the quantity obtained by the act of measuring.

**MEPPS**—Mobile Emergency Power Plant Station

**MeV**— Mega electron Volts

**Minimum Detectable Concentration (MDC)**—This term means the *a priori* radioactivity concentration level that specific instrument or technique can be expected to detect 95% of the time; the value that should be used when stating the detection capability of an instrument for a given measurement technique. The MDC is the detection limit, $L_D$, multiplied by an appropriate conversion factor to give units of radioactivity concentration.

**Minimum detectable count rate (MDCR)**—The minimum detectable count rate is the *a priori* count rate that a specific instrument and technique can be expected to detect.

**MLLW** —mean lower low water, which is the average height of the lowest tide recorded at a tide station each day during the recording period.

**mrem/y (millirem per year)**—One one-thousandth (0.001) of a rem per year.

**MSL**—mean sea level

**NAVD88**—North American Vertical Datum 1988

**NCUAQMD**—North Coast Unified Air Quality Management District

**NDCTP**—Nuclear Decommissioning Cost Triennial Proceeding

**NEI**—Nuclear Energy Institute

**NIST**— National Institute of Standards and Technology

**Non-impacted Area**—An area where there is no reasonable possibility (extremely low probability) for residual radioactivity to exist.

**Nonparametric test**—A test based on relatively few assumptions about the exact form of the underlying probability distributions of the measurements. As a consequence, nonparametric tests are generally valid for a fairly broad class of distributions. The Wilcoxon Rank Sum test and the Sign test are examples of nonparametric tests.

**NRC**—Nuclear Regulatory Commission

**Null Hypothesis ($H_0$)**—A statistical scenario set up to be nullified, refuted or rejected ('disproved statistically') in order to demonstrate compliance with the release criteria.

**ODCM**—Offsite Dose Calculation Manual

**OWS**—Oil/Water Separator

**PCB**—Polychlorinated Biphenyl

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

**PG&E**—Pacific Gas and Electric

**$PM_{10}$**—particulate matter of 10 microns

**Power (1-$\beta$)**—This term refers to the probability of rejecting the *null hypothesis* when it is false. The power is equal to one minus the *Type II* error rate, *i.e.* (1-$\beta$).

**PRCC**—Partial Rank Correlation Coefficient

**Precision**—A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

**Probabilistic**—Refers to computer codes or analyses that use a random sampling method to select parameter values from a distribution. Results of the calculations are also in the form of a distribution of values. The results of the calculation do not typically include the probability of the scenario occurring.

**PSDAR**—Post-Shutdown Decommissioning Activities Report

**QAPP**—Quality Assurance Project Plan

**QC**—Quality Control

**RA**—Restricted Area

**RCA**—Radiological Control Area

**RCRA**—*Resource Conservation and Recovery Act of 1976*

**Reference area**—Geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units at remediation site. A site radiological reference area (background area) is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the site area being remediated, but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if that site had never been contaminated. More than one reference area may be necessary for valid comparisons if a site exhibits considerable physical, chemical, radiological, or biological variability.

**Reference coordinate system**—A grid of intersecting lines referenced to a fixed site location or benchmark. Typically, the lines are arranged in a perpendicular pattern dividing the survey location into squares or blocks of equal areas. Other patterns include three-dimensional and polar coordinate systems.

**Relative shift ($\Delta/\sigma$)**—$\Delta$ divided by $\sigma$, the standard deviation of the measurements.

**Release criterion**—A regulatory limit expressed in terms of dose or risk.

**REMP**—Radiological Environmental Monitoring Program

**Replicate**—A repeated analysis of the same sample or repeated measurement at the same location.

**RESRAD Code**—A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in soils.

**RESRAD-BUILD Code**—A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in BUILDings.

**Restricted Area**—Any area to which access is limited by a licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

**RGWMP**—REMP Ground Water Monitoring Program

**RWP**—Radiation Work Permit

**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.

**Scanning**—An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation.

**SCM**—Site Conceptual Model (same as Conceptual Site Model)

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

**SFP**—Spent Fuel Pool

**Sign Test**—A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide-of-interest is not present in background or present in a small fraction of the DCGL, and the distribution of data is not symmetric.

**Single nuclide DCGL**—A radionuclide-specific activity concentration that would result in an annual total effective dose equivalent (TEDE) of 25 mrem with no other radionuclides present.

**$S_o$**—Sensitivity Threshold

**Source Term**—Refers to a conceptual representation of the residual radioactivity at a site or facility.

**Split Sample**—A sample that has been homogenized and divided into two or more aliquots for subsequent analysis.

**Standard normal distribution**—A normal (Gaussian) distribution with mean zero and variance one.

**Survey Area**—An area established and classified based on a common radiological history, logical physical boundaries, and site landmarks for the purpose of documenting and conveying radiological information.

**Survey Area Report**—A report including all the survey units within a survey area providing a complete and unambiguous record of the radiological status of each survey unit relative to the established DCGLs.

**Survey Package**—A document developed by the DQO process providing the methodology by which to perform the final status survey.

**Survey Unit**—A geographical area consisting of structures or land areas of specified size and shape at a site for which a separate decision will be made as to whether or not the unit attains the site-specific reference-based cleanup standard for the designated pollution parameter. Survey units are generally formed by grouping contiguous site areas with similar use histories and having the same contamination potential (classification). Survey units are established to facilitate the survey process and the statistical analysis of survey data. One, or more, survey units makeup a survey area.

**Systematic error**—An error of observation based on system faults which are biased in one or more ways, *e.g.*, tending to be on one side of the true value more than the other.

**TBD**—HBPP Technical Basis Documents

**TCP**—Traffic Control Plan

**Total Effective Dose Equivalent (TEDE)**—The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (CEDE) (for internal exposures).

**Triangular sampling grid**—A grid of sampling locations that is arranged in a triangular pattern.

**Turnover Survey**—A final operational radiological survey performed by the Radiation Protection (RP) Department after the completion of decommissioning activities in an area to verify that the area is ready for Final Status Survey.

**Type I error**—A decision error that occurs when the null hypothesis is rejected when it is true. The probability of making a Type I decision error is called alpha ($\alpha$).

**Type II error**—A decision error that occurs when the null hypothesis is accepted when it is false. The probability of making a Type II decision error is called beta ($\beta$).

**Unity rule**—A rule applied when more than one radionuclide is present at a concentration that is distinguishable from background and where a single concentration comparison does not apply. In this case, the mixture of radionuclides is compared against default concentrations by applying the unity rule. This is accomplished by determining: 1) the ratio between the concentration of each radionuclide in the mixture, and 2) the concentration for that radionuclide in an appropriate listing of default values. The sum of the ratios for all radionuclides in the mixture should not exceed 1.

**VSP**—Visual Sample Plan software used for plotting sample/measurement locations.

**Wilcoxon Rank Sum (WRS) test**—A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide-of-interest is present in background.

**$W_r$**—This represents the sum of the ranks of the adjusted measurements from the reference area, used as the test statistic for the Wilcoxon Rank Sum test.

**$W_s$**—The sum of the ranks of the measurements from the survey unit, used with the Wilcoxon Rank Sum test.

**WWI**—Wastewater Impoundments

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# 1 INTRODUCTION

Humboldt Bay Power Plant (HBPP), Unit 3, located at 1000 King Salmon Avenue, Eureka, California, was a 63 MWe Boiling Water Reactor (BWR). Unit 3 last operated in 1976 and was permanently defueled in 1984. Transfer of spent fuel to the onsite Independent Spent Fuel Storage Installation (ISFSI) was completed in December 2008.

Pacific Gas and Electric (PG&E) began actively decommissioning Unit 3 in June 2009. The HBPP, Unit 3, License Termination Plan (LTP) describes the remaining activities that PG&E will perform to complete nuclear decommissioning. The LTP will address PG&E's plans for demonstrating to the Nuclear Regulatory Commission (NRC) that the HBPP Unit 3 license for possession of radioactive material is ready to be terminated.

NRC has established specific radiological criteria for release of a nuclear power plant site for unrestricted use that must be met prior to terminating a reactor license. NRC requires that the remaining radioactivity distinguishable from background radiation, not result in a Total Effective Dose Equivalent (TEDE) that would exceed 25 mrem per year to an average member of the critical group, including that from groundwater sources of drinking water, and also that the residual radioactivity be reduced to levels that are as low as reasonably achievable (ALARA). Determination of radioactivity levels that are ALARA is made with consideration of potential detriments that may result from further decontamination and waste disposal.

A fundamental input into the development of the HBPP Unit 3 LTP is the site conceptual model. The HBPP site is currently an industrial site supplying electricity to the surrounding areas and will continue to do so for at least the life of the Humboldt Bay Generating Station (HBGS), which is 30 years. It is unlikely that the HBPP site will be used for any purpose other than an industrial site; however, PG&E has chosen the conservative approach of remediating and surveying to the resident farmer scenario at license termination.

PG&E is submitting this LTP for HBPP, Unit 3. Following are the licensee name, address, license number, and docket number for HBPP Unit 3.

Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94105
License No. DPR-7
Docket No. 50-133

## 1.1 Historical Background and Site Description

### *1.1.1 Historical Background*

The HBPP site also includes the HBGS (163 MWe). The 163 MWe fossil-fueled HBGS began commercial operation in 2010, replacing HBPP Units 1 and 2, and the backup power mobile emergency power plant station (MEPPS). The HBGS will be operated for at least 30 years.

HBPP, Unit 3, is a physical extension of the partially removed fossil Units 1 and 2. Unit 3 commenced commercial operations in 1963 and last operated in July 1976. Unit 3 consisted of a General Electric natural circulation, boiling water reactor, an associated turbine-generator, and the necessary support and auxiliary systems.

During its operational period, Unit 3 experienced a variety of operating events (e.g., fuel failures, maintenance, leaks, spills, and repairs) that have affected decontamination and decommissioning processes. Radiological contamination of the site is found within systems, on component and structure interiors, and in soil located inside and adjacent to the Unit 3 Restricted Area (RA). Subsequent chapters of this LTP will elaborate on these events.

Unit 3 was granted a construction permit by the Atomic Energy Commission (AEC) on October 17, 1960. Operating License DPR-7 was issued in August 1962, and the unit began commercial operation in August 1963. On May 17, 1976, the NRC issued an order that required satisfactory completion of a seismic design upgrade program and resolution of specified geologic and seismic concerns prior to return to power following the upcoming 1976 shutdown. On July 2, 1976, Unit 3 was shut down for refueling. In December 1980, it became apparent that the cost of completing the required backfits would make it uneconomical to restart the unit. PG&E ultimately concluded that the seismic and other modifications required (i.e., in response to the Three Mile Island accident in 1979) were not economical and in June 1983 announced its intention to decommission the unit.

The Unit 3 reactor was permanently defueled in 1984 and on July 30, 1984, PG&E submitted a license amendment request (LAR) to possess fuel for up to 30 years, but no longer operate, and to decommission using the SAFSTOR method.

On July 16, 1985, NRC issued License Amendment (LA) 19 to place Unit 3 in a possess-but-not-operate status and on July 19, 1988, NRC issued LA 23 approving the Decommissioning Plan and authorizing the decommissioning of HBPP, Unit 3.

PG&E submitted the HBPP, Unit 3, Post-Shutdown Decommissioning Activities Report (PSDAR) to NRC on February 27, 1998, in accordance with 10 CFR 50.82 (a)(4)(i). The PSDAR and the Defueled Safety Analysis Report (DSAR) superseded the original Decommissioning Plan and provided the information required by 10 CFR 50.82(a)(4). By December 2008, all spent fuel had been removed from the spent fuel pool and transferred to the 10 CFR 72-licensed ISFSI.

### *1.1.2 Site Description*

Figure 1-1 shows the geographical locations of HBPP and Unit 3 relative to the "true north" orientation. HBPP is located near the coastal community of King Salmon on the shore of Humboldt Bay in Humboldt County, in northwestern California. Unit 3 is located within the PG&E owner-controlled area at HBPP. Figure 1-2 provides an aerial view of the site with the approximate HBPP 10 CFR 50 licensed area indicated by a line drawn on the figure. The Unit 3 structures, as well as the temporary trailers, will be removed. Some office buildings will remain to support the HBGS and ISFSI.

PG&E owns approximately 143 acres on the shore of Humboldt Bay opposite the bay entrance. PG&E also owns the water areas extending approximately 500 feet into Humboldt Bay from the land area. Eureka, the largest city in Humboldt County, is located approximately three miles north-northeast of the site. There are also several small residential communities within five miles of the HBPP site, including King Salmon, Humboldt Hill, Fields Landing, and

the suburban communities surrounding Eureka. There are several marine landings in the community of King Salmon, which is located just west of the entrance gate to the HBPP owner-controlled area. The community of King Salmon serves frequent commercial and recreational boat traffic, including commercial and sport fishing.

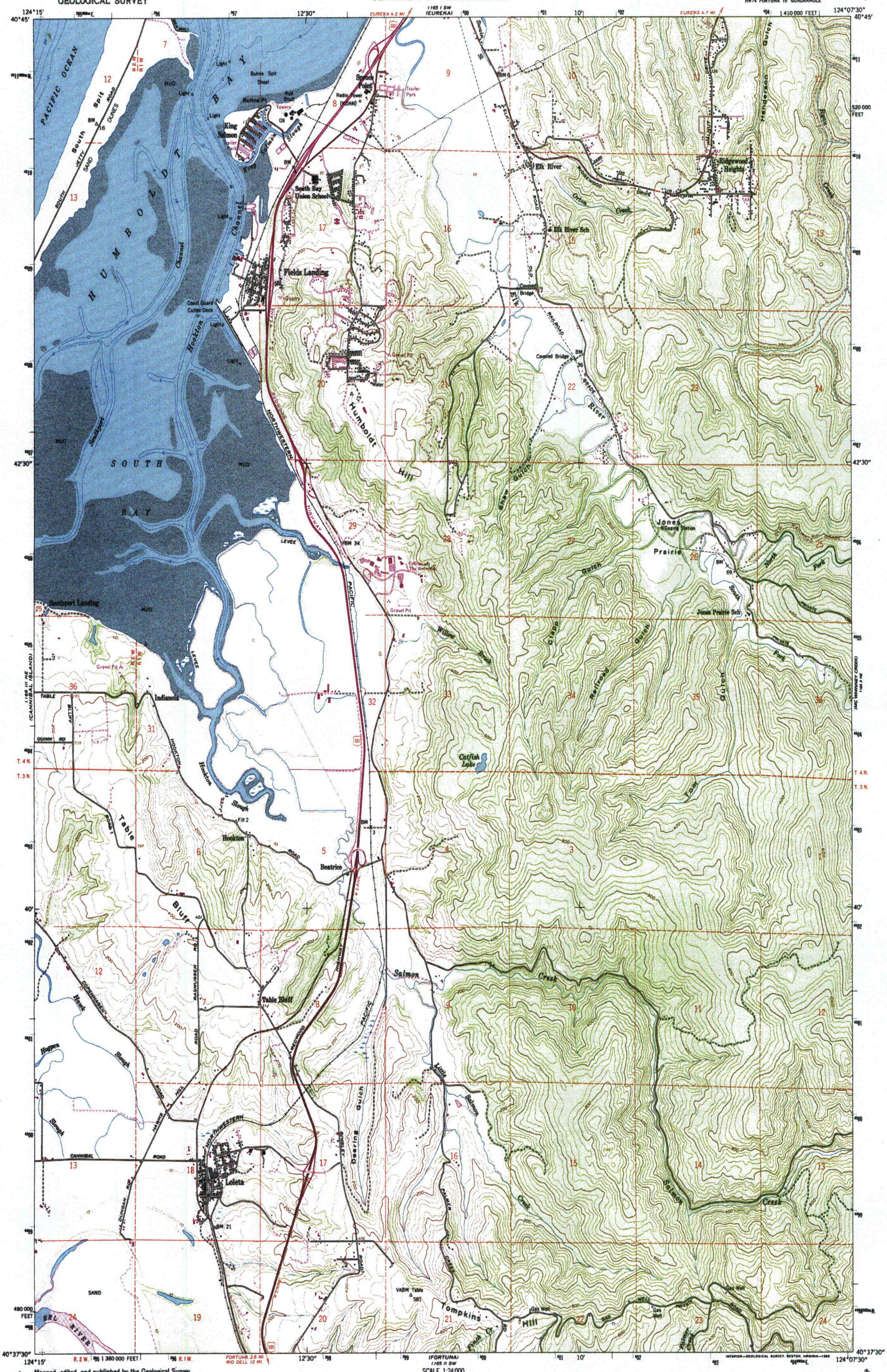
HBPP site terrain varies from submerged and low tidal land, protected by dikes and tide gates, to a high precipitous bluff along the southwestern boundary. Elevations range from approximately minus 3 feet to positive 65 feet, based on a datum of the mean lower low water (MLLW) level.
Figure 1-3 provides the contours of HBPP.

# Figure 1-1

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FIELDS LANDING QUADRANGLE
CALIFORNIA–HUMBOLDT CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 FORTUNA 15' QUADRANGLE




Mapped, edited, and published by the Geological Survey

Control by USGS, USC&GS, USCE, and State of California

Topography from aerial photographs by photogrammetric methods and by planetable surveys 1959. Aerial photographs taken 1956

Hydrography compiled from USC&GS chart 5832 (1956)

Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 1
1000-meter Universal Transverse Mercator grid ticks, zone 10, shown in blue

To place on the predicted North American Datum 1983 move the projection lines 20 meters north and 97 meters east as shown by dashed corner ticks

Land lines are unsurveyed in part of T.3 N.-R. 1 W.

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES IN FEET—DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 4 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, P.O. BOX 25286, DENVER, COLORADO 80225
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

Revisions shown in purple compiled from aerial photographs taken 1972. This information not field checked

ROAD CLASSIFICATION
Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
U.S. Route — State Route

FIELDS LANDING, CALIF.
NW/4 FORTUNA 15' QUADRANGLE
40124-F2-TF-024
1959
PHOTOREVISED 1972
DMA 1165 II NW—SERIES V895

**Figure 1-2. Aerial View of HBPP with Site Boundary**

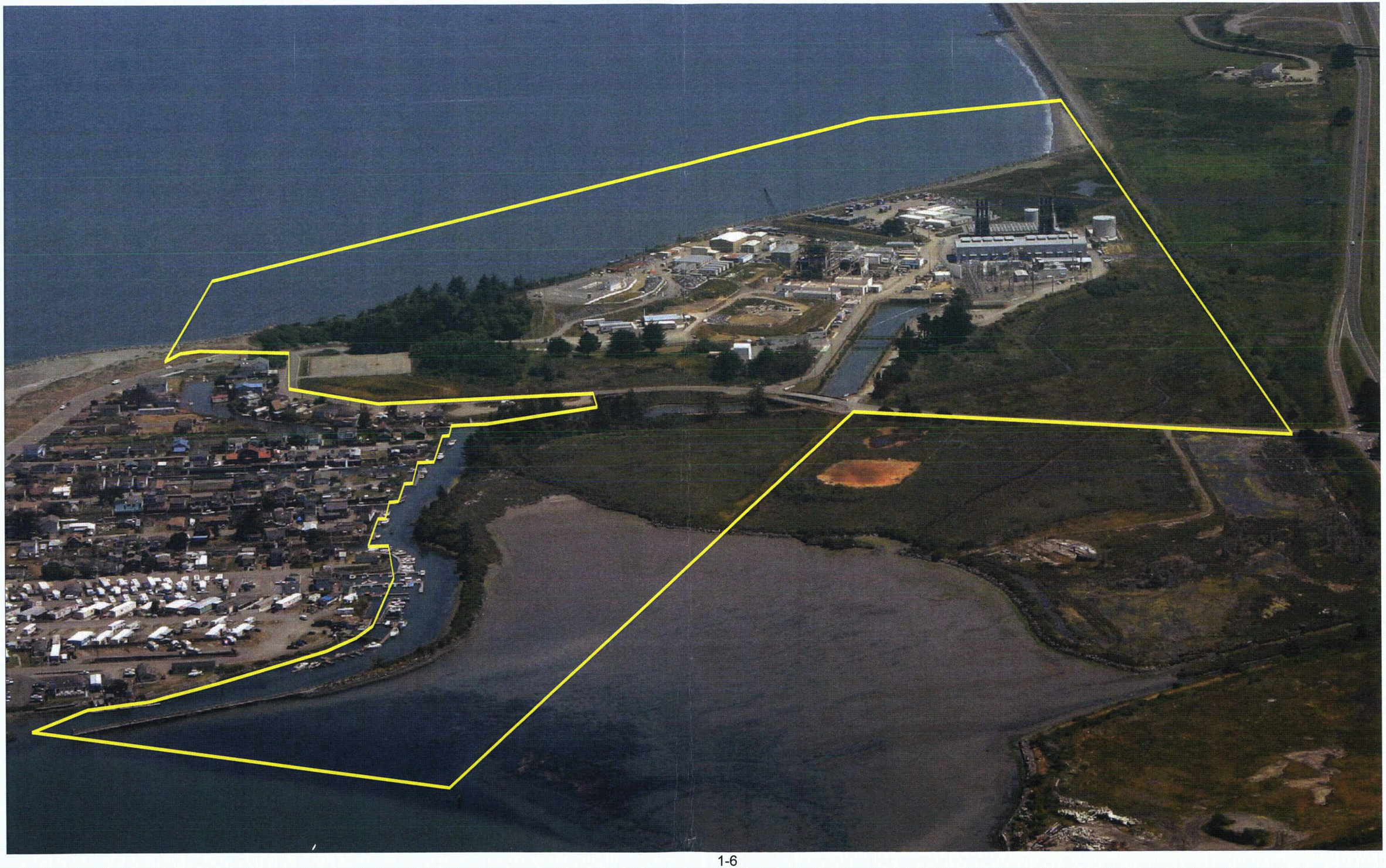
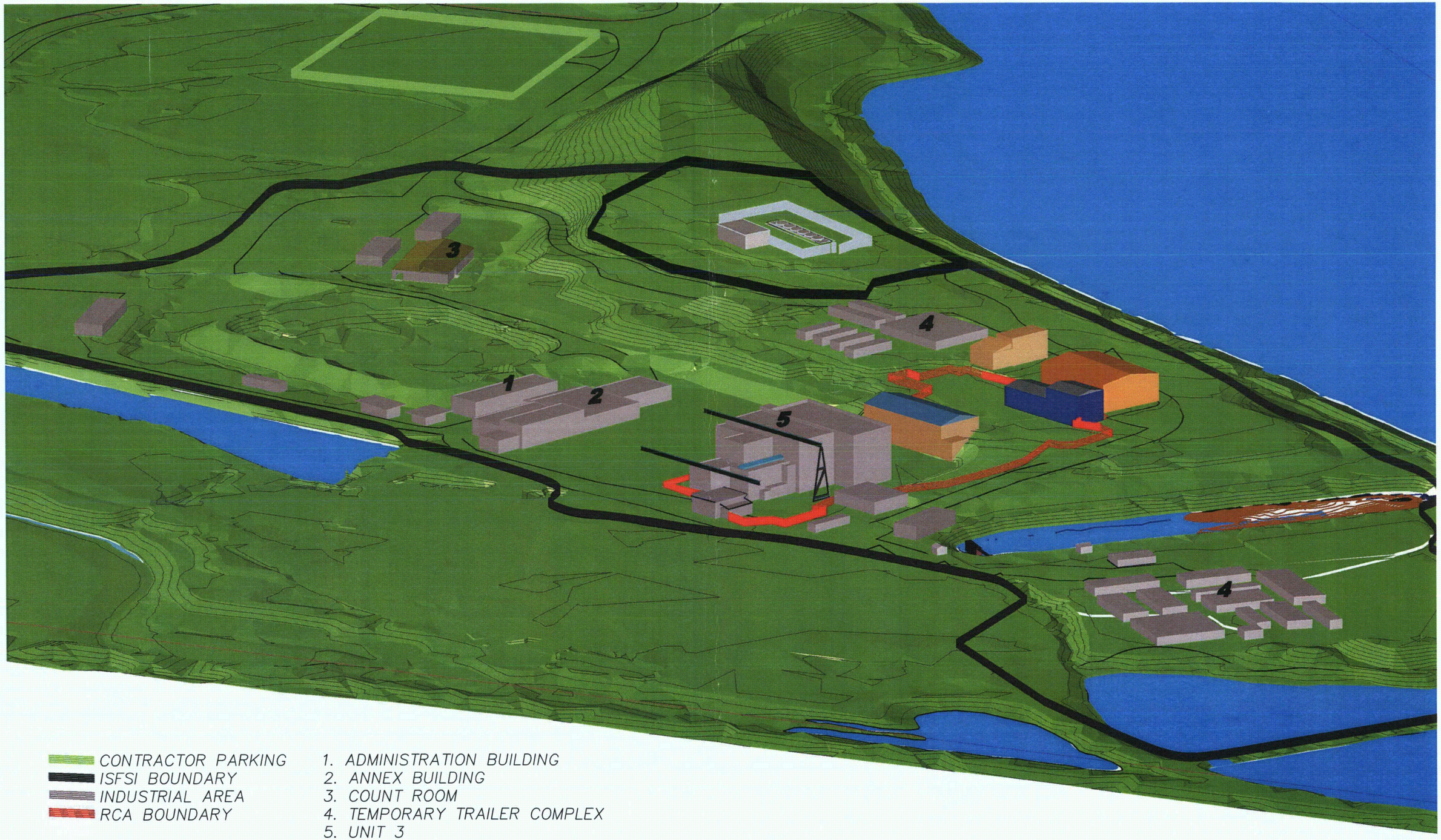


Figure 1-3 Contour Map of HBPP



Humboldt County is mostly mountainous except for the level plain that surrounds Humboldt Bay. The coastal mountains extend to the central valley. The terrain near the site rises rapidly from the bay on the north side to an elevation of approximately 65 feet MLLW at Buhne Point peninsula. Terrain to the north and east of the site is generally flat. To the south and east, the terrain rises rapidly forming Humboldt Hill, which reaches an elevation of over 500 feet MLLW within two miles of the site and is the location of several small neighborhoods.

The HBPP site is located within the hydrologic unit defined as the Redwood Creek-Mad River – Humboldt Bay Unit. The four major creeks that drain into Humboldt Bay are Freshwater Creek, Elk River, Salmon Creek, and Jacoby Creek. Several smaller tributaries also drain into the bay. Salmon Creek and Elk River are the nearest streams to the site, located one mile south and one mile north of HBPP, respectively.

The owner-controlled area is not traversed by railroad. It is bisected by King Salmon Avenue, but there have not been any changes to the original site boundary. The only access to the site is from the south via King Salmon Avenue, which also serves the community of King Salmon situated on the western part of the peninsula. Public trails run along the shoreline and along the fence to the northwest of the owner-controlled area. The major public access in the site vicinity and to other Humboldt County communities is via US Highway 101, which generally traverses north to south through Humboldt County. This highway passes about 0.2 miles east of Unit 3 and is accessible approximately 0.35 miles southeast of the site.

### *1.1.3 Population*

The HBPP site is located on the northern California Coast of Humboldt County. In 2010, the U.S. Census Bureau estimated the population of Humboldt County at 134,623.

The nearest and largest population center in Humboldt County is Eureka located approximately 3 miles north-northeast of the site with a population of approximately 26,000. King Salmon is located adjacent to and west of the

site; and Fields Landing, population 222, is located approximately 0.4 miles south.

## 1.1.4 Land and Water Use

### 1.1.4.1 Land Use

The power plant site is on land zoned as coastal dependent industrial with combining district designations for coastal resource dependent, flood hazard, and coastal wetland. The project site is currently used for industrial purposes (i.e., electricity production). The majority of the project is in an unincorporated area within Humboldt County's jurisdiction. Eureka's sphere of influence extends west and south of the project site, and the city considers land within this designated area as land that may be annexed to the city in the future.

An existing public trail, included as part of the California Coastal Trail system, is located on the north and western side of the HBPP site along Humboldt Bay. Recreational opportunities within Humboldt Bay are numerous and include boating, fishing, camping, and bird watching. The following designated recreational areas are located in Humboldt Bay, within a 3-mile radius of the project site: Samoa Dunes Recreation Area, South Spit, Fields Landing County Park, Humboldt Bay National Wildlife Refuge, and Elk River Wildlife Area.

None of the areas on which decommissioning activities will occur is used for agricultural production. Prime agricultural land in the Elk River Valley is located within one mile of HBPP.

Although Humboldt County has a certified Local Coastal Program, the HBPP site is within the retained jurisdiction of the California Coastal Commission (CCC).

### 1.1.4.2 Water Supply

The district operates two separate water systems, a domestic water system, and a raw water system. Drinking water to HBPP is supplied through the

domestic water system. Raw water is taken directly from the surface of the Mad River and delivered untreated to industrial customers. HBPP does not use raw water from the Humboldt Bay Municipal Water District. The Humboldt Bay Municipal Water District produces 20 million gallons per day of water from five Ranney wells in the Mad River near Essex, located approximately 17 miles from the HBPP site, and from three wells located at the base of Humboldt Hill, approximately 4 miles from the HBPP site.

## 1.2 Decommissioning Approach

PG&E is submitting this LTP to address residual radioactivity on the HBPP site and discuss how the site will be remediated and verified to meet the release criteria. The LTP describes how the release criteria were determined and how they will be measured.

All structures associated with Unit 3 will be removed, along with temporary decommissioning support trailers. At license termination, only the following structures will remain:

- HBGS and associated structures
- Administration Building
- Administration Annex Building
- Security Building
- Count Room Building
- Training Building
- Waste Management Building
- ISFSI and supporting structures

## 1.3 Decommissioning Objective

The objective of decommissioning HBPP Unit 3 is to reduce the level of residual radioactivity remaining from reactor operation to levels that permit the release of the HBPP site for unrestricted use and allow for the termination of the 10 CFR 50 license. The HBPP, Unit 3, LTP satisfies the 10 CFR 50.82(a)(9) requirement to submit a LTP for NRC approval. The LTP submittal is accompanied by an LAR that establishes the criteria for making changes to the LTP without prior NRC approval. Once approved, the LTP will become a supplement to the HBPP, Unit 3, DSAR.

## 1.4 License Termination Plan Scope

PG&E prepared the LTP using the following guidance:

- Regulatory Guide 1.179, "Standard Format and Contents for License Termination Plans for Nuclear Power Reactors," [Reference 1.8.1]
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," [Reference 1.8.2]
- NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," [Reference 1.8.3]
- NUREG-1757, "Consolidated NMSS Decommissioning Guidance," [Reference 1.8.4]

The LTP includes a discussion of the following actions:

- Site characterization to ensure that final status surveys (FSSs) cover all areas where contamination existed, remains, or has the potential to exist
- Remaining decommissioning activities
- Plans for site remediation
- The FSS plan that will be used to confirm that the site release criteria of 10 CFR 20, Subpart E are met
- Dose modeling scenarios that ensure compliance with the site release criteria of 10 CFR 20, Subpart E
- Estimated remaining decommissioning costs
- Environmental impacts from the decommissioning of HBPP, Unit 3

## 1.5 License Termination Plan Summary

The following subsections provide a brief summary of the seven chapters that address the requirements of 10 CFR 50.82(a)(9).

### *1.5.1 Chapter 2: Site Characterization*

Chapter 2 summarizes the Historical Site Assessment (HSA). The HSA provided the preliminary information required to divide the site into survey areas. The survey areas were evaluated against Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) criteria to determine their classification. The HSA also provided the foundation for further site characterization based upon actual

surveys to determine the extent and levels of radioactive contamination prior to remediation (Chapter 4). Data collected during site characterization may be used to change the original HSA classification of an area, within the requirements specified in this LTP, up to the time of the FSS.

### 1.5.2 Chapter 3: Identification of Remaining Decommissioning Activities

Chapter 3 identifies the remaining dismantlement and decontamination activities as of this LTP submittal. The information provided in this chapter includes the following:

- A summary of those activities that have already been completed
- A description of the areas requiring remediation
- Radiological conditions that may be encountered
- Estimates of occupational radiation dose
- An estimate of the remaining quantity of radioactive material to be shipped for disposal
- A description of proposed control mechanisms to ensure remediated areas are not recontaminated

### 1.5.3 Chapter 4: Site Remediation Plans

Chapter 4 discusses the remediation techniques that may be used to reduce residual contamination to levels that comply with the unrestricted release criteria of 10 CFR 20, Subpart E. The principal materials that will be remediated are structural surfaces and soil. Chapter 4 also discusses the ALARA evaluations, which will be used to determine if remediation is warranted beyond that required to meet the radiological dose criteria, and describes the radiation protection program that will be implemented during remediation activities.

### 1.5.4 Chapter 5: Final Status Survey Plan

Chapter 5 describes the process that will be used to verify that the HBPP site complies with the 10 CFR 20 criteria for unrestricted use. The plan will be implemented in accordance with approved procedures and work instructions, which comply with the FSS Quality Assurance Project Plan

(QAPP). To ensure that survey results are of sufficient quality and quantity to support decision making, FSS design (e.g., scan area coverage, number of survey measurements, survey locations) will be developed using the Data Quality Objective Process described in the MARSSIM.

### *1.5.5 Chapter 6: Compliance with Radiological Criteria for License Termination*

Chapter 6 discusses the development of the Derived Concentration Guideline Levels (DCGLs). The DCGLs are radionuclide-specific values derived from activity-dose relationships and the analyses of potential exposure pathways. DCGLs for assessing residual radioactivity levels on building surfaces and site soil have been developed for each radionuclide of concern. Also discussed in this chapter are the identification of the site inventory of radionuclides, future land use scenarios, and dose computation models, including the sensitivity analysis, exposure pathways, and derivation of area factors.

### *1.5.6 Chapter 7: Update of Decommissioning Costs*

Chapter 7 provides a current estimate of the remaining costs to release the HBPP site for unrestricted use. This chapter also compares the remaining costs with the remaining funds, as of this LTP submittal, and gives a verification of the adequacy of financial assurance.

### *1.5.7 Chapter 8: Supplement to the Environmental Report*

Chapter 8 identifies where HBPP decommissioning activities continue to be bounded by previously issued environmental impact statements, specifically NUREG-0586, Supplement 1, the "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Regarding the Decommissioning of Nuclear Power Reactors, Final Report (Reference 1.8.5)." Where the potential impact to a NUREG-0586 Supplement 1 environmental issue is considered site specific, this chapter also contains a justification that the impact to the environment from remaining decommissioning activities will be small (i.e., no detectable impact). This section of the LTP is

prepared pursuant to 10 CFR 51.53(d) and 10 CFR 50.82(a)(9)(ii)(G).

## 1.6 License Termination Plan Change Process

PG&E is submitting this LTP as a supplement to the DSAR; thus, the LTP will be a living internal document and periodic updates will continue to be submitted in accordance with 10 CFR 50.71(e). Changes to decommissioning activities, as described in the LTP, must comply with the criteria in 10 CFR 50.59 and 50.82. Additionally, NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," specifies additional restrictions on changes to the LTP. A change may not be made without prior NRC approval if a change would result in any of the following:

- An increase in the DCGLs and related minimum detectable concentrations (for both scan and fixed measurement methods)
- An increase in the radioactivity level, relative to the applicable DCGL, at which investigation occurs
- A change in the statistical test applied to other than the Sign Test or Wilcoxon Rank Sum Test
- An increase in the Type 1 decision error as stated in the LTP
- A significant environmental impact not previously reviewed

Additionally, the NRC must be notified at least 14 days prior to reclassification of a survey unit to a less restrictive classification (e.g., Class 2 to Class 3). Reclassification of a survey unit to a more restrictive classification (e.g., Class 2 to Class 1) may be done without prior notification.

## 1.7 License Termination Plan Information Contacts

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## 1.8 References

1.8.1 U.S. Nuclear Regulatory Commission Regulatory Guide 1.179, "Standard Format and Contents for License Termination Plans for Nuclear Power Reactors," January 1999

1.8.2 U.S. Nuclear Regulatory Commission NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," August 2000

1.8.3 U.S. Nuclear Regulatory Commission NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," April 2003

1.8.4 U.S. Nuclear Regulatory Commission NUREG-1757, "Consolidated NMSS Decommissioning Guidance," September 2006

1.8.5 U.S. Nuclear Regulatory Commission NUREG-0586, Supplement 1, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Regarding the Decommissioning of Nuclear Power Reactors, Final Report," November 2002

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# 2 SITE CHARACTERIZATION

## 2.1 Historical Site Assessment Summary

### 2.1.1 Introduction

The Historical Site Assessment (HSA) [Reference 2-2] describes the site's physical configuration, identifies the radioactive constituents of the site contamination, assesses the migration of contaminants, identifies contaminated media, identifies non-impacted and impacted areas, and classifies impacted areas.

Pacific Gas and Electric (PG&E) has conducted the HSA of its Humboldt Bay Power Plant (HBPP), Unit 3, site in accordance with the guidance of NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," [Reference 2-1] in support of the ultimate decommissioning and license termination of the facility. The HSA formally began in 2006, following several preliminary assessments of the impact of facility operations on the remediation required prior to the performance of the Final Status Survey (FSS). These preliminary surveys included interviewing current and former HBPP site personnel during the site inspection and via telephone communications. An initial characterization survey was performed in 1997. The HSA was formally compiled in 2006 and updated in 2009 and 2011. The purpose of the HSA is to document a comprehensive investigation identifying, collecting, organizing, and evaluating historical information relevant to the HBPP site. The HSA focuses on open land areas and those structures that will remain at the time of FSS.

The HSA consisted of a review of the following items:

- Radiological Characterization Reports
- Environmental Reports
- Environmental Monitoring Reports
- Licensee Event Reports
- Construction Photographs
- Historical Photographs
- Topographical Maps
- Construction Drawings
- As Built Drawings
- Plant Operating Reports

- Plant Safety Analyses
- Radiological Surveys
- Plant Operating Logs

Concurrent with the performance of the HSA was the initial segregation of the facility into individual specific, uniquely identified, survey areas. This provides the basis for development of area-specific site drawings and survey maps required to document the characterization, remediation, and final release survey process. A major output from the HSA process was the information used as the basis for the preliminary MARSSIM classifications of the initial survey areas.

The initial classification of the site areas was based on the historical information and site characterization data. Data from subsequent characterization may be used to change the original classification of an area up to the time of the FSS as long as the classification reflects the level of residual activity existing prior to any remediation in the area.

### 2.1.2 Objectives of the Historical Site Assessment

PG&E conducted the HSA of the HBPP site to meet the following objectives:

- Identify known and potential sources of radioactive material and radioactively contaminated areas, including systems, structures, and environmental media based on the investigation and evaluation of existing information.
- Identify radionuclides of concern.
- Identify areas of the site with no conceivable or likely potential for radioactive or hazardous materials contamination and assign a preliminary classification of Non-Impacted while assigning a preliminary classification of Impacted to all remaining portions of the site.
- Develop the records to be used during the design of subsequent scoping, characterization, remediation, and the FSS.
- Provide preliminary information necessary to identify and segregate the site into survey areas evaluated against criteria specified in the MARSSIM guidelines for classification. This classification will designate the need for, and level of, remedial action required within a particular survey unit as well as the level of survey intensity required during the FSS.

### 2.1.3 Property Identification

Chapters 1 and 8 describe the HBPP site and environs.

### 2.1.4 HSA Methodology

#### *2.1.4.1 Approach and Rationale*

The primary objective of the HSA records search process was the identification of those events posing a significant probability of affecting the radiological characterization of the site. These included system, structure, or area contamination from system failures resulting in airborne releases, liquid spills or releases, or the loss of control over solid material management. Each event identified that posed a realistic potential to impact the characterization of the site was further investigated. This investigation focused on the scope of the contaminant sampling and analysis, remedial actions taken to mitigate the situation, and any post-remedial action sampling, survey, and analysis in an attempt to identify the "as left" condition of the event location. The following items were included in the research associated with the development of the HSA:

- Relevant excerpts from written correspondences and reports
- Personnel interviews of current and former HBPP personnel employed during the time that Unit 3 was in operation
- Site inspection, using historical site drawings, photographs, prints, and diagrams to identify, locate, confirm, and document areas of concern

Information from this research was used in the HSA development, including the compilation of data, evaluation of results, documentation of findings, and the characterization and identification of survey areas.

#### *2.1.4.2 Documents Reviewed*

Records maintained to satisfy the requirements of 10 CFR Part 50.75(g)(1) [2-7] provided a major source of documentation for the HSA records review process.

#### *2.1.4.3 Site Reconnaissance*

As allowed by MARSSIM Section 3.5, a formal site reconnaissance was not performed, based on the continuous occupancy of the site by the licensee, the detailed information available through the records and other documents, and the personnel interviews performed. Investigations were performed to verify locations and current conditions of questionable items or issues (radioactive liquid spills or spread of contamination) discovered during the review of historical records.

#### *2.1.4.4 Personnel Interviews*

Personal interviews of current and former HBPP site personnel were held during the site inspection and via telephone during the HSA process. Personnel were selected based on their employment history at the HBPP site. Interview efforts were focused on personnel who were employed during the time that Unit 3 was in operation. Personnel were interviewed that held positions in maintenance, qualified reactor operators, and radiation protection. Undocumented events were not discovered during this process, but the interviews did prove helpful in assessing the historical operations.

#### *2.1.4.5 Historical Construction Photograph Review*

Collections of historical photographs were reviewed to assess their contribution to the HSA. A selection of historical photographs is included as Appendix 2-A.

### 2.1.5 Operational History

#### *2.1.5.1 Introduction*

PG&E is the holder of the Humboldt Bay Power Plant, Unit 3, Operating License, DPR-7. Unit 3 was granted a construction permit by the Atomic Energy Commission (AEC) on October 17, 1960, and construction began in November 1960. The AEC issued Provisional Operating License No. DPR-7 for Unit 3 in August 1962. Unit 3 achieved initial criticality on February 16, 1963, and began commercial operation in August 1963.

On July 2, 1976, Unit 3 was shut down for annual refueling and seismic modifications. In December 1980, it became

apparent that the cost of completing the required upgrades made the possibility of restarting Unit 3 uneconomical. Work was suspended at that time awaiting further guidance regarding modification requirements. In 1983, updated economic analyses indicated that restarting Unit 3 would probably not be cost effective, and in June 1983, PG&E announced its intention to decommission the unit. A possession only license amendment was issued in 1985 and the plant was placed in a SAFSTOR status.

PG&E received approval by the NRC for its decommissioning plan (DP) in July 1988; however, since this was prior to the 1996 NRC decommissioning rule, the licensee converted the DP into its Defueled Safety Analysis Report (DSAR) [Reference 2-8], which is updated every two years.

In February 1998, PG&E issued a Post Shutdown Decommissioning Activity Report (PSDAR). The plant is currently in DECON with active decommissioning activities ongoing.

Table 2-1 summarizes the operational/post-operational history.

**Table 2-1 Operational/Post-operational Chronological Summary**

| | |
|---|---|
| Unit 3 construction permit granted by AEC | October 17, 1960 |
| Unit 3 construction begins | November 1960 |
| AEC issues operating license DPR-7 | August 1962 |
| Unit 3 achieves criticality | February 16, 1963 |
| Unit 3 begins commercial operation | August 1963 |
| Unit 3 shutdown for refueling and seismic modifications | July 2, 1976 |
| Work suspended awaiting modifications guidance | December 1980 |
| PG&E announces decision to decommission Unit 3 | June 1983 |
| Possession only license amendment issued | July 16, 1985 |
| NRC approves HBPP Decommissioning Plan | July 19, 1988 |
| PG&E issues a PSDAR | February 27, 1998 |
| NRC issues license for Humboldt Bay Independent Spent Fuel Storage Installation (ISFSI) | November 17, 2005 |
| All fuel removed from spent fuel pool (SFP) | December 2008 |

#### *2.1.5.2 Regulatory Overview*

NRC inspectors from Region IV offices perform routine onsite inspections of HBPP site activities. The NRC is notified of any incidents onsite per the existing protocol established with NRC Region IV and NRC reporting

regulations. NRC headquarters reviews license amendment requests, exemption requests, and other submittals.

#### 2.1.5.3 *Waste Handling Procedures*

The DSAR, Section 1.5, describes the systems and equipment for handling radioactive waste generated as a byproduct of prior plant operation and maintenance of the SFP. DSAR, Section 1.5, describes radioactive waste processing and disposal methods. HBPP waste handling procedures are intended to contain, adequately treat, and dispose of these radioactive byproducts. The waste disposal system uses several basic methods to treat, and dispose of radioactive material:

- Package and shipment to an permitted disposal facility
- Filtration and ion exchange to remove radioactive constituents from liquids
- Dilution of low-activity liquid and gaseous discharges

Spent fuel was removed from the site and shipped to a reprocessing facility in the early years of plant operation. The last spent fuel shipments from HBPP occurred in 1971. All the stainless steel clad fuel assemblies that were prone to failure were removed from site during this period. After that date, spent fuel remained onsite in the SFP until December 2008, when the last of the fuel in the SFP was moved to the ISFSI.

Construction of buildings and roads during and after nuclear operations at the HBPP site involved excavation of contaminated soils. By site procedure, contaminated soils were sent to an NRC-licensed disposal facility. Soils that were deemed noncontaminated by site procedures were placed onsite either west or east of the discharge canal.

#### 2.1.5.4 *Current Site Usage*

##### 2.1.5.4.1 *Description of Unit 3 Operations*

Currently, site operations focus primarily on tasks and activities required to complete the dismantlement and decontamination of the facility.

##### *2.1.5.4.2 Site Characterization*

Characterizations of HBPP structures, soils, and sediments were performed on two separate occasions; one in 1997 and one in 2008. Section 2.3 explains the methodology employed for the characterization effort at HBPP.

### *2.1.5.5 Site Dismantlement*

#### *2.1.5.5.1 Major Dismantlement Activities within the Restricted Area (RA)* as of November 29, 2012

- Removed Unit 3 turbine and generator
- Removed reactor vessel head
- Removed reactor feed pumps
- Removed dry well shield plug
- Removed SFP storage racks
- Removed reactor vessel internals

#### *2.1.5.5.2 Major Dismantlement Activities outside the RA as of November 29, 2012*

- Fossil Units 1 and 2 have been removed
- Fuel Oil Tanks 1 and 2 have been removed
- Unit 1 and 2 Transformers have been removed
- Site is "cold and dark" with temporary power supplying Unit 3

### *2.1.5.6 Radiological Sources*

#### *2.1.5.6.1 RA Contamination*

All areas within the RA have been identified as having been radiologically affected by the operation of the facility, unplanned events, or subsequent decommissioning activities.

#### *2.1.5.6.2 Areas Outside the RA Contamination*

Areas outside the RA have been affected by radiological events, by the deposition of stack releases, or through routine radioactive effluent liquid releases. The exception to this is the bay area, where no contamination has been detected. The bay area will be classified pending further characterization.

### 2.1.6 Event Descriptions

Table 2-2 provides a summary of events/issues that affected various HBPP areas.

**Table 2-2 List of Events/Issues Affecting HBPP Areas**

| Event/Issue | Location | Synopsis |
|---|---|---|
| Liquid Radwaste (LRW) Concentrator Steam Condensate Leakage to Yard Drain North Loop | Shown as location 1 on Figure 2-1 | On 9/28/67, contamination was found near a yard drain (described as either "by the Condensate Storage Tank" or "by Radwaste"). The contamination appeared to come from the radwaste concentrator after a valving error contaminated the (normally clean) condensate from the concentrator supply steam. |
| Possible Radwaste Spill to Radwaste Tankage Area Drain | Shown as location 2 on Figure 2-1 | On 3/19/68, there was the potential that a leaking hose connection could have released one to 10 gallons of concentrator waste to the radwaste tankage area sump, which at that point was valved to the Outfall Canal. |
| Overflow of Condensate Tank | Shown as location 3 on Figure 2-1 | Notes mention contamination near a "storm drain located by the Condensate Storage Tank," but the remainder of the text discusses leakage from the Concentrator. It is hypothetically possible to overflow the tank, but as yet, no specific events have been identified. |
| Overflow of LRW Concentrator to Concentrated Waste Tank (CWT) Vault, radwaste tankage sump and its drain to the outfall canal | Sump Drain Line referenced in Figure 2-1 | On 1/26/73, concentrated waste was found to be leaking through a piping penetration from the CWT Vault to the radwaste tankage area, into the tankage area sump, and through the sump drain line to the Outfall Canal. |
| LRW Concentrator Steam Condensate Leakage to Radwaste Tankage Sump | Shown as location 4 on Figure 2-1 | On 11/25/75, the condensate "drips," from the steam trap for the steam supply to the concentrator, appeared to have been temporarily contaminated. These drips drained to the radwaste tankage area sump, which at that time could be valved either to the radwaste building sump or to the Outfall Canal. |

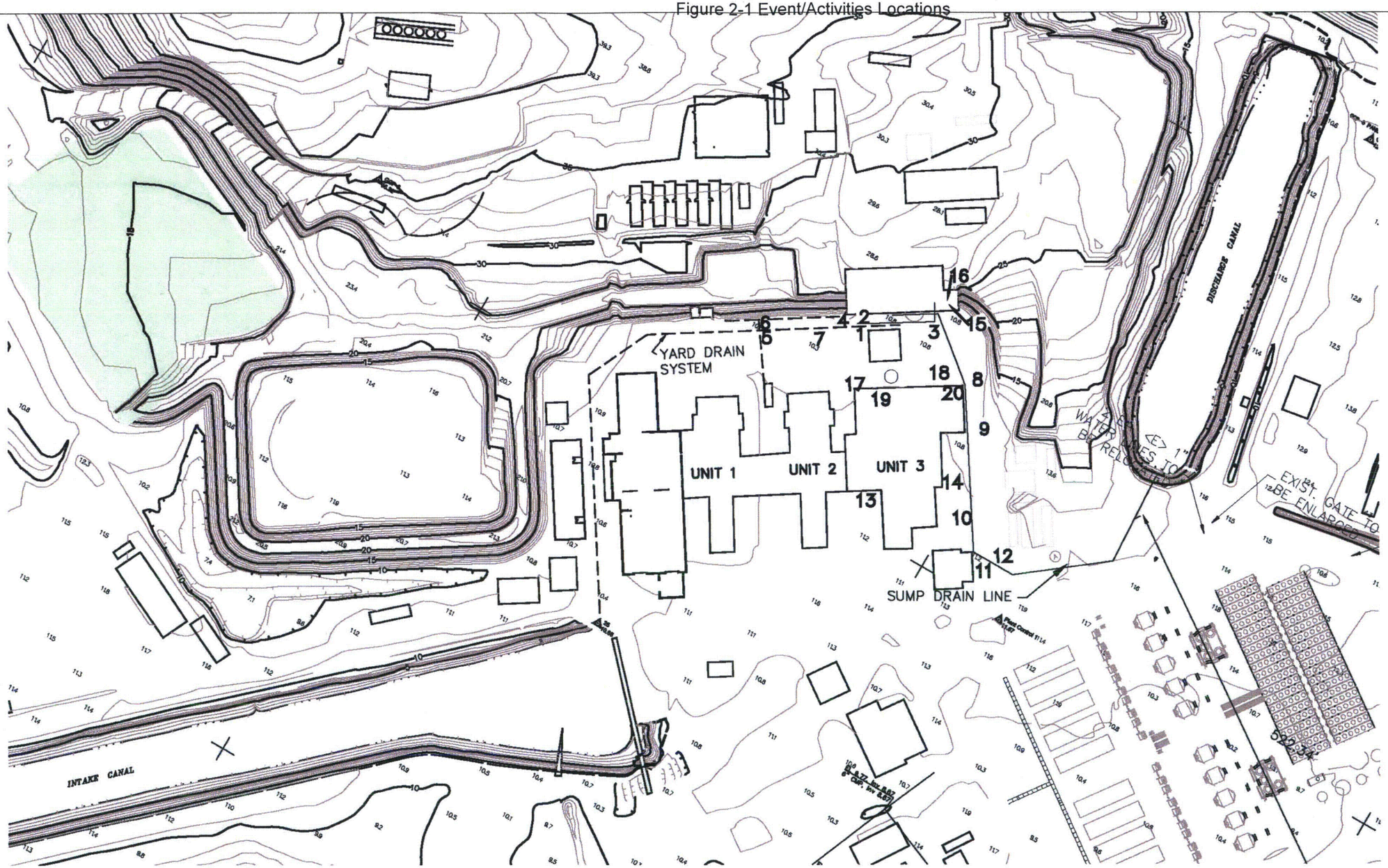
| Event/Issue | Location | Synopsis |
|---|---|---|
| Subsequent contamination of electric conduit/pullbox, yard north of Unit 2, and north loop of yard drains, to intake canal, and of piping pits under #3/4 Condensate Storage Tanks, from earlier overflow of LRW Concentrator to CWT Vault | Yard Drain System shown as dotted line on Figure | On 9/7/73, after a sudden rain shower, contaminated liquid came up through openings in a manhole cover to an electric pull box located at the southwest corner of the liquid radwaste tankage area. The contaminated liquid flowed across the pavement into the yard drains (in the Unit 3 yard, north of Unit 2 fans, and between the #2/3 condensate storage tanks). The liquid also followed a ditch along the bank north of Unit 2, going through drain rock and a perforated pipe into the yard drain system. The contamination originated from the overflow of the CWT vault on 1/26/73 |
| Yard Drain System | Yard Drain System shown as dotted line on Figure 2-1 | The sediment in the drains is known to have been contaminated. As much material as possible was removed from the interior of the sumps and piping, about 1999. |
| Pavement Contamination north of Unit 2, and under Unit 2 Fans – March, 1975 | Shown as location 5 on Figure 2-1 | Smearable contamination was found, associated with water puddles in the yard, in low spots south of the newly paved roadway, and under the Unit 2 fans. |
| Pavement Contamination north of Unit 2 – 1989 | Shown as location 5 on Figure 2-1 | Fixed pavement contamination and contaminated soil were found 9/7/88 and 8/30/89. Subsequent surveys found pavement/soil contamination along south side of roadway from Unit 3 RA fence to #3 condensate tank. |
| Unit 2 Yard Remediation – 1991 | Shown as location 6 on Figure 2-1 | Contaminated perforated drainpipe and contaminated drain rock (from original drainage ditch between roadway and dirt bank) were removed. Contaminated soil (above about 10 pCi/gram Cs-137 or Co-60) was removed from the area. |
| Contamination Under Unit 2 Fans – Approx. 1991 | Shown as location 7 on Figure 2-1 | Contaminated soil under fan/ducts was not accessible for removal, so was covered with concrete "Gunnite," about the same time as the 1991 Unit 2 Yard Remediation. |

| Event/Issue | Location | Synopsis |
|---|---|---|
| Overflow of Condensate Demineralizers | Shown as location 8 on Figure 2-1 | Discussions with plant personnel suggest that condensate was released from the condensate demineralizer system in amounts sufficient to overload the drains so that water flowed out the door to the yard. This may have happened more than once, in the period between 1967 and 1974. |
| Ultrasonic Water spill | Shown as location 9 on Figure 2-1 | Prior to 4/3/86, a water supply hose was run from a clean water tap (below the stairway to the yard) to fill an Ultrasonic decontamination tank in the Hot Shop. On 4/3/86, the hose was disconnected from the tap and laid on the ground. Since the other end was submerged in the tank, and the hose was filled with water, water began to be siphoned from the tank to the yard, running into the adjacent yard drain. |
| Yard Contamination by General Contractor (G.C.) Paint Buildings | Shown as location 10 on Figure 2-1 | On 12/2/77, concrete core drills (uses to install seismic anchors in concrete) were being cleaned in the yard, when some contaminated water was spilled. On 12/14/77, contaminated water was subsequently found outside the adjacent fence. |
| Railroad French Drain | Shown as location 11 on Figure 2-1 | In mid-1993, while excavating to connect a new oil-water separator discharge line to the outfall tube, a previously unknown French drain (rock and perforated drainpipe) was found to be contaminated. The pipe appears to follow (alongside) the path of the (newer) rail spur into Unit 3. |
| Contamination at Railroad Gate | Shown as location 12 on Figure 2-1 | On 10/9/80, contamination was found on the ground or pavement on both sides of the RA fence near the gate. In mid-1993, contaminated soil was found while excavating to connect a new oil-water separator discharge line to the outfall tube. |

| Event/Issue | Location | Synopsis |
|---|---|---|
| Unit 2 lube oil sump, Oily water Separator contamination | Shown as location 13 on Figure 2-1 | On 11/21/83, about 1,200 gallons of Unit 3 Closed Cooling Water was spilled, going to the Unit 2 oily water sump, then to the Unit 2 oil-water separator, and then to the Low Volume Waste sump. |
| Condensate Pump spill to Yard Drain | Shown as location 14 on Figure 2-1 | Surveys on 11/1/74 indicate a spill to the yard from a condensate pump. This may have occurred when #5 condensate pump was used to pump down the condenser. |
| Radwaste Treatment Buildings roof – drum spill | Shown as location 15 on Figure 2-1 | On 10/9/79, contaminated liquid was spilled on the roof of the radwaste building. Some of the contaminated liquid seems to have reached the drain at the east end of the lower section of the roof. |
| Radwaste Treatment Buildings roof/truck | Shown as location 16 on Figure 2-1 | On 11/14/80, concentrated waste was being solidified (in a liner on a truck) with urea formaldehyde. When the acid catalyst was added to the mix, it began to foam, and several gallons flowed onto the trailer, and then to the ground. |
| Reactor Water into Firewater System | Shown as location 17 on Figure 2-1 | On 7/17/70, a reactor trip resulted in the Low Pressure Core Flooding System valves opening before the firewater pumps came up to full pressure. As a result, there was the potential for a short time for contaminated shutdown system water (potentially followed by reactor water) to flow into the Firewater System, instead of the preferred opposite condition. |
| SFP Leakage | Shown as location 18 on Figure 2-1 | In March 1966, it was discovered that a leak in the SFP liner had developed, changing the water loss from about 0.23 inch per day to about 0.42 inch per day, or nominally between 75 to 130 gallons per day. |

| Event/Issue | Location | Synopsis |
|---|---|---|
| Caisson Leakage | Shown as location 19 on Figure 2-1 | Beginning in 1992, the Caisson sump leak rate (groundwater in leakage) began to increase, from less than 100 gallons/day to about 7,000 gallons/day by 1997. The Caisson In-Leakage Repair Project (CIRP) plugged the leak and the leak rate decreased to about 10 gallons/day in September 1997. |
| Off-Gas Tunnel Demineralizer Resin Spill | Shown as location 20 on Figure 2-1 | In July 2005, the resin transfer line from the SFP demineralizer (through the off-gas tunnel) to the resin disposal tank was found to be blocked. In January 2006, elevated radioactivity levels were identified in liquid radwaste. This led to an inspection of the off-gas tunnel, which revealed resin and resin-like material in the tunnel sump near the off-gas filter. The resin cleanup was completed on March 31, 2006. |

Figure 2-1 Event/Activities Locations




LEGEND:

| | |
|---|---|
| 1 – 20 | SPILLS |
| ---------- | YARD DRAIN LINE |
| ———— | SUMP DRAIN LINE |

PLAN VIEW
SCALE: 1"=100'

| DATE | | REVISION DESCRIPTION | HUMBOLDT BAY POWER PLANT – PG&E CO. UNIT 3 DECOMMISSIONING SITE SPILL LOCATIONS | | |
|---|---|---|---|---|---|
| 01, NOVEMBER 2010 | | | | | |
| PR | BSE | | | | |
| CK | M.E. | | | | |
| AP | B.B. | | | | |
| | | | DRAWING | SHEET | REV |
| | | | DSK–SITE–LTP | 1 of 3 | 0 |

### 2.1.7 Survey Unit Identification and Classification

#### *2.1.7.1 Survey Areas*

The entire HBPP site, with the exception of the ISFSI, which is under a 10 CFR 72 license, is divided into areas. Areas are typically larger physical sections of the site that may contain one or more survey units, depending on their classification. Some characterization has been performed within the ISFSI area supporting a Class 3 area. This area will be released from the 10 CFR 50 license and will remain under the Part 72 license until such time as the spent fuel is moved to a federal repository.

#### *2.1.7.2 Survey Units*

A Survey Unit is a physical area consisting of buildings, structures, or land areas of specifically defined shapes and sizes, for which a unique decision will be made regarding whether the presence of any residual radioactive material meets or exceeds the predetermined release criteria. A Survey Unit is a single contiguous area, where size is dependent upon its physical characteristics (open land vs. structural building) and radiological conditions, and where operational conditions are reasonably consistent with the exposure modeling used to determine the classification.

#### *2.1.7.3 Initial Designation of Areas*

Using reasonable and available physical and documented references, 17 areas were identified and assigned a unique Survey Area identification. Current area designations (areas of the site are depicted in Figure 2-2, Area Designations) are summarized in Table 2-3.

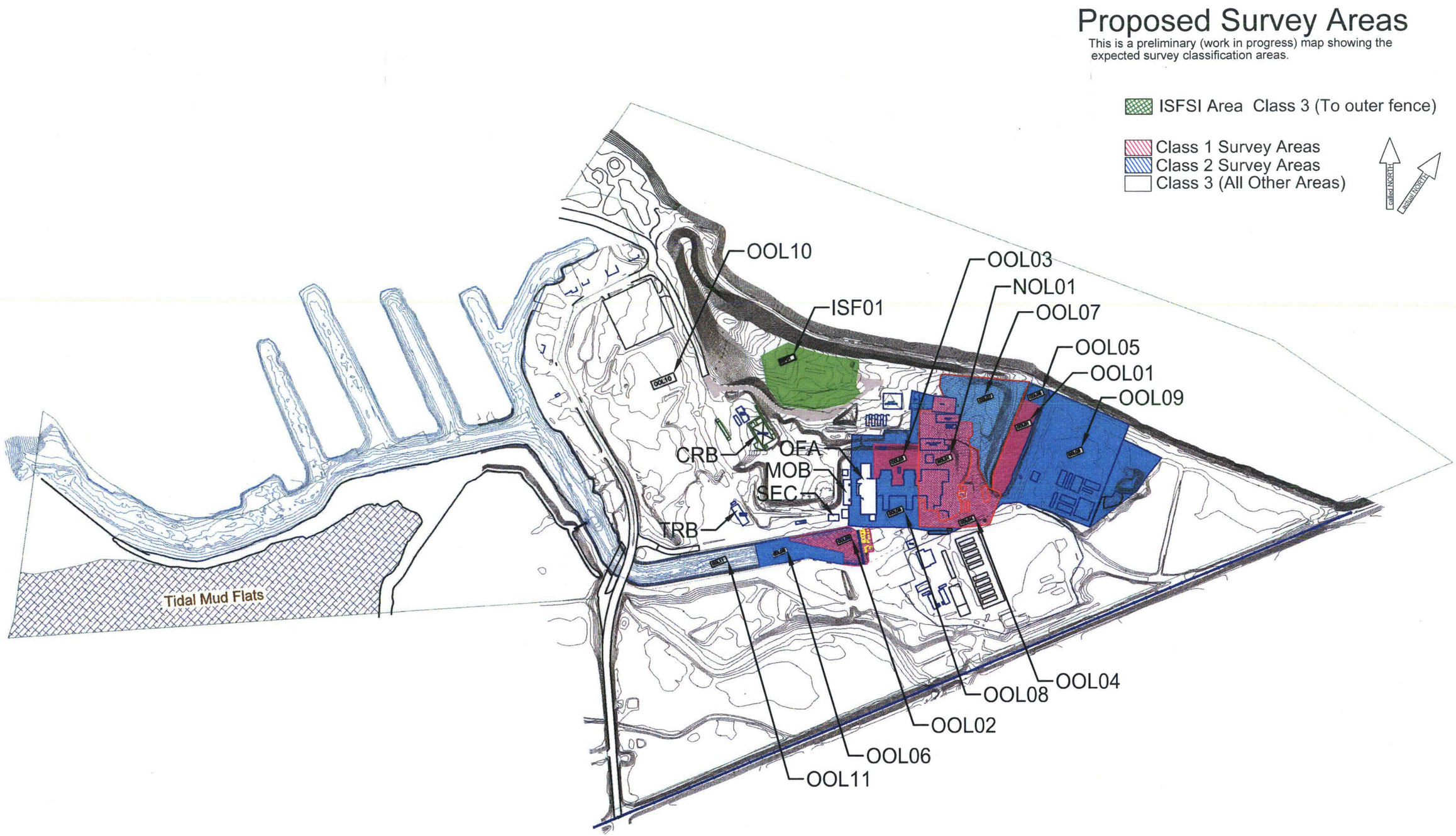
**Table 2-3 Survey Area Summary Information**

| Survey Area Designator | Name/Building | Total Area Footprint (Square Feet) | Total Area Footprint (Square Meters) | Classification |
|---|---|---|---|---|
| NOL01 | Open land area (inside RA) | 81,989 | 7617 | Class 1 |
| OOL01 | Discharge Canal South | 26,596 | 2471 | Class 1 |
| OOL02 | Intake East | 6,755 | 628 | Class 1 |
| OOL03 | Open Land Area Outside the RA | 21,412 | 1989 | Class 1 |

| Survey Area Designator | Name/Building | Total Area Footprint (Square Feet) | Total Area Footprint (Square Meters) | Classification |
|---|---|---|---|---|
| OOL04 | Sump Drain Line Land Area | 4,929 | 458 | Class 1 |
| OOL05 | Discharge Canal North | 5,987 | 556 | Class 2 |
| OOL06 | Intake Center | 22,039 | 2047 | Class 2 |
| OOL07 | NOL01 Boundary East | 89,621 | 8326 | Class 2 |
| OOL08 | NOL Boundary West | 73,594 | 6837 | Class 2 |
| OOL09 | Hazardous Waste Area | 11,109 | 1032 | Class 2 |
| OOL10 | Remainder of Land Area | 2,531,578 | 235,191 | Class 3 |
| OOL11 | Intake West | 26,582 | 2470 | Class 3 |
| OFA | Office Annex | 2906 | 270 | Class 3 |
| ISF01 | ISFSI area | 59,600 | 5540 | Class 3 |
| TRB | Training Building | 431 | 40 | Class 3 |
| SEC | Security Building | 527 | 49 | Class 3 |
| MOB | Main Office Building | 4402 | 409 | Class 3 |
| CRB | Count room Building | 4004 | 372 | Class 1 |
| WMB | Waste Management Building | * | * | Class 1 |

* To be constructed

Figure 2-2 Survey Area Locations



### 2.1.8 Area Radiological Impact Summaries

#### *2.1.8.1 NOL01-Open Land Area inside the RA*

Survey Area NOL01 consists of the open land area within the boundary of the RA. Survey Area NOL01 contains about 7,617 square meters ($m^2$) of surface area made up of soils, engineered materials, gravel, and sand.

NOL01 is bounded by OOL07 and OOL08 on the north, OOL03 and OOL08 on the west, OOL04 and OOL08 on the south, and OOL07 on the east. NOL01 lies within the Unit 3 restricted area fencing. All the structures, systems, and components supporting Unit 3 are located within NOL01.

The following events and activities may have affected Survey Area NOL01:

- LRW concentrator steam condensate leakage to yard drain north loop
- Overflow of condensate tank
- Overflow of LRW concentrator to CWT vault, radwaste tankage sump and its drain to the outfall canal
- LRW concentrator steam condensate leakage to radwaste tankage sump
- Overflow of condensate demineralizers
- Ultrasonic water spill
- Yard contamination by G.C. Paint Buildings
- Railroad French drain
- Contamination at railroad gate
- Condensate pump spill to yard drain
- Radwaste Treatment Building roof (drum spill)
- Radwaste Treatment Building roof/truck
- SFP leakage
- Caisson leakage
- Offgas tunnel demineralizer resin spill
- Wet and dry deposition from stack releases

Translocation pathways within NOL01 include:

- Radioactive liquids from events to the surface soils and downward to the subsurface
- Leakage from the SFP to the subsurface soils
- Leakage from subsurface components (e.g., French drains) to the subsurface soils
- Wet and dry deposition of radioactive materials to the surface via Unit 3 stack releases

An extensive characterization was performed in 1997 [2-5] consisting of soil and sediment sampling. Table 2-4 provides a summary of the characterization within NOL01.

**Table 2-4 NOL01 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 2SS034 | 0.20 | 0.07 | 0.5 |
| 2SS035 | 0.77 | ND | 0.5 |
| 2SS028 | 2.65 | 0.28 | 0.5 |
| 2SS033 | 1.85 | 0.24 | 0.5 |
| 1S0026 | 0.38 | 0.09 | 0.8 |
| 1S0027 | 0.54 | ND | 0.5 |
| 1S0027 | 0.09 | ND | 3.5 |
| 1S0028 | 0.07 | ND | 3.5 |
| 1S0028 | 0.09 | ND | 4.0 |
| 1S0024 | 0.24 | 0.58 | 1.0 |
| 1S0024 | 0.16 | 0.22 | 2.0 |
| 1S0029 | 0.11 | ND | 1.0 |
| 1S0023 | 0.24 | ND | 1.0 |
| 1S0023 | 0.42 | ND | 2.0 |
| 1S0022 | 0.11 | ND | 1.0 |
| 1S0022 | 0.28 | ND | 2.0 |
| 1S0021 | 2.18 | ND | 1.0 |
| 1S0021 | 0.16 | ND | 2.0 |
| 1S0020 | 1.23 | ND | 1.0 |
| 1S0020 | 5.90 | ND | 2.0 |
| 1S0020 | 0.40 | ND | 3.0 |
| 1S0020 | 0.13 | ND | 4.0 |
| 1S0019 | 1.35 | ND | 1.0 |
| 1S0019 | 0.30 | ND | 2.0 |
| 1S0018 | 1.55 | ND | 1.0 |
| 1S0017 | 0.26 | ND | 1.5 |
| 1S0017 | 0.06 | ND | 4.0 |
| 1S0059 | 0.31 | 0.08 | 1.0 |
| 1S0059 | 2.23 | 0.28 | 2.0 |
| 1S0059 | 0.07 | ND | 3.0 |
| 1S0060 | 0.23 | ND | 0.5 |
| 1S0060 | 0.78 | ND | 1.5 |
| 1S0012 | 0.11 | ND | 0.5 |

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 1S0013 | 0.05 | ND | 1.0 |
| 1S0011 | 1.13 | 0.12 | 0.5 |
| 1S0058 | 2.13 | 2.34 | 1.5 |
| 1S0062 | 3.98 | 0.3 | 0.5 |
| 1S0062 | 0.52 | ND | 1.5 |
| 1S0062 | 0.24 | 0.13 | 2.5 |
| 1S0062 | 0.47 | 0.11 | 3.5 |
| 1S0062 | 0.27 | ND | 4.0 |
| 1S0051 | 0.09 | 0.06 | 1.0 |
| 1S0051 | 0.64 | 0.12 | 2.0 |
| 1S0051 | 0.14 | ND | 3.0 |
| 1S0048 | 0.74 | ND | 1.0 |
| 1S0048 | 0.09 | ND | 2.0 |
| 1S0048 | 0.07 | ND | 4.0 |
| 1S0049 | 9.29 | 0.32 | 1.0 |
| 1S0049 | 21.50 | 0.57 | 2.0 |
| 1S0049 | 8.20 | 0.60 | 5.0 |
| 1S0049 | 0.46 | ND | 6.0 |
| 1S0049 | 0.31 | ND | 7.0 |
| 1S0049 | 0.24 | ND | 8.0 |
| 1S0049 | 0.17 | ND | 9.0 |
| 1S0049 | 0.11 | ND | 10.0 |
| 1S0050 | 3.80 | ND | 1.0 |
| 1S0050 | 4.55 | 0.06 | 2.0 |
| 1S0050 | 3.40 | ND | 3.0 |
| 1S0050 | 1.39 | ND | 4.0 |
| 1S0047 | 0.20 | ND | 1.0 |
| 1S0047 | 0.22 | ND | 2.0 |
| 1S0008 | 0.12 | ND | 1.0 |
| 1S0008 | 0.37 | ND | 2.0 |
| 1S0008 | 0.13 | ND | 3.0 |
| 1S0056 | 0.16 | 0.07 | 1.5 |
| 1S0056 | ND | 0.10 | 3.5 |
| 1S0046 | 0.08 | ND | 1.0 |
| 1S0046 | 0.09 | ND | 4.0 |
| 1S0076 | 0.09 | ND | 0.5 |
| 1S0076 | 2.3 | ND | 1.5 |
| 1S0076 | 26.15 | ND | 2.5 |
| 1S0076 | 6.98 | ND | 3.0 |
| 1S0053 | 0.67 | 0.08 | 1.0 |
| 1S0053 | 19.67 | ND | 2.0 |
| 1S0053 | 18.30 | 0.12 | 3.5 |
| 1S0053 | 17.67 | 0.16 | 4.5 |
| 1S0053 | 39.19 | ND | 5.0 |
| 1S0053 | 27.67 | ND | 6.0 |
| 1S0053 | 31.43 | 0.16 | 7.0 |
| 1S0053 | 11.00 | 0.15 | 8.0 |
| 1S0053 | 13.89 | ND | 9.0 |
| 1S0053 | 29.02 | 0.12 | 9.5 |
| 1S0077 | 17.77 | 3.65 | 0.5 |
| 1S0077 | 14.39 | 0.48 | 1.5 |

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 1S0077 | 17.96 | 0.34 | 2.5 |
| 1S0077 | 13.09 | 0.28 | 3.5 |
| 1S0077 | 11.04 | 0.12 | 4.5 |
| 1S0077 | 24.87 | 0.22 | 5.5 |
| 1S0077 | 25.97 | 0.15 | 6.5 |
| 1S0077 | 16.49 | 0.50 | 7.5 |
| 1S0077 | 12.89 | 0.63 | 8.5 |
| 1S0077 | 30.91 | 0.18 | 9.5 |
| 1S0077 | 18.82 | ND | 10.5 |
| 1S0077 | 6.29 | 0.14 | 11.5 |
| 1S0077 | 3.52 | ND | 12 |
| 1S0034 | 0.33 | ND | 1.0 |
| 1S0054 | 0.08 | 0.06 | 2.0 |
| 1S0045 | 3.09 | 0.39 | 1.0 |
| 1S0045 | 0.17 | ND | 2.0 |
| 1S0044 | 10.13 | 3.57 | 4.0 |
| 1S0043 | 10.03 | 0.09 | 1.5 |
| 1S0004 | 0.32 | ND | 1.0 |
| 1S0042 | 2.27 | 0.34 | 1.0 |
| 1S0005 | 0.21 | ND | 2.0 |
| 1S0041 | 0.16 | ND | 1.0 |
| 1S0041 | 1.99 | ND | 3.0 |
| 1S0041 | 0.13 | ND | 4.0 |
| 1S0040 | 0.14 | 0.08 | 1.5 |
| 1S0006 | 0.12 | ND | 2.0 |
| 1S0037 | 0.35 | 0.12 | 1.0 |
| 1S0037 | 0.10 | ND | 2.5 |
| 1S0038 | 0.26 | 0.08 | 1.0 |
| 1S0039 | 0.08 | ND | 1.5 |
| 1S0039 | ND | 0.10 | 3.5 |
| 1S0039 | ND | 0.14 | 5.5 |
| 1S0039 | 0.15 | ND | 6.0 |
| 1S0007 | 0.17 | ND | 2.0 |

ND = Not detected

As seen in Table 2-4, activity in the soils of NOL01 varies considerably. Levels of contamination in the first 0.5 foot from the surface average approximately 1 pCi/g Cs-137 and 0.12 pCi/g Co-60. However, areas where events have occurred exhibit considerably greater contamination, not only at the surface but also at depths to 12 feet, or greater. In these areas, contamination oscillates around 17 pCi/g for some depth, until the concentrations start to decrease. It is apparent that extensive remediation will occur in NOL01; therefore, NOL01 is classified as a Class 1 area.

#### 2.1.8.2 *OOL01 - Discharge Canal South*

Survey Area OOL01 consists of the open land area within the southern section of the Discharge Canal. Survey Area OOL01 contains about 2,471 $m^2$ of surface area made up primarily of silt and sand.

OOL01 is bounded by OOL05 on the north, OOL09 on the east, OOL04 on the south, and OOL07 on the west. OOL01 is the site where circulating water, from the units, discharged to prior to entering the bay. The outer boundary of the survey area is the high water mark. Silting in of sediment has occurred since circulation water flow has ceased to a depth of approximately 10-15 feet.

The following events and activities may have affected Survey Area OOL01:

- Routine discharges of radioactive liquids from Unit 3
- Possible radwaste spill to radwaste tankage area drain
- Overflow of LRW concentrator to CWT vault, radwaste tankage sump and its drain to the outfall canal
- LRW concentrator steam condensate leakage to radwaste tankage sump
- Wet and dry deposition from stack releases

Translocation pathways within OOL01 include the following:

- Routine discharges of radioactive liquid from Unit 3 to the canal with the activity concentrating within the top 2 feet of the sediment
- Non-routine discharges of radioactive liquids to the canal with the activity depositing as described previously
- Activity from the deposition of stack releases settle on the water surface and progress downward into the sediments

An extensive characterization was performed in 1997 consisting of soil and sediment sampling. Table 2-5 provides a summary of the characterization within OOL01 to the original depth.

**Table 2-5 OOL01 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 6SD027 | 42.24 | ND | 0.5 |
| 6SD028 | 9.62 | ND | 0.5 |
| 6SD025 | 5.86 | 2.20 | 1.7 |
| 6SD023 | 0.37 | 0.17 | 0.5 |
| 6SD024 | 10.08 | 0.34 | 1.7 |
| 6SD026 | 10.67 | 2.94 | 1.7 |
| 6SD030 | 1.51 | ND | 1.7 |
| 6SD031 | 9.48 | 1.37 | 1.7 |
| 6SD032 | 8.54 | 0.45 | 1.7 |
| 6SD033 | 8.57 | 1.31 | 1.7 |
| 6SD034 | 8.78 | 0.99 | 1.7 |
| 6SD052 | 0.50 | ND | 1.5 |
| 6SD052 | 0.26 | ND | 2.0 |
| 6SD035 | 7.93 | 1.67 | 1.7 |
| 6SD036 | 11.77 | 0.45 | 1.7 |
| 6SD037 | 3.63 | 0.65 | 1.7 |
| 6SD038 | 13.92 | 0.87 | 1.7 |
| 6SD039 | 11.21 | 0.54 | 1.7 |
| 6SD053 | 0.56 | ND | 2.0 |
| 6SD040 | 8.96 | 0.69 | 1.7 |
| 6SD041 | 8.58 | 0.64 | 1.7 |
| 6SD040 | 8.96 | 0.69 | 1.7 |

ND = Not detected

As seen in Table 2-5, activity in the sediments, prior to silting in, of OOL01 vary considerably. Generally, levels of contamination average approximately 8.7 pCi/g for Cs-137 and 1.0 pCi/g for Co-60. Concentration levels at the point of entry of the circulating water into the canal are greater than the remainder of the canal readings. An additional characterization was performed in 2008 to examine the concentrations at depths greater than those sampled in 1997. The results of those surveys determined that the contamination was limited to the top 2 feet in the sediment. It is apparent that remediation will occur in OOL01; therefore, OOL01 is classified as a Class 1 area.

#### *2.1.8.3 OOL02-Intake East*

Survey Area OOL02 consists of the open land area within the eastern portion of the Intake Canal. Survey Area OOL02 contains about 628 $m^2$ of surface area made up primarily of silt and sand.

OOL02 is bounded by OOL08 on the north and east, OOL10 on the south, and OOL06 on the west.

The following events and activities may have affected Survey Area NOL01:

- LRW concentrator steam condensate leakage to yard drain north loop
- Wet and dry deposition from stack discharges

Translocation pathways within OOL02 include the following:

- Radioactive liquid from the yard drain north loop proceeding and discharging into the intake where the activity deposits into the sediments
- Activity from the stack depositions settling onto the surface of the water and migrating downward into the sediments

Table 2-6 provides the results of the 1997 characterization effort.

**Table 2-6 OOL02 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 6SD020 | 5.30 | 0.46 | 0.5 |
| 6SD022 | 22.39 | 0.30 | 1.7 |
| 6SD021 | 0.57 | ND | 1.7 |

ND = Not detected

As seen in Table 2-6, activity in the sediments of OOL02 will necessitate some degree of remediation. Additional characterization is scheduled for this survey area to fill in the data gaps. OOL02 is classified as a Class 1 area.

#### *2.1.8.4 OOL03 Open Land Area outside the RA*

Survey Area OOL03 consists of the open land area north of Units 1 and 2. OOL03 encompasses the north yard and embankment. Survey Area OOL03 contains about 1,989 $m^2$of surface area made up primarily of soils and engineered materials.

OOL03 is bounded by OOL08 on the north, west, and south sides; NOL01 bounds the Survey Area on the east.

The following events and activities may have affected Survey Area OOL03:

- Subsequent contamination of electric conduit/pullbox, yard north of Unit 2, and north loop of yard drains
- Pavement contamination north of Unit 2, and under Unit 2 fans
- Pavement contamination north of Unit 2 – 1989
- Unit 2 yard remediation – 1991
- Contamination under Unit 2 fans – Approximately 1991
- Unit 2 lube oil sump, oily water separator contamination
- Wet and dry deposition from Unit 3 stack discharges

Translocation pathways within OOL03 include the following:

- Radioactive liquid traveling across the yard area from Unit 3 and into the yard drain north of Unit 2
- Liquids from the above event followed a ditch along the bank north of Unit 2, going through drain rock and a perforated pipe into the soils
- Activity from the deposition of stack releases settling onto the surfaces of the Survey Area

Table 2-7 provides the results of the 1997 characterization effort.

**Table 2-7 OOL03 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 1S0071 | 0.71 | ND | 0.5 |
| 1S0071 | 0.09 | ND | 1.5 |
| 1S0072 | 1.26 | ND | 0.5 |
| 1S0072 | 0.56 | 0.18 | 1.5 |
| 1S0072 | 0.23 | 0.10 | 2.5 |
| 1S0073 | 0.47 | ND | 0.5 |
| 1S0073 | 0.17 | ND | 1.5 |
| 4S0040 | 3.19 | 0.49 | 0.5 |
| 4S0040 | 0.72 | ND | 1.5 |
| 1S0074 | 0.93 | 0.12 | 0.5 |
| 1S0074 | 0.17 | ND | 1.5 |
| 4S0039 | 3.57 | 0.25 | 0.5 |
| 4S0039 | 0.30 | 0.10 | 1.5 |
| 4S0039 | 0.33 | ND | 2.5 |
| 4S0039 | 0.20 | ND | 3.0 |

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 1S0075 | 0.87 | ND | 0.5 |
| 1S0075 | 0.06 | ND | 1.5 |
| 1S0075 | 0.17 | ND | 2.5 |
| 4S0038 | 11.30 | 0.23 | 0.5 |
| 4S0038 | 1.79 | ND | 1.5 |
| 4S0038 | 1.67 | 0.06 | 2.5 |
| 4S0038 | 1.48 | 0.09 | 3.0 |
| 4S0038 | 0.21 | ND | 3.5 |
| 4S0037 | 0.21 | ND | 0.5 |
| 1S0065 | 18.22 | 0.19 | 0.5 |
| 1S0066 | 23.70 | 0.14 | 0.5 |
| 1S0066 | 1.11 | ND | 1.0 |
| 1S0067 | 14.06 | 0.13 | 0.5 |
| 1S0067 | 3.12 | ND | 1.0 |
| 1S0068 | 11.84 | 0.11 | 0.5 |
| 1S0068 | 0.88 | ND | 1.0 |
| 1S0069 | 9.98 | ND | 0.5 |
| 1S0069 | 0.42 | ND | 1.0 |
| 1S0070 | 2.76 | ND | 0.5 |
| 1S0070 | 2.32 | ND | 1.0 |
| 1S0063 | 11.81 | 0.18 | 0.5 |
| 1S0033 | 0.41 | ND | 4.0 |
| 1S0064 | 19.55 | 0.48 | 0.5 |
| 1S0064 | 0.8. | ND | 1.0 |
| 1S0032 | 0.23 | ND | 1.0 |
| 1S0034 | 0.33 | ND | 1.0 |

ND = Not detected

As seen in Table 2-7, activity in the soils of OOL03 will necessitate some degree of remediation. OOL03 is classified as a Class 1 area.

#### *2.1.8.5 OOL04 - Sump Drain Line Land Area*

Survey Area OOL04 consists of a narrow strip of open land area traveling from Unit 3 to the Discharge Canal. Buried beneath OOL04 is the sump drain line. Survey Area OOL04 contains about 458 $m^2$ of surface area made up primarily of soil.

During the initial phase of the HBGS construction in 2008, utilities and obstructions were removed or relocated from the HBGS footprint area to prepare for the HBGS builder to begin construction. While a utility line was being relocated to an area outside of the HBGS footprint area, the soil was removed from the top of the discharge tubes. An access portal or manhole was discovered in this area. The radwaste tankage drain line connected into this concrete monolith. The line then exited the monolith toward the

discharge canal. The drain line, as well as the concrete monolith, was significantly contaminated (20 mrem/hr on the concrete surface).

The concrete monolith was removed as well as most of the drain line toward the Unit 3 RA. Soil samples in the area were greater than 50pCi/g. The soil was removed to "near background levels." The area above the discharge tubes and around the radwaste tankage drain line is designated a Class 1area.

OOL04 is bounded by OOL08 and OOL10 on the south, OOL10 and OOL09 on the east NOL01 and OOL08 on the west and NOL01, OOL01 and OOL07 bound the survey area on the north.

The following events and activities may have affected Survey Area OOL04:

- Routine discharges of radioactive liquids from Unit 3
- Possible radwaste spill to radwaste tankage area drain
- Overflow of LRW concentrator to CWT Vault, radwaste tankage sump and its drain to the Outfall Canal
- Wet and dry deposition from Unit 3 stack discharges

Translocation pathways within OOL04 include the following:

- Routine, as well as non-routine, discharges through the drain line with the potential for the migration of activity from the piping to the subsurface soils below
- Activity from the stack deposition settling onto the surfaces of the soils

Since there have been significantly contaminated soils in this area, the area above the discharge tubes and around the radwaste tankage drain line is designated a Class 1 area.

#### *2.1.8.6 OOL05 - Discharge Canal North*

Survey Area OOL05 consists of the north end of the Discharge Canal. Characterization sampling has identified a reduction in the concentration of activity, prompting a different classification from the remainder of the canal.

Survey Area OOL05 contains about 556 $m^2$ of surface area made up primarily of silt and sediment.

In 2008, 19 sediment sampling borings were advanced to characterize radiological and environmental chemical soil conditions in the HBPP Discharge Canal and to determine the environmental impacts at the plant. The reasoning and rationale for the locations of the 19 sample borings was to provide a sufficient spatial characterization of the Discharge Canal soils for decision-making purposes. The samples collected in 1997 by IT/Duratek ("Structural Characterization Report for Humboldt Bay Power Plant," March, 1998) were all collected down the centerline of the discharge canal. Several samples had elevated concentrations of Cs-137 at the lowest depth of sample (approximately 1.7 feet) into the native sediment; however, the northernmost end of the canal indicated considerably less activity than the remainder of the canal.

OOL05 is bounded by OOL01 on the south, OOL09 on the east, OOL07 on the west side; OOL10 bound the Survey Area on the north.

The following events and activities may have affected Survey Area OOL04:

- Routine discharges of radioactive liquids from Unit 3
- Possible radwaste spill to radwaste tankage area drain
- Overflow of LRW concentrator to CWT vault, radwaste tankage sump and its drain to the Outfall Canal
- LRW concentrator steam condensate leakage to radwaste tankage sump
- Wet and dry deposition from Unit 3 stack releases

Translocation pathways within OOL05 include the following:

- Some of the activity from the routine and non-routine liquid releases into the discharge canal reaching the northern section and progressing downward into the sediments below

- Activity settling onto the surfaces of the water from the deposition of stack releases settling into the sediments below

Table 2-8 provides the results of the 1997 characterization effort.

**Table 2-8 OOL05 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 6SD043 | 1.75 | 0.19 | 1.7 |
| 6SD044 | 1.73 | 0.28 | 1.7 |
| 6SD045 | 0.18 | ND | 1.7 |

ND = Not detected

Since activity has been found in this area, albeit at low levels, OOL05 is classified as a Class 2 Survey Area. Further characterization is scheduled for this area.

#### *2.1.8.7 OOL06 – Intake Center*

Survey Area OOL06 consists of the open land area within the center portion of the Intake Canal. Survey Area OOL06 contains about 2,047 $m^2$ of surface area made up primarily of silt and sand.

OOL06 is bounded by OOL08 on the north, OOL02 on the east, OOL10 on the south, and OOL11 on the west.

The following events and activities may have affected Survey Area NOL01:

- LRW concentrator steam condensate leakage to yard drain north loop
- Wet and dry deposition of activity from Unit 3 stack releases

Translocation pathways within OOL06 include the following:

- A portion of the activity from the yard drain discharge migration into the Survey Area, due to tidal influences, traveling downward into the sediments below
- Activity from the deposition from stack releases settling onto the water surface and traveling downward into the sediments below

Table 2-9 provides the results of the 1997 characterization effort.

**Table 2-9 OOL06 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 6SD018 | 0.23 | ND | 1.7 |
| 6SD017 | 0.18 | ND | 1.7 |

ND = Not detected

Since limited characterization data exist for this survey area, and the potential exists for the area to be impacted, OOL06 is classified as a Class 2 Survey Area. Further characterization is scheduled for this area.

#### *2.1.8.8 OOL07 – NOL Boundary East*

Survey Area OOL07 consists of the open land area bordering the eastern side of the Class 1 Survey Area NOL01. Survey Area OOL07 contains about 8,326 $m^2$ of surface area made up primarily of soils and engineered materials.

OOL07 is bounded by OOL10 on the north, OOL01 and OOL05 on the east, OOL04 on the south, and NOL01 on the west.

The following events and activities may have affected Survey Area OOL07:

- Wet and dry deposition from the stack releases
- Liquid spills crossing over into OOL07 from NOL01

Translocation pathways within OOL07 include the following:

- Radioactive liquids migrating from NOL01 crossing into OOL07 settling onto and beneath the soils
- Activity from the deposition from stack releases settling onto the surface of the Survey Area

Table 2-10 provides the results of the 1997 characterization effort.

**Table 2-10 OOL07 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 2SS026 | 0.08 | ND | 0.5 |
| 2SS029 | 0.62 | ND | 0.5 |
| 4SO027 | 0.07 | 0.11 | 1-3 |
| 4SO028 | 0.12 | 0.16 | 0.5 |

ND = Not detected

Since limited characterization data exist for this Survey Area, further characterization is scheduled for this area. OOL06 is classified as a Class 2 Survey Area.

#### *2.1.8.9 OOL08 – NOL Boundary West*

Survey Area OOL08 consists of the open land area bordering the western side of the Class 1 Survey Area NOL01. Survey Area OOL08 contains about 6,837 $m^2$ of surface area made up primarily of soils and engineered materials.

OOL08 is bounded by OOL10 on the north and west, OOL10 and OOL02 on the south, and NOL01, OOL04, and OOL07 on the east.

The following events and activities may have affected Survey Area OOL08:

- Wet and dry deposition from the stack releases
- Liquid spills crossing over into OOL08, OOL03 and NOL01

Translocation pathways within OOL08 include the following:

- Radioactivity in this survey area would translocate in much the same way as activity in OOL07

Table 2-11 provides the results of the 1997 characterization effort.

**Table 2-11 OOL08 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 2SS003 | 0.24 | ND | 0.5 |
| 2SS024 | 0.71 | ND | 0.5 |
| 2SS016 | 0.16 | ND | 0.5 |
| 4SO030 | 0.20 | ND | 0.5 |
| 2SS019 | 0.23 | ND | 0.5 |
| 4SO002 | 0.26 | ND | 0.5 |
| 4SO002 | 0.09 | ND | 3.5 |

ND = Not detected

OOL08 is classified as a Class 2 Survey Area. Further characterization is scheduled for this area.

#### *2.1.8.10 OOL09 – Hazardous Waste Area*

Survey Area OOL09 consists of the open land area east of the discharge canal and the site occupied by temporary trailers. Survey Area OOL09 contains about 1,032 $m^2$ of surface area made up primarily of soils and engineered materials.

OOL09 is bounded by OOL10 on the north, south and east and OOL01, OOL04 and OOL05 on the west side.

The following events and activities may have affected Survey Area OOL09:

- The placement of slightly contaminated hazardous waste spoils in the area

Translocation pathways within OOL09 include the following:

- Small quantities of radioactive material could leach from the spoils pile onto the soils where it was placed
- Activity from the deposition of stack releases could settle onto the soils

Table 2-12 provides the results of the 1997 characterization effort.

**Table 2-12 OOL09 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) | Depth (feet) |
|---|---|---|---|
| 4SO036 | 0.1 | ND | 3.5 |
| 4SO036 | ND | 0.1 | 4.0 |
| 4SO035 | 3.87 | 1.28 | 0.5 |
| 4SO042 | 0.08 | ND | 0.5 |
| 4SO042 | 0.09 | ND | 1.5 |
| 4SO042 | 0.11 | ND | 2.5 |
| 4SO044 | 0.12 | ND | 0.5 |
| 4SO044 | 0.08 | ND | 1.5 |
| 4SO044 | 0.07 | 0.05 | 2.5 |
| 4SO045 | 0.14 | ND | 0.5 |
| 4SO045 | 0.07 | ND | 1.5 |
| 4SO045 | 0.12 | ND | 2.5 |

ND = Not detected

OOL09 is classified as a Class 2 survey area. Further characterization is scheduled for this area.

#### *2.1.8.11 OOL10 – Remainder of Land Area*

Survey Area OOL10 consists of the remainder of the open land areas, with the exception of the western portion of the Intake. Survey Area OOL10 contains about 234,584 $m^2$ of surface area made up primarily of soils and engineered materials.

OOL10 is bounded by the bay on the north and non-PG&E property on the remaining sides.

The following events and activities may have affected Survey Area OOL10:

- Wet and dry deposition of activity from Unit 3 stack releases

Translocation pathways within OOL10 include the following:

- Activity from the deposition from Unit 3 stack releases settling onto the soil surfaces

Table 2-13 provides a summary of the results of the 1997 characterization effort.

**Table 2-13 OOL10 Characterization Data**

| Nuclide | Samples Analyzed | Number Detections | Mean pCi/g |
|---|---|---|---|
| Cs-137 | 35 | 21 | 0.30 |
| Cs-137 | 36 | 30 | 0.46 |

OOL10 is classified as a Class 3 survey area.

#### *2.1.8.12 OOL11 – Intake West*

Survey Area OOL11 consists of the open land area within the western portion of the Intake Canal. Survey Area OOL11 contains about 2,470 $m^2$ of surface area made up primarily of silt and sand.

OOL11 is bounded by OOL11 on the north and south sides, non-PG&E property on the west, and OOL06 on the east.

The following events and activities may have affected Survey Area OOL11:

- LRW concentrator steam condensate leakage to yard drain north loop
- Wet and dry deposition of activity from Unit 3 stack releases

Translocation pathways within OOL10 include the following:

- The possible migration of activity from the yard drain discharge and deposition from stack releases into the survey area due to tidal influences

Table 2-14 provides the results of the 1997 characterization effort.

**Table 2-14 OOL11 Characterization Data**

| Location | Cs-137 (pCi/g) | Co-60 (pCi/g) |
|---|---|---|
| 6SD010 | 0.08 | ND |
| 6SD013 | ND | 0.08 |

ND = Not detected

Since limited characterization data exist for this survey area, and the potential exists for the area to be impacted, OOL11 is classified as a Class3 survey area. Further characterization is scheduled for this area.

#### *2.1.8.13 OFA01 – Office Annex*

Survey Area OFA01 consists of the Office Annex Building. Survey Area OFA01 footprint contains about 270 $m^2$ of surface area. The Office Annex is a concrete block structure for administrative offices constructed in 1980s.

OFA01 is bounded by OOL10 on the north, west, and south sides, and OOL08 on the east.

The following events and activities may have affected Survey Area OFA01:

- Wet and dry depositions from Unit 3 stack discharges

Translocation pathways within OFA01 include the following:

- Activity from the deposition from stack releases settling onto the building surfaces (more so on the roofs than the remainder of the surfaces)

A characterization was performed September 2008 consisting of 41 fixed-point measurements. No measurements on the building's exterior walls exceeded the Minimum Detectable Activity (MDA) for the instrument. The 19 measurements that exceeded the instrument's MDA are listed in Table 2-15.

Table 2-15 provides the results of the 2008 characterization effort.

**Table 2-15 OFA01 Characterization Data**

| Location | Dpm/100cm2 | Location | Dpm/100cm2 |
|---|---|---|---|
| Floor | 223 | Roof | 458 |
| Floor | 627 | Roof | 465 |
| Roof | 559 | Roof | 397 |
| Roof | 455 | Roof | 386 |
| Roof | 429 | Roof | 437 |
| Roof | 415 | Roof | 483 |
| Roof | 382 | Roof | 368 |
| Roof | 447 | Roof | 408 |

| Location | Dpm/100cm2 | Location | Dpm/100cm2 |
|---|---|---|---|
| Roof | 451 | Roof | 307 |
| Roof | 433 | | |

OFA01 is classified as a Class 3 survey area.

#### *2.1.8.14 ISF01 – ISFSI area*

Survey Area ISF01 consists of the ISFSI. Survey Area ISF01 footprint contains about 5540 $m^2$ of surface area. ISF01 is located at the top of the hill on the west side of the site.

ISF01 is bounded by OOL10 on all sides.

The following events and activities may have affected Survey Area ISF01:

- Wet and dry depositions from Unit 3 stack discharges

Translocation pathways within ISF01 include the following:

- Activity from the deposition from stack releases settling onto the soil surfaces.

Table 2-16 provides the results of the 2008 characterization effort.

**Table 2-16 ISF01 Characterization Data**

| Location | dpm/100cm2 |
|---|---|
| 2SS017 | 0.13 |
| 2SS039 | 0.12 |
| 2SS038 | 0.21 |
| 2SS036 | 0.17 |
| 2SS037 | ND |

ND = Not detected

ISF01 is classified as a Class 3 Survey Area. The ISFSI Security Building was constructed after Unit 3 shutdown and is therefore classified as non-impacted. The ISF01 will remain under the HBPP 10 CFR 72 license after it is released from the Part 50 license.

#### *2.1.8.15 TRB01 – Training Building*

Survey Area TRB01 consists of the Training Building. Survey Area TRB01 footprint contains about 40 $m^2$ of surface area.

The Training Building is located adjacent to the PG&E employee parking lot.

The Training Building was used by the Training Coordinator. It is a concrete block structure, constructed about 1974, originally intended to be a security search area. It has been used for training and is now used by security personnel.

TRB01 is bounded by OOL10 on all sides.

The following events and activities may have affected Survey Area TRB01:

- Wet and dry depositions from Unit 3 stack discharges

Translocation pathways within TRB01 include the following:

- Activity from the deposition from stack releases settling onto the building surfaces (more so on the roofs than the remainder of the surfaces)

A characterization was performed September 2008 consisting of 30 fixed-point measurements. Of the 30 measurements taken, 17 exceeded the instrument's MDA and are listed in Table 2-17.

Table 2-17 provides the results of the 2008 characterization effort.

**Table 2-17 TRB01 Characterization Data**

| Location | dpm/100cm2 | Location | dpm/100cm2 |
|---|---|---|---|
| Roof | 307 | Roof | 281 |
| Roof | 256 | Roof | 289 |
| Roof | 213 | Roof | 404 |
| Roof | 296 | Interior | 733 |
| Roof | 361 | Interior | 265 |
| Roof | 242 | Interior | 249 |
| Roof | 307 | Exterior Walls | 340 |
| Exterior Walls | 257 | Exterior Walls | 310 |
| Exterior Walls | 234 | | |

TRB01 is classified as a Class 3 Survey Area.

#### *2.1.8.16 SEC01 – Security Building*

Survey Area SEC01 consists of the Security Building. Survey Area SEC01 footprint contains about 49 $m^2$ of

surface area. The Security Building is located adjacent to the access road at the entrance to the Industrial Area.

The Security Building is a small concrete block building housing the security officers and the site entry port. It was constructed about 1974 and originally intended as a security search area. It has been used for training, and is now office space for the plant security force.

SEC01 is bounded by OOL10 on all sides.

The following events and activities may have affected Survey Area SEC01:

- Wet and dry depositions from Unit 3 stack discharges

Translocation pathways within SEC01 include the following:

- Activity from the deposition from stack releases settling onto the building surfaces (more so on the roofs than the remainder of the surfaces)

A characterization was performed September 2008 consisting of 31 fixed-point measurements. Of the 31 measurements taken, 14 exceeded the instrument's MDA and are listed in Table 2-18.

Table 2-18 provides the results of the 2008 characterization effort.

**Table 2-18 SEC01 Characterization Data**

| Location | dpm/100cm2 | Location | dpm/100cm2 |
|---|---|---|---|
| Roof | 328 | Interior | 483 |
| Roof | 224 | Interior | 292 |
| Roof | 213 | Exterior Walls | 495 |
| Roof | 516 | Exterior Walls | 306 |
| Interior | 296 | Exterior Walls | 246 |
| Interior | 253 | Exterior Walls | 355 |
| Interior | 260 | Exterior Walls | 299 |

SEC01 is classified as a Class 3 Survey Area.

#### *2.1.8.17 MOB01 Main Office Building*

Survey Area MOB01 consists of the Main Office Building. Survey Area MOB01 footprint contains about 409 $m^2$ of

surface area. The Main Office Building is located across from the Office Annex.

The original Main Office Building was built during Unit 1 plant construction. An addition was added to the structure in the 1970s and remodeling has been performed on the structure. Currently, the structure is used for offices, tool room, and an electrical shop.

MOB01 is bounded by OOL08 on all sides with the exception of a small area on the east side, which is bounded by OOL03.

The following events and activities may have affected Survey Area MOB01:

- Wet and dry depositions from Unit 3 stack discharges

Translocation pathways within MOB01 include the following:

- Activity from the deposition from stack releases settling onto the building surfaces (more so on the roofs than the remainder of the surfaces)

A characterization was performed September 2008 consisting of 120 fixed-point measurements. Of the 120 measurements taken, 47 exceeded the instrument's MDA and are listed in Table 2-19.

Table 2-19 provides the results of the 2008 characterization effort.

**Table 2-19 MOB01 Characterization Data**

| Location | dpm/100cm2 | Location | dpm/100cm2 |
|---|---|---|---|
| Walls/Ceilings | 331 | Roof | 335 |
| Walls/Ceilings | 255 | Roof | 281 |
| Floor | 221 | Roof | 249 |
| Floor | 347 | Roof | 415 |
| Roof | 263 | Roof | 361 |
| Roof | 285 | Roof | 285 |
| Roof | 451 | Roof | 249 |
| Roof | 390 | Roof | 281 |
| Roof | 303 | Roof | 328 |
| Roof | 361 | Roof | 566 |
| Roof | 299 | Roof | 411 |
| Roof | 563 | Roof | 397 |
| Roof | 415 | Roof | 397 |

| Location | dpm/100cm2 | Location | dpm/100cm2 |
|---|---|---|---|
| Roof | 516 | Roof | 292 |
| Roof | 415 | Roof | 624 |
| Roof | 519 | Roof | 530 |
| Roof | 595 | Roof | 548 |
| Roof | 1025 | Roof | 631 |
| Roof | 1021 | Roof | 967 |
| Roof | 1126 | Roof | 877 |
| Roof | 224 | Roof | 628 |
| Roof | 696 | Roof | 548 |
| Roof | 520 | Roof | 404 |
| Roof | 628 | | |

MOB01 is classified as a Class 3 Survey Area.

#### *2.1.8.18 CRB01 Count Room Building*

Survey Area CRB01 consists of the Count Room Building. Survey Area CRB01 footprint contains about 372 $m^2$ of surface area. The Count Room Building is located in the southwest corner of the site.

The original Count Room Building was built during 2010. Currently, the structure is used for preparing and counting samples and houses the whole-body counter.

CRB01 is bounded by OOL10 on all sides.

The following events and activities may have affected Survey Area CRB01:

- Sample preparation activities potentially impact the survey area

Characterization data is unavailable for this survey area and will be scheduled prior to the survey package development.

Since no events have been identified that would have affected this survey area, it has been classified as a Class 1 area.

### 2.1.9 HSA Findings

#### *2.1.9.1 Potential Contaminates*

The primary contaminants of concern for the HBPP site are Fe-55, Co-60, Cs-134, Cs-137, Ni-63, Pu-238/241, and Am-241. Since the plant has been in cold shutdown and SAFSTOR since 1976, the more abundant activation and

fission products, Fe-55 and Co-60, have decayed to 0.1 percent and 1.6 percent, respectively, of their total activity because of their short half-life. This has led to Cs-137 and Ni-63 as the most abundant radionuclides in the HBPP inventory. Personnel at HBPP have seen an increase in Am-241 since the shutdown of Unit 3. The increase is most likely from the beta decay of Pu-241 to Am-241. The radionuclide inventory performed in 1981 did not include analysis for Pu-241, possibly due to detection limits. Plutonium-241 decays by a very weak beta at 20.8 KeV. It also decays by alpha emission to Np-237; however, this mode of decay has a relative abundance of less than one percent. No equilibrium point will be reached between Pu-241 and Am-241 because of their short to long half-lives, 14.4 years and 432.7 years, respectively. The increase of Am-241 should reach 90 percent of its maximum in approximately 48 years from the date of the last fuel cladding failure, which occurred in1965. This will occur around the year 2013, and the maximum should occur about 73 years after the last fuel failure (or 2038).

### 2.1.10 HSA Conclusions

Data from the HSA investigation suggest that the land and structures that may require remediation lie very near to the Unit 3 nuclear reactor. The Unit 3 reactor and buildings will require remediation before they are demolished to ensure the offsite dose limits delineated in the plant's Offsite Dose Calculation Manual (ODCM) are not exceeded and remediated such that FSS can be achieved. All materials above the DCGLs would be disposed at an NRC-licensed waste disposal facility.

The migration of surface and subsurface contamination appears to be limited to areas within proximity of Unit 3. The areas of concern for the HBGS facility and the ISFSI show little to no affect from operations at HBPP and the available data suggest that these areas do not require remediation.

All classifications are subject to change if new data becomes available.

## 2.2 Hydrogeological Investigations

### 2.2.1 Previous Reports and Studies

A substantial amount of subsurface investigative work has been done on the HBPP site beginning in the 1950s. Historical subsurface

studies at the HBPP site have ranged in purpose and specific area and/or depth of interest. Types of exploration include borings for geotechnical, hydrogeologic, seismic, and stratigraphic investigations; shallow trenches for fault investigations; and installation of groundwater monitoring wells for contamination detection and monitoring. Numerous data-review documents and hydrogeologic studies have been produced for the HBPP site. The following subsurface studies and documents were considered the most relevant available:

**Bechtel Civil & Minerals, Inc.: "Interoffice Memorandum, Humboldt Bay Power Plant Unit #3 Report of 1984 Geologic Activities." August 1984.**

Bechtel's investigation consisted of the installation of 12 boreholes near Unit 3, 11 of which were subsequently constructed as monitor wells (MW-1 through MW-11). The purpose of Bechtel's study was "to provide input to geology, groundwater and seismology sections of an environmental report to be filed with PG&E's decommissioning permit request," and to collect data for use in "evaluating the direction and rate of possible contaminant migration." A flowmeter survey was conducted in five of the monitor wells (MW-2, MW-3, MW-4, MW-10, and MW-11) to assess groundwater flow direction and velocity. Five of the monitor wells installed by Bechtel (MW-1, MW-2, MW-4, MW-6, and MW-11) were recently redeveloped and play an active role in the current groundwater monitoring program.

**PG&E Department of Engineering Research: "Effects of Tides on Groundwater Flow at Humboldt Bay Power Plant," January 1987**

This report presents the results of a groundwater flow analysis within the first and second water bearing zones near the Wastewater Impoundments (WWI) and the Oil/Water Separator (OWS). Although the WWI area is north of Unit 3 and outside the study area, the OWS is adjacent to the southern boundary of Unit 3. The study used pressure transducers and continuous data acquisition systems to track the influence of the tides on groundwater flow.

**PG&E Technical and Ecological Services, Water Resources Unit: "Humboldt Bay Power Plant Wastewater Treatment Impoundments Hydrogeologic Characterization Study," November 1988**

This study characterizes groundwater flow within the area of the wastewater treatment impoundments east of the Discharge Canal.

The study is a follow-up to the 1987 study mentioned previously and included an analysis of data acquired from 30 wells (piezometer and monitoring wells) installed at four different levels within the first and second water-bearing zones.

**PG&E Geosciences: "Technical Report TR-HBIP-2002-01, Seismic Hazard Assessment for the Humboldt Bay ISFSI Project, Revision 0." December 27, 2002**

This technical report presents the results of a comprehensive review of both regional and local seismic hazards for the HBPP site. It includes a review of historical subsurface work and presents updated cross-sections and geologic mapping.

**ENERCON Services, Inc.: "Humboldt Bay Power Plant Tritium Evaluation," December 2006**

In this report, ENERCON presents the results of a review of the existing groundwater-monitoring program at HBPP, in which they identify sources of potential radiological release into the groundwater, identify potential migration pathways, and evaluate the existing monitor well network in terms of its effectiveness for detecting radiological releases. The report lays the groundwork for meeting the requirements set forth in the Nuclear Energy Institute (NEI) groundwater protection initiative. Recommendations included the installation of seven new monitoring wells. (SHN Consulting installed these seven monitoring wells in August 2008.)

**PG&E: "DECON-POS-H011: Groundwater Investigation History, Control, and Management, Revision B." May 2009**

This position paper, one of a series developed to aid in the decommissioning of Unit 3, outlines the issues, strategies, and costs for groundwater monitoring and control during decommissioning activities, particularly with respect to the planned removal of subgrade structures.

As previously noted, this strategy is good for the current condition and to assess offsite migration of contaminants, but not the final as left remediated site with a well network that will support the Resident Farmer Scenario and resident farmer well.

### 2.2.2 Current Groundwater Monitoring

Seven monitor wells, which are referred to as the "Intermediate Screened Wells," have screened intervals within an elevation range of

approximately minus 24 to minus 40 feet North American Vertical Datum 1988 (NAVD88). The remaining five monitor wells are referred to as the "Deep Screened Wells," and have a screen interval at an elevation range of approximately minus 62 to minus 82 feet NAVD88. Unit 3 area monitor wells were originally sampled on a quarterly basis and, as part of modifications to the Radiological Environmental Monitoring Program (REMP), HBPP increased groundwater gauging events to monthly intervals in 2010. At this time, the shallow zone monitor wells installed by Arcadis in 2009 are not part of the REMP groundwater monitoring program (RGWMP), though several of these wells have been sampled and groundwater measurements are taken from selected wells during quarterly monitoring events. Table 2-20 provides the HBPP monitor well elevations and depths. Additional wells are slated to be installed to provide additional future monitoring to determine the impact of decommissioning activities on groundwater (e.g. within the slurry wall area).

**Table 2-20 Monitoring Well Elevation and Depth**

| Well Location | Date Installed | Top of Casing Elevation (feet[1]) | Screen Interval (BGS)[2] | Screen Interval (feet)[1,3] |
|---|---|---|---|---|
| MW-1 | Jun-84 | 10.84 | 39.9 to 44.3 | -28.91 to -33.31 |
| MW-2 | Jun-84 | 10.94 | 39.8 to 49.2 | -28.9 to -38.3 |
| MW-4 | Jun-84 | 11.13 | 41.0 to 50.2 | -29.71 to -38.91 |
| MW-6 | Jun-84 | 10.79 | 44.2 to 48.5 | -33.54 to -37.84 |
| MW-11 | Jun-84 | 11.39 | 35.8 to 45.0 | -23.98 to -33.18 |
| RCW-SFP- | Aug-08 | 26.22 | 56.5 to 66.0 | -30..01 to - |
| RCW-SFP- | Aug-08 | 32.40 | 57.1 to 66.6 | -28.29 to -37.79 |
| RCW-CS-1 | Aug-08 | 10.50 | 73.0 to 82.5 | -62.27 to -71.77 |
| RCW-CS-2 | Aug-08 | 10.62 | 73.5 to 83.0 | -62.70 to -72.20 |
| RCW-CS-3 | Aug-08 | 10.91 | 73.5 to 83.0 | -62.44 to -71.94 |
| RCW-CS-4 | Aug-08 | 10.90 | 83.5 to 93.0 | -72.38 to -81.88 |
| RCW-CS-5 | Aug-08 | 10.92 | 84.0 to 93.5 | -72.84 to -82.34 |
| 5G-MW-03 | Jan-09 | 23.90 | 20.0 to 30.0 | 3.90 to -6.10 |
| 1C-MW-06 | Jan-09 | 10.28 | 15.0 to 25.0 | -4.72 to -14.72 |
| 1C-MW-07 | Jan-09 | 10.36 | 15.0 to 25.0 | -4.64 to -14.64 |
| 1C-MW-08 | Jan-09 | 10.69 | 15.0 to 25.0 | -4.31 to -14.31 |
| 1E-MW-12 | Jan-09 | 10.42 | 15.0 to 25.0 | -4.58 to -14.58 |
| 1E-MW-13 | Jan-09 | 11.39 | 15.0 to 25.0 | -3.61 to -13.61 |

Referenced to NAVD88 (North American Vertical Datum 1988)

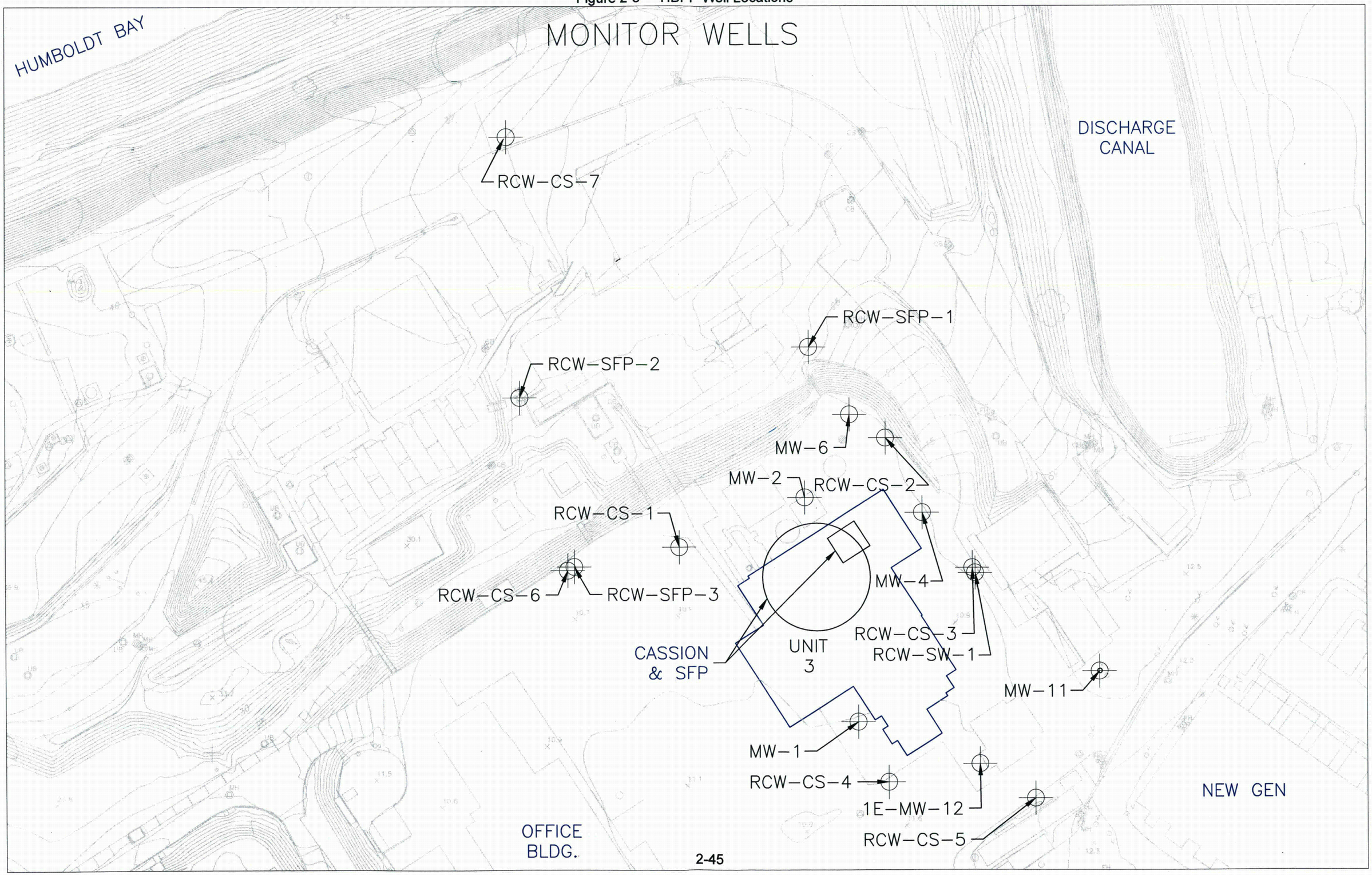
BGS: Below Ground Surface

Well screen depth adjusted to top of casing elevation

### 2.2.3 Groundwater Monitoring Results

Appendix 2-C provides the results of groundwater monitoring for 2009 and 2010.

Figure 2-3 HBPP Well Locations



## 2.3 Site Characterization Surveys

### 2.3.1 1997 Characterization Survey

The objective of this radiological survey was to assess the nature, degree, and extent of radiological contamination in sediments and shallow soils at HBPP. The primary purpose of the survey was to provide a decision-making basis for developing remediation requirements and cost estimates leading to the future decommissioning of Unit 3. Additional objectives of the site characterization survey included the following:

- Identifying areas not affected by HBPP operations and in which radioactivity is indistinguishable from background
- Confirming and updating survey unit classifications
- Providing a basis for development of data quality objectives for the final survey
- Obtaining data that may be used in the final site survey

The scope of the investigation included sampling of sediments and surface and shallow subsurface soils to a nominal depth of 4 feet below ground surface.

#### *2.3.1.1 Methodology*

The radiological survey of shallow soils and sediment at HBPP was conducted using a graded approach that assumed all areas of the plant were either Class 1, 2, or 3. Prior to the sampling, a preliminary classification of sediments and soils at HBPP was performed, based on the facility layout, operational history, interviews with PG&E staff, and information presented in *Residual Radionuclide Distribution and Inventory at the Humboldt Bay Nuclear Power Plant* (Battelle, 1983). Environmental media were initially divided into six survey units.

Survey Unit 1, the Unit 3 RA comprised surface and shallow subsurface soils hypothesized to be affected by release of liquids to the land surface and by aerial deposition from the Unit 3 stack. Survey Unit 2, the relatively undisturbed upland soils in outlying areas, was hypothesized to be affected only by aerial deposition from the stack. Survey Unit 3, the relatively undisturbed low-lying or wetland-type

soils in outlying areas, was hypothesized to be similarly affected by emissions from the stack, but was also hypothesized to be affected by contaminated sediments transported from the central portions of the plant during rainfall events. Survey Unit 4, the disturbed soils surrounding Units 1 through 3, was hypothesized to be affected by stack emissions, as well as earthmoving activities that may have resulted in the relocation or shallow burial of contaminated soil. Survey Unit 5, the sediments of Humboldt Bay, was hypothesized to be affected by stack emissions and sediment transported from the plant. Survey Unit 6, the sloughs, canals, and ditches of HBPP, was hypothesized to be affected by stack emissions, liquid releases, or transport of sediments from the plant.

The minimum number of samples expected to be required to meet the statistical requirements of the final survey were estimated using the approach documented in MARSSIM. This approach includes the use of nonparametric statistical methods including the Wilcoxon Rank Sum test and Sign test. For survey units subjected to random or systematic sampling, a decision rule was developed as follows: "If the mean concentration of the survey unit adjusted to account for background radiation exceeds the investigation levels, then the survey unit is assumed to require remediation." It was assumed that this decision rule would be tested using the Wilcoxon Rank Sum test or Sign test. Next, a relative shift of 1.6 was estimated by assuming that the Lower Bound of the Gray Region was 50 percent of the investigation level, and the relative standard deviation of survey results was 30 percent for all radionuclides. Using a relative shift of 1.6 and a decision error rate of 5 percent for alpha and beta type errors, the estimated numbers of samples required to perform the Wilcoxon Rank Sum and Sign tests were 16 and 17, respectively (Tables 5.3 and 5.5 in MARSSIM). As described in MARSSIM, these numbers included a 20 percent contingency to account for unusable sample results. The number of samples was further increased to 30 in most survey units to account for the following uncertainties:

- Site-specific standard deviations were unavailable.

- Site-specific cleanup standards had not been agreed upon at that time.
- Acceptable decision error rates for the final survey had not been agreed upon at that time

#### *2.3.1.2 Survey Instrumentation*

Survey instrumentation was selected to ensure that sensitivities were sufficient to detect the expected radionuclides at the minimum detection requirements. A list of the survey instrumentation, radiations detected, and calibration sources is provided in Table 2-21.

**Table 2-21 Survey Instrumentation**

| Instrument/ Detector | Detector Type | Radiation Detected | Calibration Source | Use |
|---|---|---|---|---|
| Eberline ESP-1/SPA-3 | NaI Detector (gamma scintillator) | Gamma | Cesium-137 | Qualitative Soil Contamination Measurement |
| TSA Large Area Detector | Plastic Scintillator | Beta/Gamma | Cesium-137 | Qualitative Soil Contamination Measurement |
| EG&G Ortec NOMAD Gamma Spectroscopy System | High Purity Germanium (HPGe) | Gamma | Mixed Gamma Standard | Radionuclide identification and quantification |

Soil and sediment samples were analyzed onsite using gamma spectroscopy. The samples were collected, prepared, and analyzed in accordance with the Sample Analysis and Data Management Plan (GTS Duratek, 1997) and approved procedures. Once analyzed, the samples were archived and turned over to HBPP personnel for storage pursuant to sample chain-of-custody procedure, unless the samples were shipped offsite for further analyses. A total of 706 samples were analyzed onsite, not including sample splits and duplicates.

### 2.3.2 2008 Characterization Survey

The purpose of the 2008 HBPP Characterization activities was to assess the radiological status of the HBPP site in accordance with MARSSIM guidance. The characterization activities were guided by HBPP-PP-003, "Site Characterization Plan," which used the MARSSIM Data Quality Objective (DQO) process to establish the necessary

requirements and methods for obtaining high quality characterization data. The scope of this survey was as follows:

- Identify and quantify the nature and extent of radiological materials
- Determine the distribution of radioactive material contamination in each area that contained radioactive materials contamination
- Obtain data to provide guidance for decontamination/remediation activities planning
- Obtain data to provide guidance for waste management planning
- Provide information to support the development of the site-specific DCGLs
- Provided the information needed to develop the FSS for each survey area

#### *2.3.2.1 Methodology*

The survey package development involved performing walk-downs of each area. During the walk-down, details regarding the physical survey area were compiled in the survey package, such as type of area (structure, system, or environ), surfaces in the area (wall, floor, ceiling, surface soil, or other feature), and dimensions. Data from previous HBPP characterization and scoping surveys were reviewed and used as appropriate. Each survey package contained the following eight sections of information:

1. Detailed description of the survey area and/or survey units
2. Photographs, drawing, or drawings of the survey area and/or survey units
3. Survey area operational history including summary data from previous surveys
4. Characterization survey instructions—types and number of survey measurements and/or samples prescribed for the survey
5. Survey support requirements such as shovels, scoops, ladders, global positioning system (GPS), and coring tools
6. Health and safety requirements
7. Radiation Work Permit (RWP) requirements
8. Characterization Data-survey instrument data downloads, survey reports, and sample analysis reports

For each survey area in a designated survey unit, ENERCON used 30 samples/measurements as a standard number of characterization survey locations for all areas that were designated as MARSSIM Class 2 or Class 3 at HBPP. The basis for using this number is that the quantity is an important standard number in large population statistics and was used historically in NRC guidance, NUREG/draft 5849, "Manual for Conducting Surveys in Support of License Termination." NUREG 5849 states that for survey areas with a low potential for residual contamination, 30 random measurements should be collected to identify the condition of an area within a 95 percent confidence level. Regarding the statistical number of locations using MARSSIM, the number 30 corresponds to designing a survey using the more conservative relative shift of 1, which typically provides a sample number requirement of 29. These statistical methods are only able to work if all the surfaces in the survey area have the same potential for having residual contamination (e.g., walls, floors, horizontal pipes/beams, ceilings). For Class 1 areas such as the soils around Unit 3, a more direct bounding survey was used since the data would not be used for final status surveys, given that the area would most likely require remediation.

#### *2.3.2.2 Instrumentation*

Radiological survey instrumentation was selected to ensure that sensitivities were sufficient to detect the expected radionuclides at the minimum detection requirements. A list of the survey instrumentation, radiations detected, and calibration sources is provided in Table 2-22.

**Table 2-22 2008 Characterization Instrumentation**

| Instrument/ Detector | Detector Type | Radiation Detected | Calibration Source | Use |
|---|---|---|---|---|
| Ludlum 2221 (2"X 2") | NaI Detector (gamma scintillator) | Gamma | Am-241 | Qualitative Soil Contamination Measurement |
| Ludlum Model 2360 (126 cm2 area) | Gas flow proportional | Alpha/Beta/ Gamma | Th-230/Tc-99 | Surface static/scan measurements |
| Ludlum Model 19 | NaI | Gamma | Cs-137 | Area exposure measurements |

| Instrument/ Detector | Detector Type | Radiation Detected | Calibration Source | Use |
|---|---|---|---|---|
| Ludlum Model 2929 | ZnS | Alpha/beta/ Gamma | Pu-239/Tc-99/I-131/C-14 | Swipe/smear counting |

## 2.4 Continuing Characterization

Characterization data will be collected as necessary throughout the project. Results of future characterization sample analysis will be evaluated to determine the impact, if any, on the radionuclide identities, nuclide fractions, and the classification of structures, soils and other site media

## 2.5 Summary

The characterization data collected and analyzed to date are of sufficient quantity and quality to provide the basis for the initial classification of survey areas, planning remedial activities, estimating radiological waste types and volumes, and for the development of the DCGLs. However, characterization is an ongoing process that will continue as necessary during decommissioning.

## 2.6 References

2-1 NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," August 2000

2-2 Humboldt Bay, "Historical Site Assessment 2011 Update," July 2011

2-3 HBPP Plant Operation Reports

2-4 HBPP Plant Operating Logs

2-5 IT Corporation, "Calculation of Preliminary Soil Cleanup Guidelines for Residual Radionuclides at the PG&E Humboldt Bay Power Plant, Eureka, California" Revision 0, March 1998.

2-6 Enercon Services, Inc., "Radiological Characterization Report, Humboldt Bay Power Plant, Eureka, California," HBPP-RPT-001, Revision 1, November 21, 2008.

2-7 10 CFR 50.75, "Reporting and Recordkeeping for Decommissioning Planning"

2-8 HBPP DSAR, "Defueled Safety Analysis Report for the Humboldt bay power plant unit 3," Revision 9-19, 8/17/2011

2-9 HBPP PSDAR "Post-Shutdown Decommissioning Activities Report," Revision 3

2-10 "*Residual Radionuclide Distribution and Inventory at the Humboldt Bay Nuclear Power Plant*" Battelle, 1983

2-11 "Sample Analysis and Data Management Plan" GTS Duratek, 1997

2-12 NUREG/draft 5849, "Manual for Conducting Surveys in Support of License Termination"

# Appendix 2-A

# Historical Site Photographs

**HBPP Site Pre-Construction**

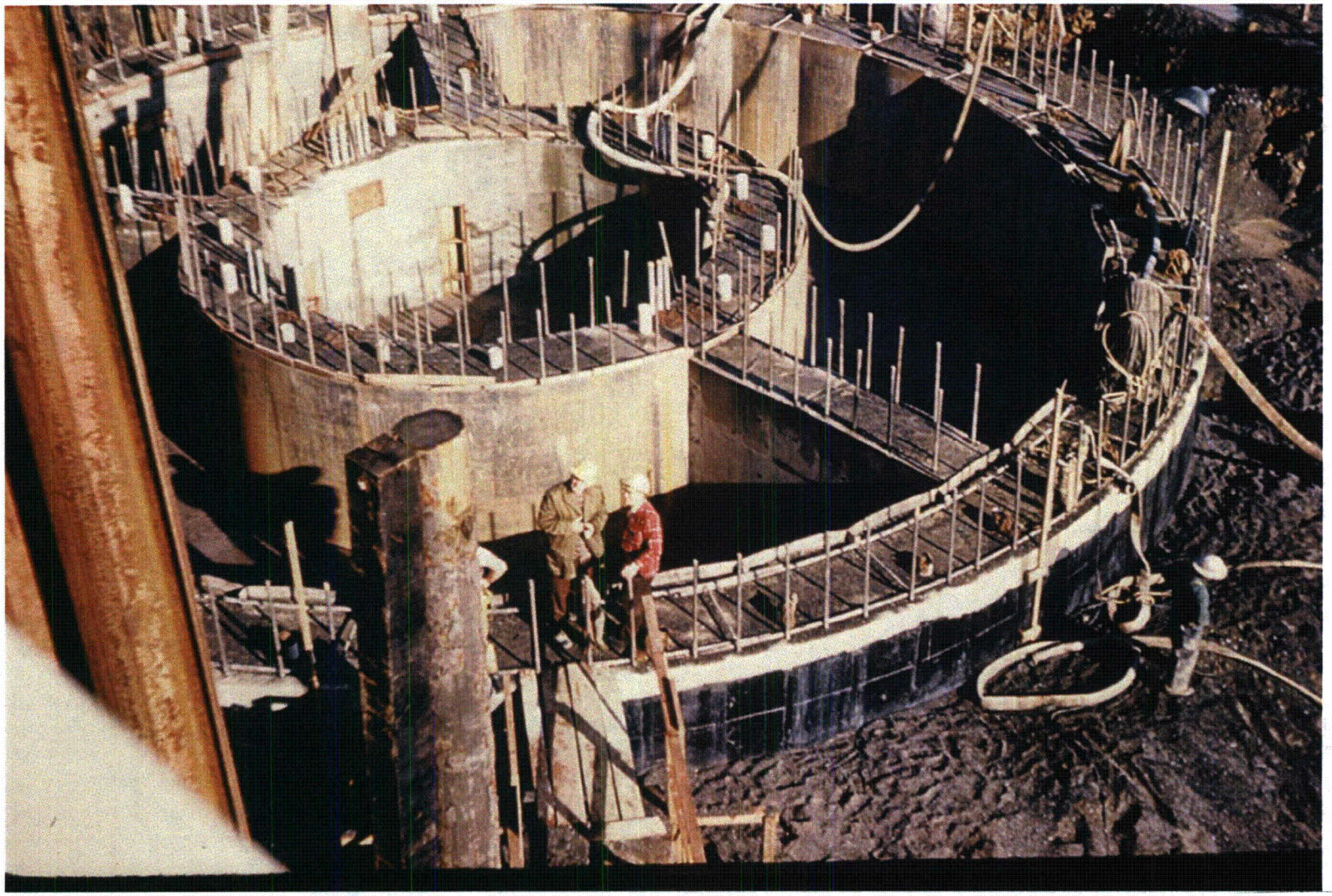
**HBPP Unit 3 Excavation**

**Driving Pilings**

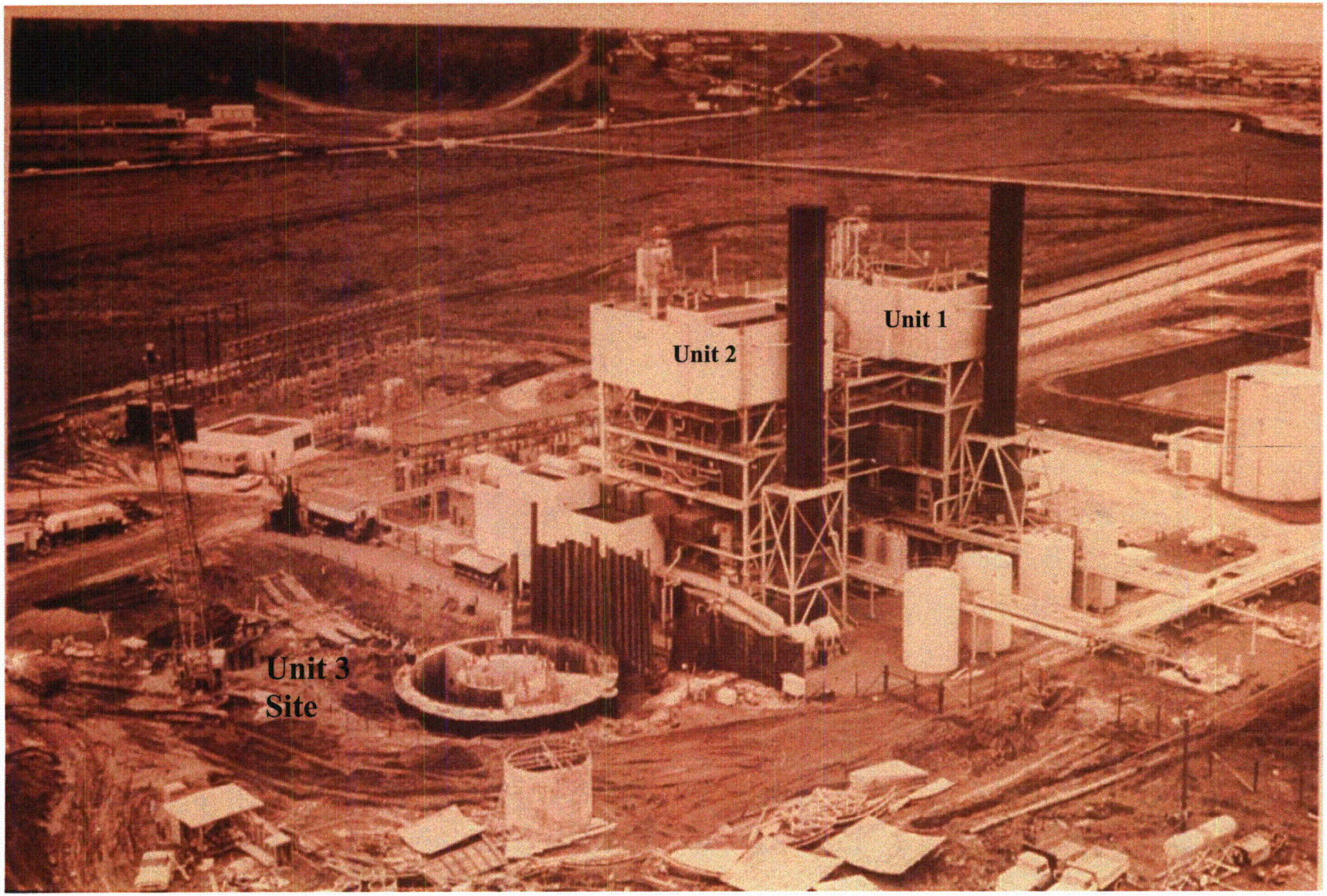
**Reactor Drywell in Place**

**SFP Excavation**

**Inner and Outer Caisson**

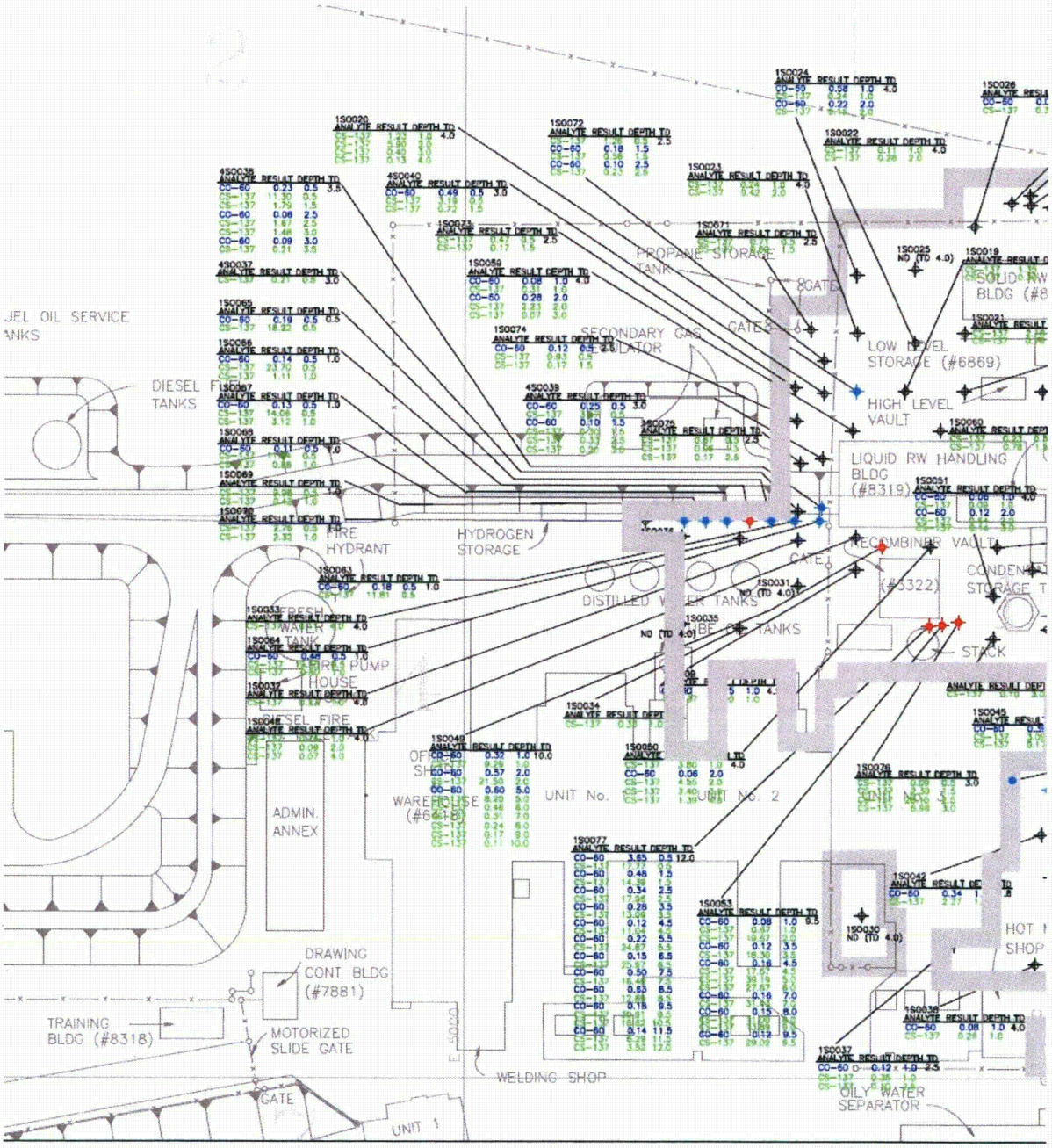


**Unit 3 during Construction**



# Appendix 2-B
# Characterization Sample Location

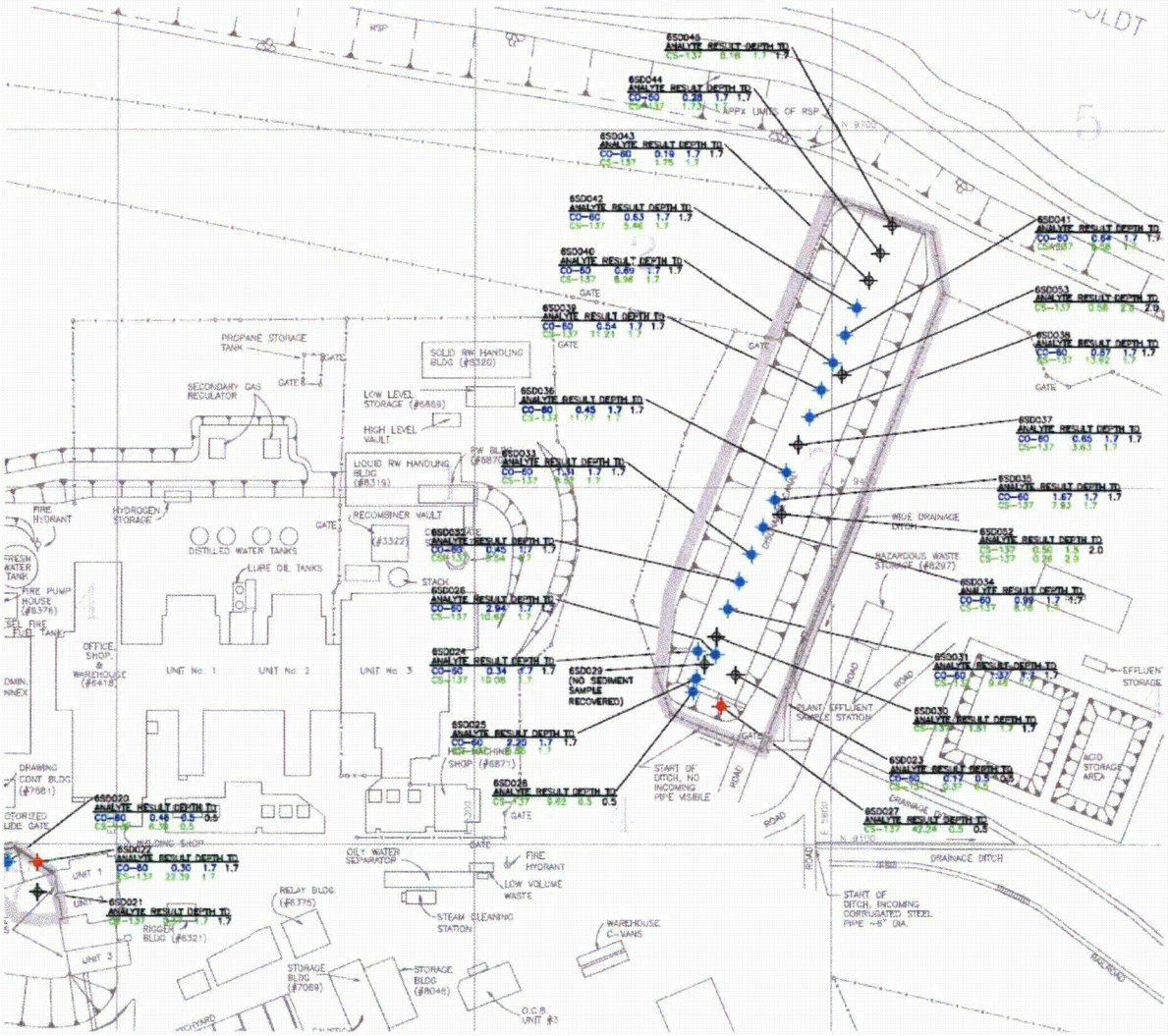
## RA West and North Yard

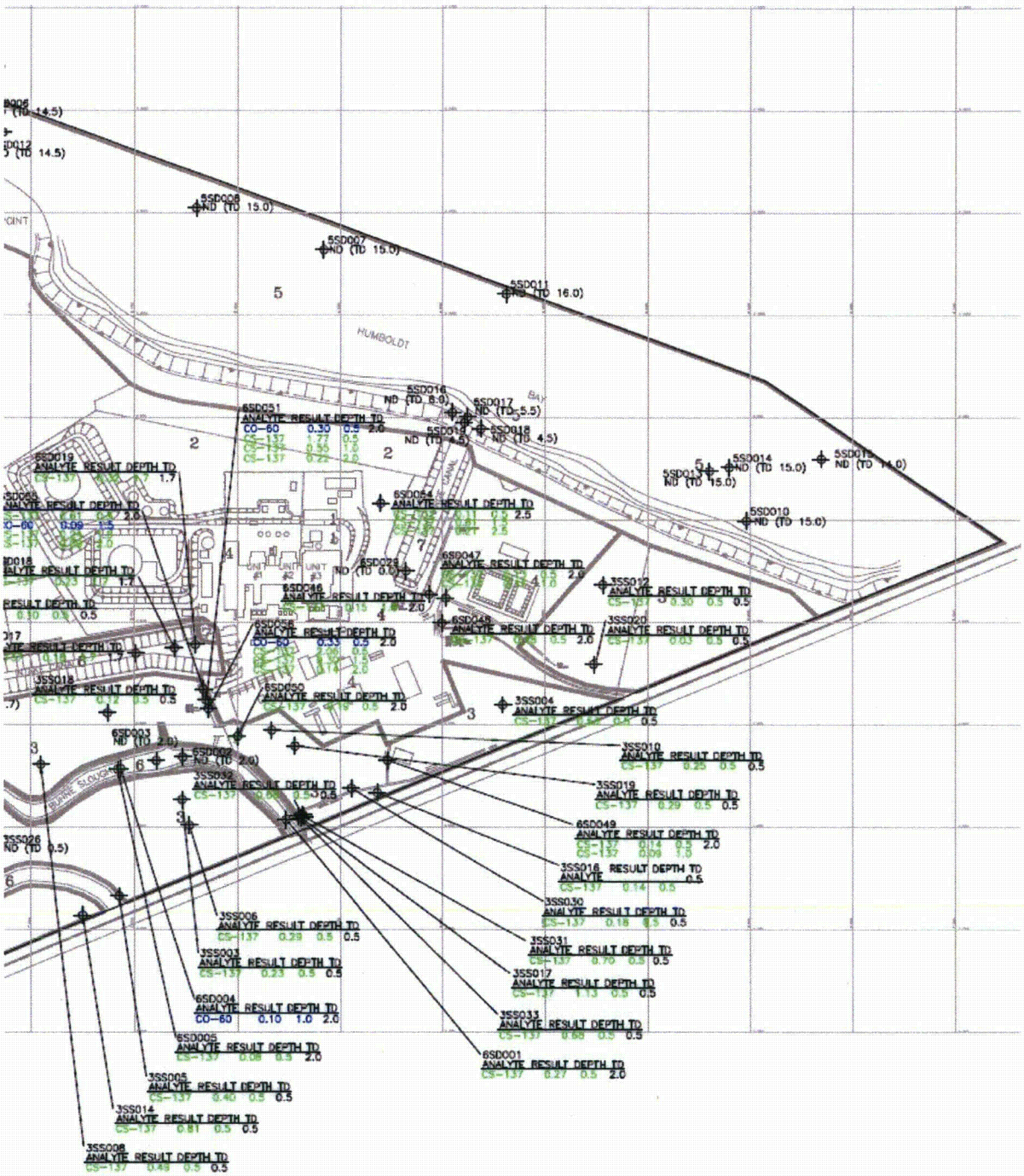


**RA East**

SOLID RW HANDLING BLDG (#8320)
GATE
LEVEL
RW HANDLING
CONDENSATE STORAGE TANK
STACK
HOT MACHINE SHOP (#6871)
HYDRANT
WIDE DRAINAGE DITCH
HAZARDOUS WASTE STORAGE (#8297)
PLANT EFFLUENT SAMPLE STATION
START OF DITCH, NO INCOMING PIPE VISIBLE
ROAD
DRAINAGE DITCH
N 9400
N 9100
E 5600

## Intake and Discharge Canals



**West Side of Site**

## East Side of Site