STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY
UTAH WATER QUALITY BOARD
SALT LAKE CITY, UTAH 84114-4870

Ground Water Discharge Permit
Permit No. UGW150002

In compliance with the provisions of the Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, as amended, the Act,

PacifiCorp Huntington Power Plant
Highway 31 West of Huntington
Huntington, Utah 84528

hereinafter referred to as the Permittee, is granted a ground water discharge permit for the operation of the Huntington Power Plant in Emery County, Utah.

The Huntington Power Plant is located on a tract of land encompassed in Section 1, Township 17 South, Range 7 East, Salt Lake Base and Meridian (39° 22' 53" North Latitude, 111° 4' 36" West Longitude).

This permit is based on representations made by the Permittee and other information contained in the administrative record. It is the responsibility of the Permittee to read and understand all provisions of this permit.

The facility shall be maintained and operated in accordance with conditions set forth in the permit and the Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6).

This renewed ground water discharge permit for the PacifiCorp Huntington Power Plant supersedes all other ground water discharge permits previously issued for this facility.

This permit shall become effective on June 23, 2011.

This permit and authorization to operate shall expire on June 23, 2016.

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Walter L. Baker, P.E.
Executive Secretary
Utah Water Quality Board

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I. SPECIFIC PERMIT CONDITIONS

A. Ground water Classification and Protection Levels

Ground water quality varies from Class II to Class IV across the power plant site, and in some areas it has been impacted by operation of the power plant. Background concentrations of contaminants in the ground water, unaffected by plant activities, cannot be determined in many wells. For these reasons, protection levels are not derived from water quality in upgradient monitor wells.

Because of site conditions, the main threat posed by ground water contamination at this site is discharge of contaminants from the land application sites and other plant facilities to Huntington Creek. Background ground water quality in monitor wells used to determine compliance is defined in Table 1, and protection levels derived from it are listed in Table 2.

Table 1. Average Background Concentrations in Compliance Monitor Wells

WELL	Boron (mg/l)	Nitrate as N (mg/l)	Total Dissolved Solids (mg/l)
Research Farm Wells			
NH1 W	5.1	4.5	3,951
NH3 W	1.4	3.3	1,777
NH6 W	0.4	0.8	599
NH8 W	0.2	1.2	467
RG-1	3.7	8.4	5,200
Old Combustion Waste Landfill Wells			
HLF-6O	<0.5	1.9	6,475
HLF-7Od	3.9	123	18,933
New Combustion Waste Landfill Wells			
HLF-3Nd	0.77	0.13	4,073
HLF-3Ns	<0.5	0.21	3867
HLF-4N	0.64	0.06	3,400
Duck Pond Drainage Wells			
HDP-1	49	10.0	10,738
HDP-2	22	34	15,375
Plant Site Wells			
HSW-1	4.5	3.8	3,849
HCP-6	0.74	1.7	2,013
HPS-1	0.69	5.19	4,730
HWW-4	0.52	1.4	1,479

Table 2. Protection Levels in Compliance Monitoring Wells

Well	Ground Water Class	Nitrate as N (mg/l)	Total Dissolved Solids (mg/l)
NH1 W	III	10.7	5,847
NH3 W	II	9.7	2,527
NH6 W	II	2.6	1,311
NH8 W	II	3.4	589
RG-1	III	12.4	6,300
HSW-1	III	6.5	4,905
HCP-6	II	1.9	2,390
HPS-1	III	8.4	6,544
HWW-4	II	2.2	1,863
HLF-6O	*	4.1	9,131
HLF-7Od	*	183	21,205
HLF-3Nd	III	0.4	4,951
HLF-3Ns	III	0.6	5017
HLF-4N	III	0.14	4,500
HDP-1	*	18	12,536
HDP-2	*	41	16,863

* Well affected by previous discharges; ground water class will not be determined

All protection levels are mean + (2 x standard deviation).

B. Permitted Facilities

This permit covers all facilities and activities at the Huntington Power Plant site which have a potential to discharge contaminants to ground water. These include land application of wastewater at the Research Farm, both the old and new combustion waste landfills, coal storage and blending areas, handling of wastewater, fuels and other industrial chemicals at the plant site, and several ponds and reservoirs associated with the plant

C. Discharge Minimization Technology

Discharge minimization technology requirements for this permit shall consist of best management practices and ground water monitoring for land application of wastewater at the Research Farm, and development of best management practices for the plant site, coal storage and handling, and the various ponds and impoundments associated with the power plant.

1. Corrective Action

PacificCorp has implemented best management practices (BMPs) to remedy ground and surface water contamination associated with the combustion waste landfills in the Duck Pond drainage.

Monitoring wells and surface water sampling in the Duck Pond drainage downgradient from the combustion waste landfills shall be used to demonstrate the effectiveness of the BMPs. If ground and surface water quality does not improve in areas affected by past discharges from the landfills, additional corrective measures may be required.

2. Land Application at the Research Farm

PacifiCorp shall follow the "Huntington Research Farm Wastewater Land Application Plan" contained in the Appendix D. If two or more consecutive samples from a compliance monitoring well adjacent to Huntington Creek exceed protection levels (Table 2), and further investigation leads to the conclusion that land application is causing ground or surface water contamination, or if other information leads to this conclusion, the Executive Secretary may require PacifiCorp to submit a revised land application plan designed to prevent excessive discharge of contaminants to ground water within six months. The revised plan shall be implemented upon approval by the Executive Secretary.

PacifiCorp shall follow the criteria for discontinuing land application contained in Appendix F to determine whether the current wastewater disposal practices at the Research Farm can continue without posing a threat to quality of waters of the state. Upon discovery that these criteria have been exceeded, PacifiCorp shall inform the Division of Water Quality in writing within 5 days, and within 30 days shall propose an alternative plan for wastewater disposal for approval by the Executive Secretary. The plan shall be implemented within one year of approval.

3. Best Management Practices

PacifiCorp shall follow best management practices for facilities on the power plant site that could potentially affect ground or surface water quality, as listed in Appendix A. Only combustion wastes, including fly ash, bottom ash, slaker grits, scrubber sludge and pyrites may be accepted for disposal at the combustion waste landfill.

D. Best Available Technology Requirement for New Construction

Any construction, modification, or operation of new waste or wastewater disposal, treatment or storage facilities shall require review of engineering design plans and specifications. All engineering plans or specifications submitted shall demonstrate compliance with all Best Available Technology requirements stipulated by the Utah Ground Water Quality Regulations (UAC R317-6). Upon Executive Secretary approval, a Construction Permit may be issued and this Permit may be re-opened and modified to include any necessary requirements.

E. Monitoring

1. General Provisions

a. *Future Modification of Monitoring Program* – If at any time the Executive Secretary determines the monitoring program to be inadequate, PacifiCorp shall submit within 30 days of receipt of written notice from the Executive Secretary a modified monitoring plan that addresses the inadequacies noted by the Executive Secretary.

b) *Compliance Monitoring Period* – Monitoring shall commence upon issuance of this permit and shall continue through the term of this permit. For any new facilities with a potential discharge to ground water that are constructed during the term of this permit, monitoring shall commence before operation of the new facility. At least one background ground water sample shall be collected at new facilities before operation commences.

c) *Laboratory Approval and Analytical Methods*– All water quality analyses shall be performed by a laboratory certified by the state of Utah to perform such analyses. Analytical methods shall conform to Table I of Appendix B of this permit. Analytical methods may only be changed after approval by the Executive Secretary.

d) *Water Level Measurement* – In association with each well sampling event, water level measurements shall be made in each monitor well prior to removal of any water from the well bore. These measurements will be made from a permanent single reference point clearly marked on the top of the well or surface casing. Measurements will be made to the nearest 0.01 foot.

e) *Sampling Protocol* – Ground and surface water quality samples will be collected, handled and analyzed in conformance with the Ground Water & Surface Water Sampling and Analysis Plan contained in Appendix E of this permit, or the most currently-approved Sampling and Analysis Plan.

2. Ground Water Monitoring

a) *Wells to be Monitored* – Wells used for compliance monitoring and informational purposes shall be sampled semi-annually for this permit. Locations, elevations and depth of screened intervals for compliance monitoring wells are listed in Table 3.

b) *Constituents Sampled* – The following analyses shall be performed on all monitoring samples from the wells listed in Table II of Appendix B:

i) Field Measurements: pH, specific conductance, water level, temperature

ii) Laboratory Analysis: Total Dissolved Solids, Major Ions (Na, K, Mg, Ca, Cl, SO_4, alkalinity), nitrate + nitrite, boron

Table 3. Location of Monitoring Wells

Well	North Latitude	West Longitude	Elevation (top of casing)	Depth of Screened Interval (feet below TOC)
NH1 W	39° 22.032'	111º 03.566'	6185.8	4.5-24.5
NH2 W	39° 22.088'	111º 03.728'	6196.6	5-20
NH3 W	39° 22.169'	111º 03.622'	6193.9	5.5-20.5
NH4 W	39° 22.353'	111º 04.117'	6254.5	39-64
NH5 W	39° 22.427'	111º 04.078'	6249.1	19-44
NH6 W	39° 22.515'	111º 04.026'	6241.8	10-25
NH7 W	39° 22.516'	111º 04.323'	6292.4	15-40
NH8 W	39° 22.706'	111º 04.326'	6273.7	5-25
RG-1	39° 22.440'	111º 03.463'	6362.2	45-75
HLF-4O	39º 22.108'	111º 04.670'	6592.3	46-66
HLF-6O	39º 22.044'	111º 04.706'	6567.05	46.4-56.4
HLF-7Od	39º 22.165'	111º 04.612'	6549.14	50-60
HLF-3Nd	39º 21.985'	111º 04.562'	6575.73	115-125
HLF-3Ns	39º 21.985'	111º 04.562'	6575.76	48-66
HLF-4N	39º 22.024'	111º 04.529'	6554.8	100-110
HDP-1	39º 22.252'	111º 04.487'	6388.27	13.4-18.4
HDP-2	39º 22.410'	111º 04.402'	6327.11	13.8-23.8
HSW-1	39º 22.546'	111º 04.640'	6437.27	80-100
HPS-1	39º 22.737'	111º 04.602'	6441.44	75-85
HWW-4	39º 22.920'	111º 04.695'	6389.32	41-51
HCP-6	39º 22.597 '	111 04.813’	6452.41	80-90

3. Surface Water Monitoring

PacifiCorp shall collect semi-annual grab samples of surface water at the locations listed in Appendix B and analyze them for the parameters listed in Part I.E.2(b). Streamflow at the sites in Huntington Creek designated H-1, H-2 and UPL-9 (locations in Table 5) shall be determined at the time of sampling. Sampling at these sites should be done concurrently with other surface water sampling required under UPDES permit No. UTR0025607.

Table 4. Location of Surface Water Monitoring Points

Site ID	North Latitude	West Longitude
H-1	39° 23.106′	111° 05.083′
H-2	39° 22.875′	111° 04.607′
UPL-9	39° 22.034′	111° 03.516′

F. Reporting Requirements

1. Ground water quality sampling results shall be submitted semi-annually to the

Executive Secretary as follows:

Half		Report Due On
1st	(January- June)	August 15
2nd	(July – December)	February 15

Unless a submittal date extension has been requested by the Permittee and granted by the Division of Water Quality, failure to submit reports within the time frame due shall be deemed as noncompliance and may result in enforcement action.

PacifiCorp shall calculate the amount of dissolved solids passing surface water monitoring points H-1, H-2 and UPL-9 in tons per day for each sampling event, and report this information in the regular semi-annual reports.

All reports required under this permit shall be submitted to:

State of Utah
Division of Water
Department of Environmental Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870
Attention: Ground Water Protection Program

2. When the permittee becomes aware of an incident of noncompliance with the terms of this permit, the Division of Water Quality shall be notified verbally by the next business day, and in writing within 5 business days. Verbal reports of noncompliance should be made at (801) 538-6146.

3. Electronic Filing Requirements - In addition to submittal of the hard copy data, upon the request of the Executive Secretary the permittee will submit the required ground water monitoring data in the electronic format to be specified. The data may be sent by e-mail, floppy disc, CD, modem or other approved transmittal mechanism.

G. Demonstration of Compliance

1. General

The permittee shall comply with the Discharge Minimization Technology, Corrective Action, Monitoring, Reporting and Compliance Schedule requirements contained in this permit.

2. Ground Water Protection Levels

If the analytical results for any ground water monitoring event at a well listed in Table 2 exceed the protection levels for that well, PacifiCorp shall notify DWQ according to the provisions of Section I.F.2 and immediately re-sample the well for all parameters listed in Section I.E.2(b). The permittee shall continue to follow a monthly monitoring schedule for the well until the parameter no longer exceeds the protection level or until notification by the Executive Secretary that a semi-annual

monitoring schedule may be resumed. Additional investigation and remedial action may also be required by the Executive Secretary.

3. Surface Water Standards
Surface water quality at downstream sampling point UPL-9 must not exceed the standards contained in UPDES Permit No. UTR0025607.

4. Noncompliance Due to Failure of Discharge Minimization Technology

The facility will be determined to be in noncompliance status if the Discharge Minimization Technology or other measures developed pursuant to Part I.C have failed or have not been maintained according to the provisions required by this permit, unless:

a. The permittee has notified the Executive Secretary of the potential noncompliance situation verbally within 24 hours and in writing within 5 days of becoming aware of it, and

b. The failure was not intentional or was not caused by the permittee's negligence, either in action or failure to act, and

c. The permittee has taken adequate remedial measures in a timely manner or has developed an approvable remedial action plan and implementation schedule for restoration of discharge minimization technology, an equivalent technology or closure of the facility (implementation of an equivalent technology will require permit modification and reissuance), and

d. The permittee has demonstrated that any discharge of a pollutant from the facility is not in violation of the provisions of UCA 19-5-107.

H. Compliance Schedule

1. Closure of Lacey's Lake

PacifiCorp shall implement the procedures and timetable in Appendix G to drain and close the Lacey's Lake unlined impoundment. Monitoring of downgradient well HSW-1 will continue for the term of this permit.

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling

Samples taken in compliance with the monitoring requirements established under Part I shall be representative of the monitored activity.

B. Analytical Procedures

Water sample analysis must be conducted according to test procedures specified under UAC R317-6-6.3.L, unless other test procedures have been specified in this permit.

C. Penalties for Tampering

The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results

Monitoring results obtained during each reporting period specified in the permit, shall be submitted to the Executive Secretary, Utah Division of Water Quality at the following address no later than the 15th day of the month following the completed reporting period:

State of Utah
Division of Water Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870
Attention: Ground Water Protection Section

E. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using approved test procedures as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted. Such increased frequency shall also be indicated.

G. Records Contents

Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;

3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. **Retention of Records**

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time.

I. **Twenty-four Hour Notice of Noncompliance Reporting**

1. The permittee shall verbally report any noncompliance which may endanger public health or the environment as soon as possible, but no later than 24 hours from the time the permittee first became aware of the circumstances. The report shall be made to the Utah Department of Environmental Quality 24 hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 536-4300, during normal business hours (Monday through Thursday 7:00 am - 6:00 pm Mountain Time).

2. A written submission shall also be provided to the Executive Secretary within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

3. Reports shall be submitted to the addresses in Part II.D, Reporting of Monitoring Results.

J. **Other Noncompliance Reporting**

Instances of noncompliance not required to be reported within 24 hours, shall be reported at the time that monitoring reports for Part II.D are submitted.

K. **Inspection and Entry**

The permittee shall allow the Executive Secretary, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions

The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under Section 19-5-115(2) of the Act a second time shall be punished by a fine not exceeding $50,000 per day. Nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

IV. GENERAL REQUIREMENTS

A. **Planned Changes**
The permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when the alteration or addition could significantly change the nature of the facility or increase the quantity of pollutants discharged.

B. **Anticipated Noncompliance**
The permittee shall give advance notice of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. **Permit Actions**
This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. **Duty to Reapply**
If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a permit renewal or extension. The application should be submitted at least 180 days before the expiration date of this permit.

E. **Duty to Provide Information**
The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. **Other Information**
When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. **Signatory Requirements**
All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed as follows:

    a. For a corporation: by a responsible corporate officer;

b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.

c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described above and submitted to the Executive Secretary, and,

b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to Authorization. If an authorization under Part IV.G.2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part IV.G.2 must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports

The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

I. **Availability of Reports**

Except for data determined to be confidential by the permittee, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Executive Secretary. As required by the Act, permit applications, permits, effluent data, and ground water quality data shall not be considered confidential.

J. **Property Rights**

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

K. **Severability**

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

L. **Transfers**

This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Executive Secretary at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

M. **State Laws**

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, penalties established pursuant to any applicable state law or regulation under authority preserved by

Section 19-5-117 of the Act.

N. Reopener Provision

This permit may be reopened and modified (following proper administrative procedures) to include the appropriate limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. If new ground water standards are adopted by the Board, the permit may be reopened and modified to extend the terms of the permit or to include pollutants covered by new standards. The permittee may apply for a variance under the conditions outlined in R317-6-6.4.D.

2. If alternative compliance mechanisms are required.

3. If subsequent ground water monitoring data reveals the background water quality values in Part I Table 1 are not accurate.

Appendix A
Best Management Practices

INTRODUCTION

The Huntington Power Plant has implemented Best Management Practices (BMPs) to prevent or minimize the potential for degradation of the surface and ground water sources. These practices are utilized in conjunction with Huntington's Storm Water Pollution Prevention Plan, Spill Prevention Control and Countermeasures Plan, Solid and Hazardous Waste Management Plan, Waste Water Land Application Plan, and Site Wide Monitoring and Sampling Plan.

Ground Water Discharge Permit (GWDP) Facilities

The facilities included in the Ground Water Discharge Permit No. UGW150002 (Table 1) are inspected on a monthly basis. In addition to the routine visual inspection of the permitted facilities, a network of surface and ground water monitoring locations have been established to monitor for any degradation of the water leaving the site. These facilities are listed in Table 1, along with the surface and ground water monitoring points established for each facility.

Table 1.
Monitoring Points for Ground Water Discharge Facilities
Huntington Power Plant

Pond/PSA	Year of Construction	Volume (acre-ft)	Liner Type	Monitoring Point(s)	
				Ground Water	Surface Water
Raw Water Pond	1977	336	None		H-1
Irrigation Pond	1977	329	Clay	HWW-7	UPL-13
Duck Pond	1979	6	None	HDP-3 NH-4W	Ck @ HDP-3 H-11 H-12
New Ash Pile Pond	2001	9.8	None	HDP-1 HDP-2 HDP-3	SF-NLF
Waste Water Holding Basin	1977	8	None	HWW-4	H-2
Lacey's Lake (closed fall 2011)	1979	4	None	HCP-6 HSW-1	Lacey's Lake
Scrubber Pond	1977	4	None	HCP-6	
Polishing Pond	1974	.25	None	HWW-4	

Potential Source Areas (PSAs)

Scrap Yards
Best management practices include:

- Consolidate scrap yards where possible and minimize their size.
- Control the storage of scrap and materials that may contain residual fluids.
- Provide level grades and gravel surfaces to retard flows and limit the spread of spills.
- Minimize storm water run-on/runoff through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.
- Inspect scrap areas at least annually. Inspections will monitor compliance with operating plans.
- Take fugitive dust control measures to minimize emissions.
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Specific monitoring points for the scrap areas are listed in Table 2.

Table 2.
Scrap Area Monitoring Point
Huntington Power Plant

Monitoring Point	Location in Flow Field
HPS-1	Downgradient of Plant Activities
HSW-1	Downgradient of Plant Activities

New Combustion Waste (Ash) Landfill
Best management practices include:

- Minimize storm water run-on/runoff through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.
- Inspect combustion waste landfill at least once per quarter. Inspections will monitor compliance with operating plans.
- Monitor the construction and contemporaneous reclamation of the ash pile.
- Take fugitive dust control measures to minimize emissions.
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Specific monitoring points for the new combustion waste landfill are listed in Table 3.

Table 3.
New FGD Waste Landfill Monitoring Points
Huntington Power Plant

Monitoring Point	Location in Flow Field
SF-NLF	Surface Downgradient of New Combustion Waste Landfill
Ck@DP3	Surface Downgradient of old/new Combustion Waste Landfill
HDP-2	Downgradient of old/new Combustion Waste Landfill
HDP-3	Downgradient of old/new Combustion Waste Landfill
HLF-3N (Nested)	Downgradient of new Combustion Waste Landfill
HLF-4N	Downgradient of new Combustion Waste Landfill

Old Combustion Waste (Ash) Landfill

Best management practices include:

- Minimize storm water run-on/runoff through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.
- Inspect class IIIb industrial waste landfill at least once per quarter. Inspections will monitor compliance with operating plans.
- Monitor the construction and contemporaneous reclamation of the ash pile.
- Take fugitive dust control measures to minimize emissions.
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Specific monitoring points for the old combustion waste landfill are listed in Table 4.

Table 4.
Old FGD Waste Landfill Monitoring Points
Huntington Power Plant

Monitoring Point	Location in Flow Field
LF-1O	Upgradient of old Combustion Waste Landfill
LF-2O	Upgradient of old Combustion Waste Landfill
LF-3O	Downgradient of old Combustion Waste Landfill
LF-4O	Downgradient of old Combustion Waste Landfill
LF-5O	Downgradient of old Combustion Waste Landfill
LF-6O	Downgradient of old Combustion Waste Landfill
LF-7O (Nested)	Downgradient of old Combustion Waste Landfill
HDP-1	Downgradient of old Combustion Waste Landfill
HDP-2	Downgradient of old/new Combustion Waste Landfill
HDP-3	Downgradient of old/new Combustion Waste Landfill
NF-OLF	Surface Downgradient of old Combustion Waste Landfill
Ck@DP3	Surface Downgradient of old/new Combustion Waste Landfill

Discharge Minimization for the Old Combustion Waste Landfill
The closure of the Old Landfill area consists of leaving all combustion wastes in place and constructing an Evapotranspiration (ET) cover over all the material except the footprint of the industrial waste landfill, and Monitored Natural Attenuation (MNA). The cover is constructed to prevent water deposited on the surface of the cap from infiltrating into the combustion waste. The Sampling and Analysis Plan focuses on the ground water and surface water downgradient of the landfill area.

Reducing infiltration combined with monitored natural attenuation (MNA) is the preferred way to restore water quality.

- Within the capped area, the expanded ET cap will eliminate the infiltration of precipitation into the landfill and eliminate run on from the surrounding terrain, thereby, allowing the existing liquid in the landfill to drain.
- MNA is allowing PacifiCorp to track the ground water elevations and contaminant concentrations over time. If decreases in contaminant concentrations are not observed, then the industrial waste landfill will also be capped and the industrial waste landfill would be relocated. This monitoring allows PacifiCorp to document the effectiveness of the corrective action and to ensure protection of public health and the environment.

Research Farm
Best management practices include:

- Minimize storm water run-on/runoff through the construction, maintenance, and use of berms, ditches, and/or storage facilities. The control devices will be inspected regularly to confirm the integrity of the facilities.
- Control irrigation application rate to prevent surface runoff and deep percolation.
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Monitoring Points specific to the Research Farm are listed in Table 5.

Table 5.
Research Farm Monitoring Points
Huntington Power Plant

Monitoring Point	Location in Flow Field
NH-1W	Downgradient Research Farm
NH-2W	Lower Research Farm
NH-3W	Lower Research Farm
NH-4W	Mid- Research Farm/Downgradient of Duck Pond Drainage
NH-5W	Mid- Research Farm
NH-6W	Mid- Research Farm
NH-7W	Upgradient of Research Farm
NH-8W	Upgradient of Research Farm
RG-1	Downgradient Research Farm
UPL-13	Surface Irrigation Pond
H-1	Surface Upgradient of Facility
H-2	Surface Upgradient of Research Farm
UPL-9	Surface Downgradient of Facility & Research Farm

Process Water Ponds
Best management practices include:

- Clay, synthetic membrane, or concrete liners will be utilized in future construction where appropriate.
- Liner integrity will be maintained on ponds constructed with liners. Inspect ponds at a minimum semi-annual for seeps or other signs of leakage.
- Avoid overfilling ponds.
- Minimize waste water flows.
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Monitoring points for process water ponds are shown in Table 1.

Flue Gas Desulfurization (FGD) Waste
Best management practices include:

- Eliminate free liquid content of FGD slurry. Use drum vacuum filters to remove free liquid from slurry prior to placement on the ash landfill.
- Ensure adequate separation between ground water and impoundment, and adequate containment of embankment.
- Clean-up spills and take fugitive dust control measures to minimize emissions.
- Monitor upstream and downstream surface and ground water locations in accordance with the Ground Water Permit. Monitoring points for FGD wastes at the Scrubber Pond are shown in Table 1, while those associated with the combustion waste landfills are shown in Tables 3 and 4.

Coal Pile

Best management practices include:

- Storm water run-on/runoff should be minimized through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.
- Minimize fugitive dust by taking measures to control emissions.
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Monitoring well **HCP-6** will be included in the semi-annual monitoring network of wells to give early warning of potential discharge of contaminants to ground water.

Plant Facilities

Specific best management practices have been developed for the following plant site categories. Each category is listed below and BMPs are described in detail in the following paragraphs.

- Good Housekeeping
- Vehicle and Equipment Cleaning, Storage, Fueling, and Maintenance Areas
- Material Storage Areas
- Loading/Unloading Areas
- Delivery Vehicles
- Ash Loading and Haul Road Areas
- Above Ground Storage Tanks, Substations, and Storage Areas
- Preventative Maintenance
- Facility Security
- Employee Training
- Continuous Improvement
- Monitor upstream and downstream surface and ground water locations in accordance with Ground Water Permit. Monitoring well **HPS-1** will be included in the semi-annual monitoring network of wells to give early warning of potential discharge of contaminants to ground water.

Good Housekeeping

Good housekeeping requires the operation and maintenance of a clean and orderly facility. All plant operations crews have specific clean-up areas assigned. In addition, site-wide clean-up days are scheduled as needed.

Vehicle and Equipment Cleaning, Storage, Fueling, and Maintenance Areas
Cleaning, storage, and maintenance of vehicles and equipment are confined to designated areas whereby the potential to degrade water sources is prevented or minimized.

The co-mingling of storm water with products used to service the vehicles and equipment is prevented or minimized through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.

Appropriate devices will be utilized to collect oil, grease and vehicle and equipment fuels. Spills will be contained, absorbed and cleaned-up in a timely manner.

Material Storage Areas
Storage containers are clearly labeled and maintained in good condition. Whenever possible, enclosed facilities will be used to store materials or provide temporary covering to minimize the potential for pollutants to come in contact with storm water.
Storm water run-on/runoff will be minimized through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.

Spills will be cleaned-up in a timely manner using dry clean-up methods.

Loading/Unloading Areas
Ensure that an appropriate spill control plan is in place and plant personnel are familiar with the plan. Locate shipping and receiving activities where spills or leaks can be contained.

Storm water run-on/runoff will be minimized through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.

Delivery Vehicles
Vehicles that arrive to make a delivery are responsible for vehicle maintenance, and for any spills incurred while on plant site. In case of spills, the driver should call the control room for needed assistance in cleaning up any spill. Adequate spill containment and countermeasures should be in place to respond to leakage or spillage from the vehicle.

The vehicle should not be left unattended during the unloading process.

Ash Hauling Vehicles
Ash hauling vehicles will be inspected, cleaned and maintained to ensure the overall integrity of the vehicle and ash container.

Fly ash will be mixed to contain the proper amount of liquid such that fugitive dust emissions are minimized.

Ash Loading and Haul Road Areas
Good housekeeping practices will be observed to reduce and/or control the tracking of ash or residue from loading areas. The ash silo building and adjacent roadways will be cleared and

cleaned of spillage and debris to minimize any contact with storm water.

Ash haul roads will be maintained in good condition to minimize bumps and uneven surfaces. The speed of the vehicles on the ash haul road will be maintained at a reasonable level for the road conditions.

Fugitive dust control measures will be taken to minimize emissions.

Storm water run-on/runoff should be minimized through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.

Above Ground Storage Tanks, Substations, and Storage Areas

Above ground petroleum storage tanks and electrical transformers will be inspected in accordance with the Spill Prevention, Control and Countermeasures (SPCC) Plan and all other bulk storage tanks will be inspected on a routine basis. Appropriate secondary containment will be provided for petroleum and bulk storage tanks to prevent spills from leaving the plant site.

Liquid level gauging devices will be provided to avoid overfilling tanks. All mobile or portable tanks will be located in a position that prevents a discharge.

All spills or releases will be cleaned-up in a timely manner.

Storm water run-on/runoff will be minimized through the construction, maintenance, and use of berms, ditches, storage facilities, and/or collection/treatment systems.

Collection Systems

Collection systems were installed to intercept leachate leaving both the New and Old Landfill areas and surface water in the Duck Pond area. A total of three collection systems were installed. The systems were installed directly below the new landfill, in the drainage below the new and old landfills, in the West End Canyon and springs near the Duck Pond inflow. The systems capture all existing surface water and a percentage of storm water generated in the area. Captured water gravity flows to the pump house sump, where it is pumped back to the facility for re-use in plant operations.

Collection System #1

Collection System #1 is located below the toe of the northwest corner of the New Landfill. System #1 intercepts and directs the surface water and shallow groundwater flows down a collection ditch. The ditch is lined with an HDPE channel lining system. A perforated 4" HDPE pipe is placed in the bottom of the ditch liner and conveys the fluid to the flanged bulkhead connection at the lowest end of the collection ditch. The ditch is covered with filter fabric and riprap and filled with medium gravel. Using a flanged connection, the perforated pipe is joined to 4-inch, solid HDPE pipe and routed from the collection system, then to the west of the existing storm water retention pond, and down an existing drainage to Collection System #2.

The pipeline is constructed with 4 inch HDPE pipe. The pipe was installed in lengths up to 40 feet

and heat-welded together at the joints. The completed pipeline was placed in a ditch approximately 3 feet deep and buried with native soils to prevent freezing. The total length of the pipeline is approximately 4,000 feet.

Collection System #2

Collection System #2 is located in the natural drainage approximately 100 feet below the confluence of the drainage from the Old Landfill and the New Landfill. This system intercepts any drainage originating from the old landfill or New Landfill that is not collected by System #1.

Collection System #2 is constructed similarly to System #1. In the event of a large storm water runoff volume flowing down the natural drainage, all flows over 120 gpm will proceed down the drainage to the existing Duck Pond. The Duck Pond will be used as a storm water collection basin which will then be discharged to the Pumphouse when flows from the collection systems have returned to normal.

Collection System #3A

Collection System #3A collects surface water flowing through the West End Canyon. System #3A is constructed similarly to Systems #1 and #2.

Collection System #3A is not connected to Systems #1 and #2. The water collected by System #3A is less contaminated than the water collected in Systems #1 and #2.

Collection System #3B

Collection System #3B collects water flowing from a seep/spring area located between the Duck Pond and the West End Canyon. System #3B is constructed similar to the previously described systems. The pipeline from System #3B is connected to the pipeline from System #3A and routed to the Pumphouse.

Pond Dredging

Periodically, dredging of site holding ponds is required. Dredging wastes will be disposed of according to the following procedure.

- Dredging materials will be removed from the pond and spread along the bottom of an earthen bermed cell near the respective pond.
- Storm water within the earthen berm will be contained.
- When the material passes a paint filter test, it will be transported for disposal in the appropriate waste landfill.
- Multiple ground water monitoring wells are completed both up and downgradient of the plant area and are sampled semi-annually to monitor water quality.

Preventative Maintenance

The Plant's work management system will be utilized to monitor and inspect systems and detect conditions that could cause breakdowns or failures which have the potential to pollute.

Facility Security

Plant property will be monitored using security personnel and other surveillance tools so that the

ingress and egress of those entering and exiting the property is known and the likelihood of vandalism is minimized.

Employee Training
When properly trained, Plant personnel are more capable of preventing spills, responding safely and effectively to an incident when one occurs, and recognizing a situation or condition that could result in surface or ground water contamination.

Continuous Improvement
The effectiveness of BMPs will be monitored using inspection programs whereby the information garnered can be utilized to improve upon current practices.

CONCLUSION

Through the implementation of Best Management Practices the entire environmental management system will better recognize impacts, reduce pollution, improve continually, and comply environmentally.

Appendix B
Monitoring Program

Ground Water

Ground water monitoring will be conducted for the constituents shown in **Table I** in the monitoring wells shown in **Table II**.

Surface Water

The surface water monitoring locations (**Table II**) will also be sampled for the analytes shown in **Table I**.

Table I. Field & Analytical Monitoring Parameters

Field Measurements		
Water Level	pH	
Temperature	Specific Conductance	
Analytical Data		
Analyte	**Method**	**Detection Limit**
Total Dissolved Solids	E160.1/A2540C	10 mg/l
Sodium	E273.1/E200.7/E200.8	1 mg/l
Potassium	E258.1/E200.7/E200.8	1 mg/l
Magnesium	E242.1/E200.7/E200.8	1 mg/l
Calcium	E215.1/E200.7/E200.8	1 mg/l
Sulfate	E300.0	1 mg/l
Alkalinity	E310.1/A2320B	5 mg/l
Carbonate	A2320B	5 mg/l
Bicarbonate	A2320B	5 mg/l
Chloride	E300.0/A4500CLB	1 mg/l
Nitrate + Nitrite	E353.2	0.1 mg/l
Boron	E200.7/E200.8	0.01 mg/l

Table II. Monitoring Locations
Huntington Power Plant

Potential Source Areas w/ Well IDs	**Purpose**	**Justification**
Ash Landfill (Old)		
LF-1O	CAP/BMP	Upgradient well for Old Ash Lf
LF-2O	CAP/BMP	Downgradient well for Old Ash Lf
LF-3O	CAP/BMP	Upgradient well for Old Ash Lf and storm water pond
LF-4O	CAP/BMP	Downgradient well for Old Ash Lf and storm water pond

Potential Source Areas w/ Well IDs	Purpose	Justification
LF-5O	CAP/BMP	Downgradient well for Old Ash Lf and storm water pond
LF-6O	CAP/BMP	Downgradient well for Old Ash Lf and storm water pond
LF-7Od	CAP/BMP	Downgradient well for Old Ash Landfill
Ash Landfill (New)		
LF-3Ns	CAP/BMP	Downgradient wells for New Ash Landfill
LF-3Nd	CAP/BMP	Downgradient wells for New Ash Landfill
LF-4N	CAP/BMP	Downgradient well for New Ash Landfill
Coal Pile		
HCP-4	BMP	Upgradient well for Coal Pile
HCP-6	BMP	Downgradient well for the Coal Pile
Duck Pond Drainage		
HDP-1	CAP	Downgradient well for both Landfills
HDP-2	CAP	Downgradient well for both Landfills
HDP-3	CAP	Downgradient well for both Landfills
Process Ponds		
HWW-4	/CAP	Downgradient well for WW Holding Basin
HWW-7	BMP	Downgradient well for Evaporation Pond
HSW-1	BMP/CAP	Downgradient well for Lacey's Lake
Plant Site		
HPS-1	BMP	Downgradient for Plant Activities
Fuel Oil Sump MW	BMP	Downgradient for Fuel Oil Sump
Research Farm		
NH1W	GWD/BMP	Downgradient for Research Farm
NH2W	GWD/BMP	Lower Research Farm
NH3W	GWD/BMP	Lower Research Farm
NH4W	GWD/BMP	Mid-Research Farm/Downgradient of Duck Pond Drainage
NH5W	GWD/BMP	Mid-Research Farm
NH6W	GWD/BMP	Mid-Research Farm
NH7W	GWD/BMP	Upgradient of Research Farm
NH8W	GWD/BMP	Upgradient of Research Farm
RG-1	GWD/BMP	Downgradient Research Farm
Surface Water Locations		
H-1	GWD/BMP	Upgradient Huntington Creek
H-2	GWD/BMP	Midpoint on Huntington Creek
UPL-9	GWD/BMP	Downgradient Huntington Creek
H-11	CAP	Spring
H-12	CAP	Duck Pond
NF-OLF	CAP	Downgradient of Old Landfill
SF-NLF	CAP	Downgradient of New Landfill
West End	CAP	Downgradient of Plant Activities

Potential Source Areas w/ Well IDs	Purpose	Justification
Canyon		
UPL-13	GWD/BMP	Routine Network for Research Farm
Landfill @ Pumphouse and	CAP	Downgradient of New Landfill
Duckpond @ Pumphouse	CAP	Downgradient of Old Landfill
Ck@DP3	CAP	Downgradient of old/new Landfill

BMP – Best Management Practice
CAP – Corrective Action Plan Monitoring
GWD – Ground Water Discharge Permit Monitoring

Operational Monitoring Schedule

Operational monitoring at the Huntington Power Plant will be completed semi-annually for all ground and surface water locations for the monitoring points in **Table II**, until modified in writing.

Table III. Monitoring Frequency
Huntington Power Plant

Monitoring Location	Sample Frequency	Duration
Farm Wells	Semi-Annual	Until Modified in Writing
PSA Wells	Semi-Annual	Until Modified in Writing
Surface Water	Semi-Annual	Until Modified in Writing

Further detailed informati on on ground and surface water monitoring at the Huntington Power Plant can be found in the Ground Water and Surface Water Sampling and Analysis Plan included as Appendix E.

Appendix C
Contingency Plan

A set of contingencies will be implemented to ensure that future impacts to ground and surface water are eliminated. Following is **Table I**, which outlines the contingency plan actions if the corrective action plan does not completely address the impacts.

Table I. Contingency Plan Summary
Huntington Power Plant

Scenario	Contingency Action
New ET cap on Old Combustion Waste Landfill deteriorates.	1. Rehabilitation of cap in deteriorated areas.
Ground water/Surface water collection systems do not satisfactorily address contaminant issues.	1. Inspect systems to ensure proper operation. 2. Upgrade systems in any area(s) where problems are occurring. 3. Replace with alternative technology (pumpback systems) if necessary.
BMPs do not provide adequate reduction of New Combustion Waste Landfill seepage.	1. Evaluate dewatering process to pinpoint and upgrade problem areas. 2. Install pumpback system on the downgradient edge of New Landfill.
MNA does not adequately address ground water contamination issues.	1. Design and implement alternate ground and surface water treatment options.

Appendix D
Huntington Research Farm
Waste Water Land Application Plan

1. Objective

The Huntington Research Farm was established on company owned property to dispose of plant waste water, as an efficient, cost effective and environmentally sound method to accomplish disposal.

The amount of water used on the Huntington farm is carefully controlled to ensure that all the waste water is evaporated, absorbed by vegetation, or otherwise used so that no waste water escapes the company owned property into surface water or percolates through the soil and into the ground water system. This is accomplished by balancing environmental and weather information using sophisticated weather data and computer modeling through Utah State University and/or private consultant, by contract. The ground water system is sampled semi-annually using monitoring wells located in strategic places around the farm properties. This information is reported to the Utah Division of Water Quality semi-annually.

The Huntington Research Farm operates under the following set of objectives:

1. Dispose of power plant waste water by efficient agricultural irrigation within environmental regulations
2. Perform research and monitoring programs, which support the continued use of waste water in agricultural irrigation.
3. Operate the farm in the most economical and efficient manner possible.
4. Investigate revenue-generating options to reduce the operating cost of the Huntington Research Farm.

The Huntington Farm is composed of an estimated five different soil series with seven different soil types within these five soil series (USDA et al. 1970). A complete text of each soil series and soil type are contained in Appendix D.1. The many different soil types pose a very complex challenge to uniform irrigation application and consistent crop growth over the field surface. Each soil series also offers a complicated set of water table and ground water problems. Water infiltration and holding capacities vary by soil type. Depth limitations and other problems with the soil profiles pose differing sets of problems for uniform irrigation application on the farm.

In order to comply with the first research farm objective, any crop that is grown must have a high water consumptive use, be salt tolerant, have a perennial growth habit, be deep rooted, and tolerant of elements contained in the waste water.

Alfalfa is grown on the largest amount of the acreage possible because of its deep root system, high water consumptive use factor, perennial growth habit, salt tolerance and high tolerance to boron. The choice for alfalfa is also supported by research conducted by Dr. John

Hanks (Hanks, 1990), which showed that alfalfa yields are higher when irrigated with saline wastewater than when irrigated with fresh water. Small grains are used in a crop rotation with alfalfa for weed control and maximum nutrient utilization. Pasture was selected to be grown on 72% (180 acres) of the Huntington farm acreage. This acreage is in pasture because of rocky terrain, where up to 30% of the surface is rock covered. Grass pastures with an alfalfa mix are easily established in a rocky field and can maintain a full cover without equipment.

2. Procedure

2.1. Soil Moisture Determination

Field determination of the initial level of available moisture is essential where correct soil moisture control for high water use and efficient irrigation in the crop with no leaching is required. During the entire season, amount and frequency of irrigation should be varied in accordance with the actual moisture used by the crop during any growing period. At the beginning of the irrigation season, the soil moisture level should be known before staring irrigation. This is accomplished each spring; farm wide, by using the annual water balance information supplied by the evapotranspiration instrumentation and checked with the manual, "feel" method (appendix D.2) of soil moisture determination. This soil moisture information is used to give a starting point for irrigation requirements at the beginning of the irrigation season.

2.2. Actual Evapotranspiration (ET_a) Determination

A procedure to measure the amount of water lost from the soil surface through evaporation and the amount of water lost through transpiration from the crop canopy, evapotranspiration (**ET**) (appendix D.3), helps to determine the amount of water that is needed to be introduced, by irrigation, into the soil profile for continued crop production and maximum water utilization. The ET rate on the Huntington Farm is determined by using the Eddy Covariance instrument pack, installed in the middle of an alfalfa (Medicago sativa, L.) field on the lower Huntington Farm and an irrigated pasture with a mix of grass and alfalfa on the Huntington Rock Garden, with enough fetch to measure ET over the fields (500 foot radius from the station).

The watering rates at the Huntington Farm are carefully monitored and controlled to prevent surface runoff and deep percolation, so as to minimize impacts to surface water and ground water. In the water budget method, the moisture in the soil is regarded as being a balance between what enters it as a result of precipitation and irrigation, and what leaves through evapotranspiration. The budget becomes merely a balance of putting back into the soil, through irrigation, water that is lost through ET. This is achieved by irrigation at or below the reported daily ET_a rate.

2.3. Application Rates

Application rate of a sprinkler system is the rate at which water is applied, expressed in units of inch/hour. The Huntington sprinkler system is designed so that the average application rate over the irrigated area is less than the basic intake rate of the surface soil to prevent runoff.

The design application rate for the Huntington farm is 0.25 inches/hour. At this rate, approximately 2.78 inches of waste water is applied during an eleven hour set. Application rates per sprinkler head are estimated by size of the nozzle in the sprinkler head and the pressure at which it operates (Appendix D.4)

2.4. Irrigation Frequency

Irrigation frequency refers to the number of days between irrigations. In practice, irrigation frequency is determined by means of water balance calculations, using available soil water capacity and the ET_a value calculated by the Eddy Covariance station.

Waste water irrigation frequency on the Huntington Farm is determined by using the daily ET_a rate over the previous days since last irrigation to get the total water usage from the available soil reservoir. When approximately 2.5 inches of water has been lost, as indicated by ET_a measurements, then an irrigation sequence is scheduled. The weather forecast is also taken into account so as to anticipate any potential precipitation events.

3. Controls

The primary control that is in place on the Huntington Farm to prevent surface runoff and leaching to ground water is the judicious application of the waste water in relation to ET_a measurements. The following measures are in place to handle the infrequent upset condition, or the unusual weather event, such as a 50 year storm.

3.1. Surface runoff

Each area of the farm is surrounded by an earthen berm that is used to channel any excess surface water to a retention pond. The ponds are of adequate size to contain a sprinkler system spill or system failure of up to 10 hours. These same ponds are designed to contain the surface runoff of a significant precipitation event. The intent of these ponds is that the bottoms would seal over time as water moved clay particles into the pore spaces. Water would then be lost through evaporation or by pumping into tank trucks.

Any surface spills that do enter waters of the State, are immediately reported to the State Division of Water Quality.

3.2. Ground Water

Ground water is protected from waste water contamination by careful control of the application of waste water for irrigation. By limiting the application quantity to not more than is lost through evapotranspiration, the amount of water in the soil profile will not exceed the capacity of the soil and will not leach into the shallow aquifers under the farm fields.

4. Records and Reports

4.1. Irrigation Records

Knowing how much waste water has been applied to any area is essential to a successful waste water land application plan. An irrigation record is kept in the Huntington Research Farm office. Each sprinkler line is identified on the farm by its own name (Appendix D.5). The name contains the farm area where it is located (rock garden, east or west), the field name, and the direction locator (east, west, north, south or center). The number of risers available for each sprinkler line is also recorded. For each of these risers, there is a record of how many sprinkler heads are on the line for that riser setting (Appendix D.6). Each day the riser position of each sprinkler line on the farm that is running is recorded. The duration of the set is recorded daily. An example of the daily irrigation record sheet is contained in Appendix D.7. Knowing the number of sprinkler heads, the operating pressure and the length of time of the irrigation set, the volume of water applied for that area can be calculated. Using this number and the TDS value for the waste water, the amount of salt applied can also be calculated.

4.2. Flow and Storage Records

The Huntington Farm uses three inline propeller type *Macrometer* flow meters to measure the gross amount of waste water delivered to each area of the farm. Flow is measured instantaneously in gallons per minute (gpm) and a totalizing meter measures total flow in acre feet (acft). One flow meter is located in the main water delivery line (mainline) before it branches to go to the two production areas of the farm and upstream of a line that gives the capacity to introduce fresh water into the waste water irrigation system. This first meter measures the flow of total waste water to the entire Huntington Farm before any fresh water is introduced. This fresh water line is metered with its own flow meter (Note: This fresh water line has not been used for over 20 years). The second flow meter is located in the lateral line just before the water enters a booster pump to deliver waste water to the rock garden area. It has the capacity to measure the gpm and total flow of water delivered, whether it is fresh water, waste water or a mix. A third meter is located in the lateral line that serves the lower farm, measuring gpm and the total flow, whether fresh or waste or a mix.

The present record keeping scheme has these four flow meters being read weekly by the farm. Waste water output to the irrigation storage reservoir (evap pond) by the power plant is recorded weekly also. This information is recorded by one flow meter located in a pump house servicing the one waste line flowing from the Huntington Power Plant to the evaporation pond. The information from the three waste water irrigation flow meters and the one power plant waste water disposal line is collected weekly by the farm. The data is forwarded to the farm manager. The manager takes the data and records the weekly irrigation rates for the two areas of the Huntington Farm and the amount of waste water added to the storage pond by the Huntington power plant. An irrigation water sample is also taken from the evaporation pond. This sample is used to report the TDS and Ph of the waste water. Weekly irrigation values and acres irrigated, by farm area are reported to ET Consultant to be compared against the actual ET (ET_a) curve for addition into the annual report from ET Consultant to PacifiCorp. The monthly ET_a summaries are kept on file in the research farm office.

The actual level of waste water in the evaporation pond is also recorded weekly by reading the elevation off of staff gauges that are located in the pond. This data is used to calculate the amount of waste water that remains in storage in the evaporation pond. At the beginning of the irrigation season, this storage volume data is used to determine the number of acres that will be required to be irrigated on the farm, in order to dispose of all the waste water in an efficient manner and within environmental regulations. This data is also used weekly, as a gross check, of the flow meters, on the water balance of water out to the farm and water into the evaporation pond from the power plant.

4.3. Crop Records

Crop production records, as well as field records, indicating which crops were grown where, are recorded and saved. Crop inputs, such as seed, fertilizer and pesticides are also recorded.

4.4. Groundwater Report

Semi-annual ground water and surface water samples are collected. Spring samples are collected in late March or early April before waste water irrigation commences and the fall sampling is completed during November, after waste water irrigation has been terminated. Results of these two sampling events are reported as required in the ground water permit. If any anomalies or exceedances are observed, they are indicated in the cover letter of the report.

4.5. Calculated Application Rate

The actual irrigation rate in inches of waste water applied will be calculated each week, combined with the weekly precipitation and compared with the measured actual evapotranspiration provided by the ET consultant. The farm manager will be responsible for this weekly evaluation and will prepare a report each month during the irrigation season to document the values. The report will be submitted to the environmental engineer. The report will contain the following:

a. Dates of each weekly period
b. Weekly flow quantity, totaled from the several flow monitors, in acre feet
c. Number of actively irrigated acres
d. Total precipitation during the week, in inches
e. Calculated irrigation rate, in inches
f. Total water applied, sum of irrigation and precipitation, in inches
g. Actual evapotranspiration amount for the week, in inches
h. Water balance calculation, in inches
i. Comments, e.g. estimated field moisture determinations, adjustments, etc.

The calculated irrigation rate will be determined by the following formula:

$$\text{Irrigation rate} = \frac{\text{Total gallons x 12}}{\text{Acres irrigated x 7.481 x 43,560}}, \text{ inches}$$

The acres irrigated value is determined by the following formula:

$$\text{Acres irrigated} = \sum \frac{(N * SH * SR)}{43{,}560} \text{ for each irrigation line used}$$

N = number of sprinkler heads on the irrigation line
SH = spacing between sprinkler heads on the line, in feet, equals 40'
SR = spacing between the risers, in feet, equals 60'

The weekly water balance calculation will be found by taking the initial available soil moisture reading and subtracting the weekly ET_a sum and adding any irrigation and precipitation values. Subsequent water balance numbers are calculated by taking the previous week's soil moisture number and adding the total water applied plus precipitation and subtracting the ET_a for the week to get a value in inches.

$$A_m = \sum ET_a - (I + P)$$

Where A_m = Available soil moisture, inches
ET_a = Sum of weekly actual evapotranspiration, inches
I = Irrigation amount, inches
P = Precipitation, inches

The precipitation and evapotranspiration rate are reported from the ET station instruments to the farm manager's office every day with the previous day's values.

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Appendix D.1

Soils of the Hunting series are deep, gently sloping, and slightly to strongly saline. They are also medium textures and are somewhat poorly drained. These soils are alluvial fans and flood plains and in narrow alluvial valleys, where they have formed in alluvium that washed from marine shale and sandstone. The vegetation is mainly saltgrass or redtop grass, but greasewood grows in places. Elevations range from 4,000 to 6,500 feet. The annual rainfall is 6 to 11 inches, and the mean annual soil temperature is between 47° and 54° F. The growing season ranges from 110 to 160 days.

In a typical profile, the surface layer is light brownish-gray, strongly calcareous loam about 9 inches thick. The underlying material is light brownish-gray and grayish-brown loam that contains a large amount of lime. Distinct mottles are at some depth between 20 and 40 inches.

The Hunting soils have a water table that is 20 to 40 inches below the surface. Most areas of Hunting soils are cultivated. Crops grown under irrigation are alfalfa, small grains, and sugar beets. Some areas are used for irrigated pasture.

Hunting loam (1 to 3 percent slopes) (Hn)**-** The profile of this soil is the one described as typical of the series. This soil generally occurs in areas of moderate size. The subsoil is mostly loam, but the texture below a depth of 40 inches ranges from clay loam to sandy loam. Typically, mottles are at a depth between 20 and 40 inches, but they are at a greater depth in places. Veins of gypsum are common, and the substratum contains 1 to 3 percent gypsum in most places.

Included in mapping were areas of soils that have a surface layer of silt loam, and other areas where the surface layer and subsoil are brown or dark brown. Also included were areas of Billings silty clay loam, areas of Rafael silt clay loam, and small spots of strongly saline-alkali soils.

Drainage is somewhat poor, and permeability is moderate. Roots penetrate deeply. Runoff is medium, and the hazard of erosion is moderate. This soil is easy to cultivate. About 12 inches of water is held by this soil, but only 5 inches of water is readily available to plants.

Seepage from irrigation canals and over irrigation of fields in higher areas contributes seepage water to these soils. Preventing seepage by lining irrigation canals and ditches and correct water application is less expensive and as effective at draining these soils. Excess water should be removed before these soils are used for crops.

Alfalfa, small grains, and sugar beets are grown under irrigation, but irrigated pasture is probably the dominant use because of the high water table. Alfalfa generally produces two full crops and a part of a third crop each year.

Soils of the Kenilworth series are stony, well drained, gently sloping to steep, and moderately coarse textured. They occupy high benches on old dissected outwash plains below very steep mountains along the western edge of the survey area. These soils have formed in a thick deposit of strongly to very strongly calcareous stony alluvium derived mainly from calcareous sandstone, quartzite, and limestone. The vegetation is mainly juniper and pinion. Elevations range from 6,000 to 7,200 feet. The annual rainfall is 8 to 12 inches, and the mean annual soil temperature is between 47° to 54° F. The frost-free season is 110 to 130 days.

In a typical profile, the surface layer is pale-brown, very strongly calcareous very stony sandy loam about 7 inches thick. The underlying material is pale brown and very pale brown stony sandy loam that is very strongly calcareous and contains 25 to 50 percent cobblestones and stones.

The Kenilworth soils are used for range. Some areas have been cleared for reseeding, but inadequate rainfall and stones on the surface prevent the success of such work in many places.

Kenilworth very stony sandy loam, 0 to 20 percent slopes, eroded (KeE2)- The profile of this soil is the one described as typical of the series. This soil occurs in large areas. Sheet erosion is active. Lime-coated gravel and cobblestones are on the surface in many places, and coatings of lime are on stones 2 to 6 inches above the surface. These lime-coated stones indicate that erosion has removed soil from around them. Gullies 2 to 3 feet deep are common in places.

This Kenilworth soil is well drained and is moderately permeable. Runoff is medium, and the susceptibility to erosion is slight to moderate. The root zone is shallow or moderately deep. Depth of root penetration is restricted by limy layers and stones. This soil retains about 4.5 inches of water, but only about 3.5 inches of water is readily available to plants.

This soil is used mainly as spring and fall range. Deer use it also for winter range. In places, juniper is cut for fence posts.

Mixed alluvial land (Mx)- consists of unconsolidated alluvium that is typically stratified and widely variable in texture, color, and consistence. It occurs along stream channels and in most places has been deposited recently by streams. This material is subject to change through periodic overflow, but it has remained in place long enough for plants to have become established. Typically, there has been no development of a soil profile, but in places the soil material near the surface is slightly darkened by organic matter. Drainage generally is restricted, and the soil material is mottled. Small areas in which the material is cobbly or stony are near the mouths of canyons. Away from the canyons, the sediments are finer textured.

This miscellaneous land type has little value for farming, except that it is used for grazing.

The Penoyer series consists of well-drained, calcareous soils that are medium textured. These soils occupy medium to large areas of alluvial fans, flood plains, and alluvial plains on the bottoms of canyons. They have formed in alluvium from sandstone, limestone, and basic igneous rocks. The natural vegetation is mainly sagebrush, Indian ricegrass, galletagrass, and shadscale. Elevations range from 4,000 to 6,5000 feet. The annual rainfall is 6 to 11 inches, and the mean annual soil temperature is 47° to 54° F. The frost-free season is 110 to 160 days.

In a typical profile, the surface layer is light brownish-gray, strongly calcareous loam about 9 inches thick. The underlying material is light brownish-gray loam and very fine sandy loam.

Nearly all areas of Penoyer soils have been cleared and are planted to crops. The soils are used mainly for alfalfa, small grains, corn, sugar beets, melons, and irrigated pasture. Where air drainage is favorable for reducing the frost hazard, these soils are used for apple orchards.

Penoyer loam, 1 to 3 percent slopes (PeB). -The profile of this soil is the one described as typical of the series. The subsoil is typically loam or very fine sandy loam. Below a depth of 40 inches, this soil is weakly stratified with clay loam to sandy loam. In places gypsum veining and olive colors are below a depth of 3 to 4 feet.

Included in the mapping were small areas of Penoyer silt loam and Penoyer silty clay loam, and small areas of olive-brown or brownish-gray soils. Other inclusions consist of few areas that are underlain by gravel and in the bottoms of canyons. In some places soils are included that have slopes of slightly less than 1 percent.

Drainage is good, and permeability is moderate. Roots penetrate deeply. This soil retains about 12 inches of water, but only about 5 inches of water is readily available to plants. Runoff is medium, and the susceptibility to erosion is moderate. This soil is easy to work and to irrigate. It has the highest natural fertility of any soil in the survey area, and it is most responsive to management. Land leveling is needed in a few areas. The frost-free season is 110 to 130 days in 3 out of 4 years.

This soil is used for spring and fall range and for irrigated pasture, alfalfa, small grains, corn, and sugar beets. Because of the short growing season, alfalfa produces only two full crops and sometimes part of a third crop each year. Corn does not mature for grain and is used for ensilage.

Penoyer loam, 3 to 6 percent slopes, eroded (PeC2),- This soil is similar to the one for which a profile is described as typical of the series, except that it has stronger slopes and is eroded. Included in mapped were minor areas of gravelly soils and of soils similar to Penoyer, except that they have an olive or brownish-gray color.

Runoff is medium, and the susceptibility to erosion is high. Sheet erosion is moderately active. Many areas contain rills and shallow gullies.

This soil is used for irrigated pasture, alfalfa, and small grains. Many areas are used for spring and fall range.

Penoyer very fine sandy loam, 3 to 6 percent slopes, eroded (PsC2), - This soil is similar to the one for which a profile is described as typical of the series, except that it is steeper, has a coarser textured surface layer, and is eroded. It occupies alluvial fans, generally near the bases of mesas.

Included in mapping were areas, less than one-half acre in extent, of fine sands that are shallow over shale and sandstone.

Runoff is medium, and the susceptibility to erosion is high. Many areas are dissected by a few deep gullies. Hummocks 6 to 12 inches high occur in areas used for range. The available water capacity is about 7.5 inches.

This soil is used mainly for spring and fall range. Some areas, however, are used for irrigated grain and alfalfa or mixtures of alfalfa and grass.

Stony alluvial land (St) - consists of extremely stony alluvium from a variety of sedimentary rocks. It is mainly on the flood plains of live and ephemeral streams, but it also occurs on mud rock flows adjacent to the flood plains. The texture ranges from sandy loam to loam. Gravel, cobblestones, and other stones 3 inches to 4 feet in diameter make up 25 to 80 percent of the soil material. The content of the stones and cobblestones varies significantly within a few feet.

The present vegetation is scattered juniper trees, galletagrass, rabbitbrush, and some big sagebrush.

Appendix D.2: <u>Manual "Feel" Method for Field Moisture Determination</u>

This method of determining soil moisture levels is fairly accurate when applied on medium textured soils (silt loams or silty clay loams). Table 2 and Table 3 set forth the interpretation of the visual examination or "feel" method. Soil moisture information throughout the soil root zone profile is necessary for evaluating overall moisture conditions. When using the visual examination method, soil samples should be taken with an auger or probe at 8", 16" and 24" depths. Samples should be taken at several locations in each field for the most reliable information.

There are three conditions of moisture in the soil. They are referred to as the basic soil moisture relations. They are saturation, field capacity and wilting range. Saturation is defined as the amount of water that can be held in the soil when all air space in that soil is completely occupied by water (conditions when free water can be found when boring into the soil). Field capacity is defined as the amount of water a soil will hold against drainage by gravity (capillary water). Wilting range is defined as the range between the moisture content in a soil when plants begin to wilt and that moisture content when plants permanently wilt.

Table 2 Practical Interpretation Chart for Soil Moisture
USDA – Soil Conservation Service

Percent of useful soil moisture remaining	FEEL OR APPEARANCE OF SOILS			
	Coarse	Light	Medium	Heavy
0	Dry, loose, single-grained flow through fingers.	Dry, loose, flows through fingers	Powder, dry, sometimes slightly crusted but easily breaks down into powdery condition.	Hard, baked, cracked, sometimes has loose crumbs on surface
50 or less	Still appears to be dry; will not form a ball with pressure*.	Still appears to be dry; will not form a ball*.	Somewhat crumbly but will hold together form pressure.	Somewhat pliable, will ball under pressure*.
50 to 75	Same as Coarse texture under 50 or less	Tends to ball under pressure but seldom will hold together	Forms a ball*, somewhat plastic; will sometimes slick slightly with pressure	Forms a ball; will ribbon out between thumb and forefinger.

75 to field capacity	Tends to stick together slightly, sometimes forms a very weak ball under pressure.	Forms weak ball, breaks easily, will not slick	Forms a ball and is very pliable; slicks readily if relatively high in clay.	Easily ribbons out between fingers; has a slick feeling.
At field capacity	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand.	Same as coarse.	Same as coarse.	Same as coarse.
Above field capacity	Free water appears when soil is bounced in hand.	Free water will be released with kneading.	Can squeeze out free water.	Puddles and free water form on surface.

*Ball is formed by squeezing a handful of soil very firmly with fingers

Table 3 Soil Moisture and Appearance Relationship Chart

(This chart indicates approximate relationships between field capacity and wilting point)

Moisture Deficiency In./ft.	SOIL TEXTURE CLASSIFICATION Coarse (Loamy Sand)	Sandy (Sandy Loam)	Medium (Loam)	Fine (Clay Loam)
	(field capacity)	(field capacity)	(field capacity)	(field capacity)
.0	Leaves wet outline on hand when squeezed.	Appears very dark, leaves wet outline on hand, makes a short ribbon.	Appears very dark, leaves a wet outline on hand, will ribbon out about one inch.	Appears very dark, leaves slight moisture on hand when squeezed, will ribbon out about two inches.
.2	Appears moist makes a weak ball.	Quite dark color, makes a hard ball.	Dark color, forms a plastic ball, slicks when rubbed.	Dark color, will slick and ribbons easily.
.4	Appears slightly moist, sticks together slightly.	Fairly dark color, makes a good ball.	Quite dark, forms a hard ball.	Quite dark, will make thick ribbon, may slick when rubbed.
.6	Dry, loose, flows thru fingers. (wilting point)	Slightly dark color, makes a weak ball.	Fairly dark, forms weak ball.	Fairly dark, makes a good ball.
.8		Lightly colored by moisture, will not ball.	Slightly dark, forms	
1.0				

1.2		weak ball.	Will ball, small clods will flatten our rather than crumble.
1.4	Very slight color due to moisture (wilting point)	Lightly colored small clods crumble fairly easily.	Slightly dark, clods crumble.
1.6		Slight color due to moisture, small	
1.8		clods are hard. (wilting point)	Some darkness due to unavailable moisture. Clods are hard, cracked.
2.0			(wilting point)

(McCulloch, 1976)

Appendix D.3: Actual Evapotranspiration (ET_a) Determination

In the Eddy Covariance method, the weather parameters such as air temperatures (Ta_1 and Ta_2) and moisture (q_1 and q_2) at one and two meters, solar (R_s) and net radiation (R_n) wind speed (U_3) and direction (WD) at 3 meters, the top soil heat flux (G, amount of energy released or absorbed by the topsoil), and precipitation, are measured every 5 seconds (averaged into 20 minutes) and stored in a data logger at the farm ET site. Weather and evapotranspiration data are gathered automatically by the Farm's computer each night. Transmissions occur using the existing farm radio channel between 1:00 a.m. and 3:00 a.m. The base station at the office computer talks to Huntington via a combination of dial-up telephone modem and radio links. This modem is connected to a radio that calls each of the two Huntington Research Farm evapotranspiration stations in succession. The data are transferred back to the office computer as an answer. These data are transferred to the ET consultants office in the early morning for daily quality control and processing. The office computer processes the data utilizing the Eddy Covariance equations and provides a daily and hourly weather summary for the ET station, printed automatically daily, as well as a monthly weather and ET summary for the station. The daily and hourly summary is available early in the morning for the coming day. This daily summary provides a single actual evapotranspiration (ET_a) value, measured in inches/day, for the previous 24 hour period.

During short periods when some sensors are not functioning properly, procedures developed in previous years are used to estimate the missing data required for computation of ET. For instance, missing global or net radiation data can be created using the linear relationship between these two parameters during the many years of data collected at the specific station.

The water balance equation and other equations required for computations of actual (ET_a, based upon the Eddy Covariance) and potential (ET_p) evapotranspiration.

The water balance at the surface (all terms in $mm \cdot time^{-1}$) is:

$$I + P = \pm LE \pm \Delta S \pm R \pm D \qquad [A1]$$

where I is irrigation, P is precipitation, LE is positive for evapotranspiration and negative for deposition (dew or frost), ΔS change in the soil moisture content (positive for depletion and negative for repletion), R is surface runoff (positive when water goes out and negative when comes in), and D is deep percolation (positive when water leaves the root zone and negative when water comes to the root zone from underneath).

The energy balance at the surface (all terms in $W.m^{-2}$) is:

$$\pm R_n = \pm LE \pm H \pm G \qquad [A2]$$

where R_n is net radiation, and LE(+ for evapotranspiration), H(+ for warming of the air), and G(+ for warming of the top soil) are latent, sensible and the top soil heat fluxes, respectively.
The Bowen-ratio, β is:

$$\beta = H / (LE) = C_p \, d\theta / (L \, dq) \qquad [A3]$$

The potential temperature, θ, in K is:

$$\theta = T(1000 / P)^{0.286} \qquad [A4]$$

The specific humidity, q, in $kg\ kg^{-1}$ is:

$$Q = 0.622\ e_a / (P - 0.378\ e_a) \quad [A5]$$

The actual vapor pressure, e_a, in mb is:

$$E_a = 6.1121 * EXP\ [17.502\ T_{dew}, °C / (240.97 + T_{dew}, °C)] \quad [A6]$$

The pressure, P, in mb is (assuming a dry adiabatic lapse rate of 10 °C/km):

$$P = 1013\ \{[288 - 0.01\ 9altitude, M)] / 288\}^{3.416} \quad [A7]$$

The latent (LE) and sensible (H) heat fluxes are:

$$LE = (R_n - G) / (1 + \beta) \quad [A8]$$

and

$$H = \beta\ (R_n - G) / (1 + \beta\ ) = \beta\ LE \quad [A9]$$

The potential evapotranspiration, ET_p, in MJ m^{-2} d^{-1} is:

$$ET_p = [\Delta / (\Delta + \gamma)](R_n - G) + 6.43\{[\ \gamma / (\ \Delta + \gamma\ )](\ e_s - e_a\ )(1.0 + 0.014u_2)\} \quad [A10]$$

Where R_n and G are in MJ $m^{-2}d^{-1}$, $e_s - e_a$ is in kPa (1 kPa = 10 mb), and u_2 is in km d^{-1}

The slope of saturation vapor pressure-temperature,Δ , in kPa $°C^{-1}$ is:

$$\Delta = 4098e_s,kPa / (T,°C + 237.3)^2 \quad [A11]$$

The saturation vapor pressure, e_s, in mb is:

$$E_s = 6.1121 * EXP[17.502\ T,°C / (240.97 + T,°C)] \quad [A12]$$

The psychrometric constant, γ, in kPa $°C^{-1}$ as:

$$\gamma = C_p.P, kPa / (0.622L) \quad [A13]$$

The latent heat of vaporization, L, in J kg^{-1} as:

$$L = 2500800 - 2366.8T,°C \quad [A14]$$

The relative humidity, RH, in % is:

$$RH = 100(\ e_a / e_s) \quad [A15]$$

Note:

The specific heat of air at constant temperature, C_p, is 1004 J $kg^{-1}K^{-1}$. Evapotranspiration, ET_a, in m d^{-1} can be computed using the computed latent heat (LE) in J m^{-2} d^{-2} divided by L p_v, where L is in J kg^{-1} and p_v = 1000 kg m^{-3} is the water density.

Appendix D.4: Standard Nozzle Performance*

Nominal stream height 7' above nozzle** @ normal pressure

Nozz. Dia.	1/8"		9/64"		5/32"		11/64"	
Nozzle PSI	GPM	Dia. Ft.	GPM	Dia. Ft.	GPM	Dia. Ft.	GPM	Dia. Ft.
50	3.18	83	4.07	85	4.98	90	6.01	95
55	3.34	84	4.27	86	5.22	91	6.30	96
60	3.48	85	4.46	87	5.45	92	6.57	97
65	3.63	86	4.55	88	5.68	93	6.83	98
70	3.76	87	4.83	89	5.60	94	7.09	99
75	3.90	88	5.00	90	6.11	95	7.34	100
80	4.02	89	5.17	91	6.30	96	7.58	101

*All sprinklers were tested under minimum wind conditions. The water pressure readings were taken below the sprinkler inlet to provide meaningful design data. All pressure readings recorded are accurate to within 2% of actual pressure. The recorded flow rate (in U.S. gallons per minute) is accurate to within 1% of actual flow.

**Standard Nozzle at mid-point of pressure range

(Weather·Tec, 1999)

Appendix D.5: Sprinkler Line Identifying Names

Huntington Research Farm

Description (Name)	Abbreviation
East Farm	
Barn East	EBE
Barn Center	EBC
Barn West	EBW
Cottage	ECTG
Front Pasture East	FPE
Front Pasture West	FPW
West Farm	
Office	OFFICE
Research North	RN
Research South	RS
Pump House	PH
Duck Pond	DP
Homestead	HSTD
Alfalfa	WA
Bull Pasture North	BPN
Bull Pasture South	BPS
Research Plot	PLOT
Rock Garden	
Rock Garden 1 South	RG1S
Rock Garden 1 North	RG1N
Rock Garden 2 South	RG2S
Rock Garden 2 North	RG2N
Rock Garden 3 South	RG3S
Rock Garden 3 North	RG3N
Rock Garden 4 South	RG4S
Rock Garden 4 Center	RD4C
Rock Garden 4 North	RG4N

Appendix D.6: Sprinkler Head Count per Line

Huntington Research Farm Riser and Sprinkler Heads

LINE	Total Riser	1	2	3	4	5	6	7	8	9	10	11	12	13
EBE	9	18	18	18	18	18	15	15	13	11				
EBC	9	21	21	21	21	21	21	16	14	14				
EBW	9	10	10	10	10	10	10	10	10	10				
OFFICE	11	33	33	33	33	31	31	29	29	27	27	25		
RN	10	10	10	10	10	10	10	10	10	10	10			
RS	10	18	18	18	16	16	14	14	14	12	10			
PH	12	26	26	26	26	26	25	23	23	21	21	21	21	
DP	13	21	21	21	21	21	19	19	17	17	15	12	9	
WA	12	22	22	22	22	22	23	23	23	24	19	19	16	16
BPN	6	29	29	29	29	29	29							
BPS	6	28	28	28	24	22	20							
RG1S	7	12	12	11	11	10	10	10						
RG1N	7	15	15	15	13	13	11	11						
RG2S	7	26	26	26	26	26	26	26						
RG2N	6	31	31	31	31	31	31							
RG3S	7	30	30	29	28	28	27	27						
RG3N	7	22	22	22	22	21	20	20						
RG4S	7	31	32	33	35	39	39	39						
RG4C	7	39	39	39	39	39	39	39						
RG4N	7	28	28	29	30	31	32	33						
FPE	4	11	17	11	29									
FPW	2	15	6											
HSTD	12	13	11	10	8	8	7		6	5	4	4	4	
ECTG	1	18												
PLOT	1	23												

Appendix D.7 Irrigation Record Sheet

Enter riser number of the sprinkler set into the portion of t
for the date in use

Huntington Research Farm Month - Date- Description (name)			Mon -1	Mon -2	Mon-3	Tue -1	Tue -2	Tue -3	Wed -1	Wed -2	Wed -3	Thu-1	Thu-2	Thu-3	Fri-1	Fri-2	Fri-3	Sa 1
Lower Farm																		
Barn East	EBE	9																
Barn Center	EBC	9																
Barn West	EBW	9																
Office	WO	11																
Research North	WRN	10																
Research South	WRS	10																
Pump House	WPH	12																
Duck Pond	WDP	12																
Alfalfa	WA	13																
Bull Pasture North	WBPN	6																
Bull Pasture South	WBPS	6																
Rock Garden																		
Rock Garden 1 South	RG1S	7																
Rock Garden 1North	RG1N	7																
Rock Garden 2 South	RG2S	7																
Rock Garden 2 North	RG2N	6																
Rock Garden 3 South	RG3S	7																
Rock Garden 3 North	RG3N	7																
Rock Garden 4 South	RG4S	7																
Rock Garden 4 Center	RG4C	7																
Rock Garden 4 North	RG4N	7																
Handlines and Solid Set Sprinklers																		
Front Pasture East	EFPE	4																
Front Pasture West	EFPW	2																
Homestead	WH	12																

Cottage	EC	1					
Research Plot	WRP	1					
System Pressure	psi						
TDS - (weekly)	ppm						

Application rate and volume equations

Total volume of wastewater delivered per sprinkler head

$H_t = V_n * (60 * (T))$

Where H_t = Total volume delivered by sprinkler head in one set, gallons

V_n = Water volume delivered for 5/32 inch nozzle, gallons per minute (gpm), equals **6.3** gpm

T = Total time of sprinkler set, hours

60 = 60 minutes/hour

Total volume of wastewater delivered per sprinkler line

$V_t = S_n * H_t$

Where V_t = Total volume delivered by sprinkler line in one set, gallons

S_n = number of sprinkler heads on line at riser set S

H_t = Total volume delivered by sprinkler head in one set, gallons

Total area sprinkler by one sprinkler head

$A_s = W_s * L_s$

Where A_s = Area sprinkled per sprinkler head, square feet (ft^2)

W_s = Width of set, feet (ft), equals **60** ft

L_s = Length of set, ft, (distance between heads) equals **40** ft

Total area sprinkled by one sprinkler line per set, square feet

$T_a = A_s * S_n * L_s$

Where T_a = Total area sprinkled by one sprinkler line, ft^2

A_s = Area sprinkled per sprinkler head, square feet (ft^2)

S_n = number of sprinkler heads on line at riser set S

L_s = Length of set, ft, (distance between heads) equals **40** ft

Total area sprinkled by one sprinkler line per set, acre

$$T_{at} = \frac{T_a}{A_f}$$

Where T_{at} = Total area sprinkled per set, acre (ac)

T_a = Total area sprinkled by one sprinkler line, ft^2

A_f = Square feet per acre foot, equals **43,560** ft^2/ac

Total volume of wastewater delivered per sprinkler line, acre feet

$$AF_v = \frac{V_t}{V_{af}}$$

Where AF_v = Total volume applied per sprinkler line, acre feet (acft)

V_t = Total volume delivered by sprinkler line in one set, gallons

V_{af} = Gallons (gals) per acft, equals **325,827** gals/acft

Total water applied per acre, acre feet per acre (acft/ac)

$$T_{af} = \frac{AF_v}{T_{at}}$$

Where T_{af} = Total water applied per acre, acft/ac

AF_v = Total volume applied per sprinkler line, acre feet (acft)

T_{at} = Total area sprinkled per set, acre (ac)

Total Water Applied per acre, acre inches per acre (acin/ac)

Tai = Taf * In

Where Tai = Total water applied per acre, acin/ac

T_{af} = Total water applied per acre, acft/ac

In = inches per foot, equals **12**, in/ft

Appendix E
Ground Water & Surface Water Sampling and Analysis Plan Huntington Power Plant

1.0 INTRODUCTION

This Sampling & Analysis Plan (SAP) is written to: 1) provide descriptions of existing monitoring locations; 2) describe sample parameters and frequency; 3) provide the Quality Assurance/Quality Control (QA/QC) requirements for the water monitoring at the Huntington Power Plant that meets State of Utah and RCRA Subtitle D regulations; and, 4) properly document all sampling procedures and sampling data.

The SAP is written to satisfy the monitoring requirements of the Ground Water Discharge Permit (permit No. UGW150002) and the *Huntington Power Plant Corrective Action Plan: Old Landfill and New Landfill Area*.

1.1 Responsible Person

Implementation of the Sampling and Analysis Plan at the Huntington Power Plant is the responsibility of the Plant's Environmental Engineer.

1.2 Corrective Action

Corrective actions may occur during the implementation of this SAP. Any changes in the sampling schedule, sampling forms, sample locations, choice of laboratory, parameters, standard operating procedures (SOP's), and methods will be documented and explained. The sampling personnel and the Huntington Power Plant Environmental Engineer are responsible for the implementation, documentation, and evaluation of the corrective actions.

2.0 GROUND WATER & SURFACE WATER MONITORING PLAN

Currently, the ground and surface water sampling conducted at the Huntington Power Plant is part of the Site-Wide Monitoring Plan.

- **Ground Water Discharge Permit**: The specific requirements of the discharge permit are incorporated into this SAP to monitor, track, and document compliance with the discharge permit.

The monitoring at the facility includes ground water and surface water monitoring. The ground water monitoring points are sampled for water level, field parameters, and laboratory parameters. All surface water monitoring points are monitored for field parameters, and laboratory parameters, select points will also be monitored for flow.

2.1 Monitoring Network

2.1.1 Ground Water

The monitoring system consists of ground water sampling in the area of the New and Old Landfills, the plant site, waste water facilities, coal pile and the Research Farm. Ground water monitoring is conducted through sampling of monitoring wells (Table III & Figure 1). The monitoring wells are located downgradient of the landfill, along the Duck Pond Drainage, the plant site, waste water facilities, coal pile and on the Research Farm Property. Field and analytical parameters are listed in Table II.

2.1.2 Surface Water

The surface water monitoring locations are along the Duck Pond Drainage, upgradient on Huntington Creek, above the farm on Huntington Creek, irrigation storage reservoir and downgradient of the farm on Huntington Creek.

All water sample locations will be monitored for the constituents shown in Table II.

Table II. Field & Analytical Monitoring Parameters

Field Measurements		
Water Level	pH	
Temperature	Specific Conductance	
Analytical Data		
Analyte	**Method**	**Detection Limit**
Total Dissolved Solids	E160.1/A2540C	10 mg/l
Sodium	E273.1/E200.7/E200.8	1 mg/l
Potassium	E258.1/E200.7/E200.8	1 mg/l
Magnesium	E242.1/E200.7/E200.8	1 mg/l
Calcium	E215.1/E200.7/E200.8	1 mg/l
Sulfate	E300.0	1 mg/l
Alkalinity	E310.1/A2320B	5 mg/l
Carbonate	A2320B	5 mg/l
Bicarbonate	A2320B	5 mg/l
Chloride	E300.0/A4500CLB	1 mg/l
Nitrate + Nitrite	E353.2	0.1 mg/l
Boron	E200.7/E200.8	0.01 mg/l

Table III lists the wells and surface water locations included in the water monitoring plan for the Huntington Power Plant facility. All existing monitoring locations are shown in Figure 1.

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Table III. Monitoring Locations
Huntington Power Plant

Potential Source Areas w/ Well IDs	Purpose	Justification
Ash Landfill (Old)		
LF-1O	CAP/BMP	Upgradient well for Old Ash Lf
LF-2O	CAP/BMP	Downgradient well for Old Ash Lf
LF-3O	CAP/BMP	Upgradient well for Old Ash Lf and storm water pond
LF-4O	CAP/BMP	Downgradient well for Old Ash Lf and storm water pond
LF-5O	CAP/BMP	Downgradient well for Old Ash Lf and storm water pond
LF-6O	CAP/BMP	Downgradient well for Old Ash Lf and storm water pond
LF-7Od	CAP/BMP	Downgradient well for Old Ash Landfill
Ash Landfill (New)		
LF-3Ns	CAP/BMP	Downgradient well for New Ash Landfill
LF-3Nd	CAP/BMP	Downgradient well for New Ash Landfill
LF-4N	CAP/BMP	Downgradient well for New Ash Landfill
Coal Pile		
HCP-4	BMP	Upgradient well for the Coal Pile
HCP-6	BMP	Downgradient well for the Coal Pile
Plant Site		
HFOS-mw	CAP	Downgradient well for historic oil spill
HPS-1	BMP	Downgradient well for Plant
Duck Pond Drainage		
HDP-1	CAP	Downgradient well for both Landfills
HDP-2	CAP	Downgradient well for both Landfills
HDP-3	CAP	Downgradient well for both Landfills
Process Ponds		
HWW-4	BMP	Downgradient well for Polishing Pond
HWW-7	BMP	Downgradient well for Evaporation Pond
HSW-1	BMP	Downgradient well for Lacey's Lake
Research Farm		
NH1W	GWD/BMP	Downgradient for Research Farm
NH2W	GWD/BMP	Lower Research Farm
NH3W	GWD/BMP	Lower Research Farm
NH4W	GWD/BMP	Mid-Research Farm/Downgradient of Duck Pond Drainage
NH5W	GWD/BMP	Mid-Research Farm
NH6W	GWD/BMP	Mid-Research Farm
NH7W	GWD/BMP	Upgradient of Research Farm
NH8W	GWD/BMP	Upgradient of Research Farm
RG-1	GWD/BMP	Dwongradient for Research Farm
Surface Water Locations		

Potential Source Areas w/ Well IDs	Purpose	Justification
H-1	GWD/BMP	Upgradient Huntington Creek
H-2	GWD/BMP	Midpoint on Huntington Creek
UPL-9	GWD/BMP	Downgradient Huntington Creek
H-11	CAP	Spring
H-12	CAP	Duck Pond
Drain-O	CAP	Downgradient of Old Landfill
Drain-N	CAP	Downgradient of New Landfill
West End Canyon	CAP	Downgradient of Landfill
UPL-13	GWD/BMP	Routine Network for Research Farm
Landfill @ Pumphouse	CAP	Downgradient of Landfill
Duck Pond @ Pumphouse	CAP	Downgradient of Landfill
HG-FD	CAP	Downgradient of Landfill
Creek at DP3	CAP	Downgradient of Landfill

BMP – Best Management Practice
CAP – Corrective Action Plan Monitoring
GWD – Ground Water Discharge Permit Monitoring

2.2 Operational Monitoring Schedule

Operational monitoring at the Huntington Power Plant will be completed semi-annually for all ground water wells and surface water locations for the monitoring points in Table III, until modified in writing.

Table IV. Monitoring Frequency
Huntington Power Plant

Monitoring Location	Sample Frequency	Duration
Farm Wells	Semi-Annual	**Until Modified in Writing**
PSA Wells	Semi-Annual	**Until Modified in Writing**
Surface Water	Semi-Annual	**Until Modified in Writing**

2.3 Post-Operational Monitoring Schedule

In order to tailor post-operational monitoring plans to adequately monitor ground water conditions at the site, a post-operational monitoring schedule will be determined by the State of Utah and Huntington Power Plant personnel as plant closure approaches. At that time, the State of Utah and Huntington Power Plant personnel will also determine post-operational monitoring points and sampling frequency.

2.4 Reporting Requirements

Semi-annual reports describing all water sampling, static water level measurements, and a summary of surface water data will be submitted to the State of Utah-Division of Water Quality and the Huntington Power Plant. Analytical results of each sampling event, inspections and maintenance, and any well construction activities, and any recommendations concerning modifications to the sampling frequency, analytical constituents or monitoring network will be submitted to the State of Utah-Division of Water Quality and Huntington Power Plant with the ground water monitoring reports.

Copies of all Field Log Books used for water monitoring must be retained. The field records must be available for UDEQ. Field Log Books will be comprised of detailed notes, forms and narratives documenting site sampling conditions and procedures to demonstrate the SAP and QA/QC Plan are being followed. Variances from the SAP will be documented and explained in the field notes. Records will be archived until the project is inactive plus five years. All data will be maintained in electronic format.

2.5 Monitoring Well Network Maintenance

2.5.1 Monitoring Well Inspections

Monitoring well inspections will be conducted and the results reported on the ground water sampling form. Ground water sampling personnel will inspect each well whenever sampling or monitoring activities are conducted. Wells will be inspected for the integrity of the locking cap, padlock, and steel well protector, and PVC well casing riser and cap.

Any foreign material removed from a well during purging or sampling activities will be described.

Monitoring well inspections will be recorded in the Field Log Book during each monitoring event.

2.5.2 Monitoring Well Inspection Reports

Any breach of integrity observed by the ground water sampling personnel will be reported to the Huntington Power Plant Environmental Engineer. If for any reason a well is destroyed or otherwise fails to function properly or its integrity is determined to be breached, the Huntington Power Plant Environmental Engineer will coordinate well repair or replacement.

2.5.3 Monitoring Well Abandonment

If the damage to or integrity of the well cannot be repaired, the well may be recommended for and properly abandoned and replaced within 180 days unless otherwise approved in writing by the State of Utah.

Well abandonment procedures are as follows:

1. Break bottom cap with a spear;
2. Pump well full of bentonite grout with a packer to force injection of grout into formation;
3. Let well sit for 24 hours;
4. Refill with grout (if necessary); and
5. Remove surface completion (if possible).

A well log report fully describing all abandonment procedures will be submitted to the State of Utah within 90 days of the abandonment activity.

2.5.4 Installation of Replacement Wells

Replacement wells, if needed, will be installed at locations which allow them to fulfill the intended purpose of the well they are replacing. Wells will be installed and completed as specified in Section 2.5 of this report. The Huntington Power Plant Environmental Engineer and his consultants, in conjunction with the State of Utah, will determine the exact well locations.

The replacement well will be developed and sampled upon installation. Following the initial sampling event, the well will be included and sampled in accordance with the established schedule for all other groundwater monitoring network wells.

2.5.5 Documentation of Well Construction

If a major plan or report, including semi-annual reports of groundwater monitoring activities, is in preparation at the time of new well construction, development or rehabilitation, the lithologic log, well construction logs, and other well construction and development details will be attached as an appendix to the major document. Otherwise, replacement well construction documentation will be submitted to the State of Utah within 90 days.

3.0 WATER SAMPLING & ANALYSIS PLAN

3.1 Objectives

The objective of this SAP is to provide detailed procedures, which are to be followed during all sampling events scheduled at the Huntington Power Plant.

3.2 Sampling Personnel

Experienced PacifiCorp personnel will conduct the routine monitoring, as needed.

3.3 Water Monitoring Locations

The locations of existing sampling locations at the Huntington Power Plant are shown in Figure 1.

3.4 Water Monitoring Parameters

A summary of the field and analytical data to be collected during each sampling event is detailed in Section 2.1, Table II.

3.5 Safety

It is the sampler's responsibility to obtain, maintain, and operate all equipment in a safe manner during a sampling event. The sampler's personal safety and that of any persons who accompany the sampler must be the primary concern at all times and in all sampling situations. A sampler who encounters a condition that may exceed the protection of their safety equipment or represent a potential hazard to human health should leave the area immediately and contact the Huntington Power Plant Environmental Engineer. Safety equipment may include but is not limited to:

Safety glasses;
Hard hat;

Safety boots;
Gloves;
Fire extinguisher;
Cell phone;
First aid kit; and
Protective clothing.

3.6 Sample Labeling and Shipping

Each sample sent to the laboratory must be labeled on the container in permanent, waterproof marking pen able to withstand long-term exposure to water. The label identification must cross-reference to the chain-of-custody form and the sampler's Field Log Book.

Sample labeling must identify four elements:

1. Day of the year;
2. Time;
3. Sample ID code; and
4. Name or chemical formula of the preservative used.

3.7 Waste Disposal

Solid and liquid wastes generated by field sampling will be disposed of in a proper manner. Any non-hazardous liquid will be disposed of at the sampling site. Hazardous liquid and solid waste products, such as disposable gloves, will be disposed of at an approved waste collection facility.

4.0 QUALITY ASSURANCE/QUALITY CONTROL PLAN

Activities required to produce accurate, precise, and repeatable results are an integral part of field sampling activities and laboratory analytical procedures.

4.1 Field Quality Assurance/Quality Control Plan

A QA/QC Plan depends on meticulous attention to detail and documentation by field personnel. Field sampling personnel are responsible for following standard operating procedures for equipment calibration and decontamination, well monitoring, sample collection including QA/QC samples, sample preservation, labeling, storage, and transportation to the analytical laboratory. All activities must be documented with care to verify correct handling and to permit accurate reporting of results.

4.1.1 Field Sampling Procedures

Field sampling procedures will include the following:

1. Equipment maintenance;
2. Equipment decontamination;
3. Equipment calibration;
4. Sample collection and preservation;
5. Sample storage and handling; and,
6. Field documentation of sampling activities.

4.1.1.1 Equipment Maintenance

Sampling equipment must be properly maintained. Table V lists sampling equipment maintenance procedures

Table V. Equipment Maintenance

Equipment:	Procedure:
Solinst Water Level Meter & Graduated Tape	Clean after each field use; Wash with mild detergent; and Rinse well, Replace 9-volt battery when the auditory or visual signal weakens or fails.
Horiba Water Quality Checker U-10 or U-50	Wash thoroughly after each field use with tap water. For longer storage, fill the small rubber cap with water and use it to cover the pH sensor. If storage is for a prolonged period (>6 months), remove the battery from the main unit.

4.1.1.2 Equipment Decontamination

All equipment, which comes in contact with ground water, will be decontaminated prior to use in a new sampling area. Table VI lists sampling equipment decontamination procedures.

Table VI. Equipment Decontamination

Equipment:	Procedure:
Solinst Water Level Meter & Graduated Tape	Wash with mild detergent or (alcanox) and a brush; Rinse with tap water; And Air dry.
Horiba Water Quality Checker U-10 or U-50	<u>Turbidity sensor</u> Wash out the tube using tap water; And Rinse with tap water. Do not use abrasives or cleaners. <u>Conductivity sensor</u> Wash out using tap water and rinse with tap water.

4.1.2 Field Documentation Procedures

A Field Log Book or Data Sheets will be maintained and prepared prior to the sampling event. Sufficient details including, but not limited to, those listed below will be included to document and permit reconstruction of all sampling events without relying on memory. The records will be completed in waterproof ink and will be legible and complete. The Field Log Book will be a compendium of forms pertinent to the specific field activity. More than one Field Log Book may be in use at one time; however, information will be recorded in only one of the logbooks to prevent

duplication or omission of information, except for that required to adequately cross-reference other information.

The first page in the Field Log Book will contain

- Name of Facility

For each site visit or sampling event, the following information will be provided:

- Date(s) of sampling;
- Names of persons sampling;
- Any visitors on-site;
- Weather conditions;
- Field activities conducted and their purposes;
- Sample collection time;
- Sample ID;
- Description of the condition, if not normal, of the protective casing, well casing, and annular seal; and
- Initials of person providing the information.

The Field Log Book will be specific to each field event and will be a compendium of forms pertinent to that specific field activity or time period. The Field Log Book for ground water sampling events will include:

- Map of sample locations at the Huntington Power Plant;
- Ordered list of sampling activities; and,
- Chain-of-custody Record.
- Field Data Sheets and Notes

4.1.3 Field Equipment Calibration

Calibration procedures are specific to each instrument. At a minimum the Horiba will be calibrated before each sampling day and the Solinist will be calibrated annually or after repairs. Table VII lists sampling equipment and its calibration procedures.

Table VII. Equipment Calibration

Equipment:	**Calibration Procedure:**
Solinst Water Level Meter & Graduated Tape	Power instrument, as probe is held vertically or horizontally 10-20 ft from cable reel, use a steel tape graduated in 0.01 ft increments to measure distance from the tip of the probe to the sensor level, the sensor to the 1 ft mark on the graduated portion of the tape, & the sensor to the 10 and/or 20 ft mark on the graduated portion of the tape. Calculate calibration correction factor (if necessary).
Equipment:	**Auto-Calibration Procedure:**
Horiba Water Quality Checker U-10	Fill the calibration beaker 2/3 with standard solution, fit the probe over the beaker, turn power on, press MODE key which puts unit into MAINT mode, check that lower cursor is in the AUTO sub-mode, press ENT key and the readout shows "CAL", after a few minutes the upper cursor will cycle through all calibration parameters, and when complete, "End" will show briefly and then return to the MEAS mode.

4.1.4 Chain-of-Custody Procedures

A chain-of-custody record supplied by the analytical laboratory will be completed for all samples as they are collected. The record will include or be similar to, depending on the laboratory requirements:

- The project name and number;
- Name of the analytical laboratory destination;
- Sampler's signature;
- Sample identification number, date and time of collection;
- Number of containers and type of sample;
- Analysis requested and number of containers provided per analysis; and
- Any special instructions or hazard warnings.

When sampling is complete, the samples will be packed for transport. A completed chain-of-custody will be enclosed in a Ziploc bag, placed inside the cooler. The samples will then be ready for shipping or delivery. Upon delivery, both parties to the exchange will sign and date the record noting the time of the exchange of custody. The sampler will be the first relinquishing signature and the laboratory personnel will be the final receiving signature. Intermediate signatures may or may not be present.

4.2 Sample Acquisition Methods

The sampling procedures described herein are designed to obtain representative ground water and surface water samples from the Huntington Power Plant.

Ground Water

Depth to water or static water level measurements will be collected during each sampling event. If previous sampling data is available, and sample collection proceeds from the well with the lowest concentration of TDS to the well with the highest concentration of TDS, decontamination is only required between PSA,s. Otherwise, decontamination is required between each well. Before being placed in each monitoring well, the water level probe will be decontaminated by rinsing the end of

the probe with distilled water. Depth to water will be measured in each monitoring well. This will allow the calculation of static ground water elevations for approximately the same time period.

To ensure that a representative sample is collected at each sampling location, the following sampling steps will be followed at each location. Sampling steps in order of performance at each well include:

- Transport all appropriate equipment to the sampling site;
- Inspect well;
- Don disposable gloves;
- Determine depth to water;
- Calculate water column volume;
- Purge well (three well volumes);
- Measure field parameters during purge and at the end of full purge;
- Withdraw sample;
- Field filter (as required); and
- Containerize/preserve sample aliquots.

If a well is purged dry prior to removing three well volumes, that well will be allowed to recover and then sampled. A note of explanation will be included in the Field Log Book. If past data shows the well will not recover in 24 hours, purge a small amount, then collect sample.

Surface Water

Surface water samples will be collected at locations shown on Figure 1. Grab samples from surface water bodies will be acceptable at the Huntington Power Plant.

- Transport all appropriate equipment to the sampling site;
- Don disposable gloves;
- Measure field parameters ;
- Withdraw sample;
- Field filter (if required); and
- Containerize/preserve sample aliquots.

In order to ensure reproducible sample data, surface water sample points will be clearly marked or located with GPS coordinates.

4.2.1 Well Inspection

In accordance with Section 2.5.1, the protective casing will be examined for damage during each monitoring event. The padlock and cap will be inspected and then removed. The riser casing and cap will also be inspected for damage. Observed odors will be noted. Detailed notes of any damage ascertained will be recorded in the Field Log Book.

4.2.2 Determine Static Water Height

Static water level measurements will be taken at each monitoring well sampled. The steps are as follows:

1. Locate well and note general condition in Field Log Book;

2. Unlock casing and uncap monitor well;
3. Don clean disposable sample gloves;
4. Measure and record (±0.01 ft) static water level in Field Log Book;
5. Calculate volume of well water to be removed and record in Field Log Book;
   2" well = total height water x 0.16 gallons/foot x 3 volumes,
   4" well = total height water x 0.65 gallons/foot x 3 volumes,
6. Cap and lock well if not sampling immediately; and
7. Rinse water level probe with distilled water.

4.2.3 Well Purging

Well purging will be performed at each monitoring well sampled. The steps are as follows:

1. Purge minimum of 3 well volumes or until well bails dry,
2. Record total volume of water removed in Field Log Book;
3. Record observations of purged water; and
4. Properly dispose of purge water.

4.2.4 Surface Water Discharge Measurements

Select gauging station near sample site H-1, H-2, and UPL-9. Location should have a uniform channel shape and flow should be as uniform as possible. Location should not have the possibility of bypass and should not be located downstream of any in-stream structures such as bridges.

Cold weather conditions, when sampling personnel must be in the water must be minimized and periods when ice has built up or is breaking up will be avoided, as well as periods of high flows due to rapid precipitation or snow melt

Samples and measurements will be collected semi-annual to coincide with the groundwater sampling schedule of April and October.

1. Extend Tape across channel and measure total channel width (w).
2. Divide the channel into one foot equal sections (b).
3. Collect velocity readings (v) in the horizontal center of each stream segment at 60% of the total depth (d).
4. Record the stage reading from each location.
5. Record all measurements in a field notebook.

4.2.5 Sample Withdrawal

Sample withdrawal procedures are as follows:

1. Don disposable gloves;
2. Label bottles using waterproof marker;
3. Lower bailer or pump to collect ground water samples, add preservatives (if required) to the sample bottle;
4. Collect sample for field parameters;
5. Measure and record field parameters;
6. Withdraw sample and fill all sample bottles;
7. Check all sample bottle caps for tightness;

8. Place sample in cooler for on-site storage and transport to the lab;
9. Record sample ID, location, well ID, date, time, and other observations in Field Log Book;
10. Rinse all equipment with distilled water; and
11. Cap and lock well.

Appendix F
Criteria to End Land Application of Waste Water

All soil-plant-salt-water systems have a self-regulating nature. The soil has a finite capacity for salt storage that is determined by plant sensitivity to salinity. No matter how little one irrigates, eventually the salt storage capacity of the soil is exhausted and the accumulated salt causes a yield reduction (in addition to any yield loss from water limitations). This salinity-induced yield loss results in a decrease in transpiration (or plant water uptake) and the water not used by the plant becomes drainage. Thus, leaching is inevitable. As long as water is the limiting growth factor, leaching may be prevented. But, when salt becomes the limiting factor, leaching must occur. The accumulating salt effectively shortens the root zone so that over time, fewer and fewer roots actively extract water.

The useful lifetime of the Huntington Research Farm will end when the crop plants cannot transpire all of the waste water. At that point, irrigation will produce leaching in violation of the Ground Water Discharge Permit, Permit No. UGW150002. PacifiCorp will need to watch for the accumulation of a reservoir of saline water in the lower reaches of the root zone that is not used up over the growing season.

Current protocols at the Huntington Research Farm include:

- Monitoring plant health, growth and yield. Data will be collected three times each growing season.
- Monitoring soil salt accumulation with depth, well below the root zone. Soil samples will be taken twice, spring and fall, annually.
- Monitoring soil moisture with depth, well below the root zone. Neutron probe data will be collected at least spring and fall.
- Monitoring potential and actual plant water use, evapotranspiration. Data is collected daily.

The combination of these observations allows us to determine if the plants are being unduly restricted in growth (and hence, water uptake), if salt and water are accumulating in the lower reaches of the root zone of each individual crop, and most importantly, if a persistent residual reservoir of un-transpired saline water is building up in the root zone.

If the latter condition (a buildup of unused saline water in the lower 25 to 50 cm of the crop root zone) were to occur and persist over two growing seasons, recommendations will be made for the discontinuance of waste water irrigation at the site. This criterion is integrative of the overall function of the system. It takes into account seasonal differences in plant growth, irrigation water salinity, the self-regulating dynamics of saline soil water movement in the profile, and the precipitation/dissolution dynamics of salt stored within the soil.

Monitoring data and results will be included in an annual report that will be filed in the Huntington Research Farm office for inspection.

Appendix G

Closure Plan
Lacey's Lake Pond Area

PacifiCorp Huntington Power Plant

May 2011

Prepared by:
URS Corporation

INTRODUCTION

PacifiCorp Huntington Power Plant (Huntington) management has determined that closure of Lacey's Lake will reduce the environmental footprint of the plant by eliminating an unlined surface water impoundment. Lacey's Lake is listed in Huntington's Ground Water Discharge Permit (Permit) number 150002 (UDEQ, 2009), issued by the Utah Division of Water Quality (DWQ), as an unlined pond with potential to impact groundwater. The purpose of this plan is to describe Huntington's approach to closing Lacey's Lake for DWQ review and approval.

The primary objective of the proposed actions is to mitigate potential impacts to groundwater by removing Lacey's Lake and adjacent waste handling areas and restoring the area for continued industrial use. The following section describes the operational history of Lacey's Lake. Section 2 describes the actions necessary to close Lacey's Lake. Section 3 includes Huntington's anticipated project schedule. Section 4 describes post closure reporting.

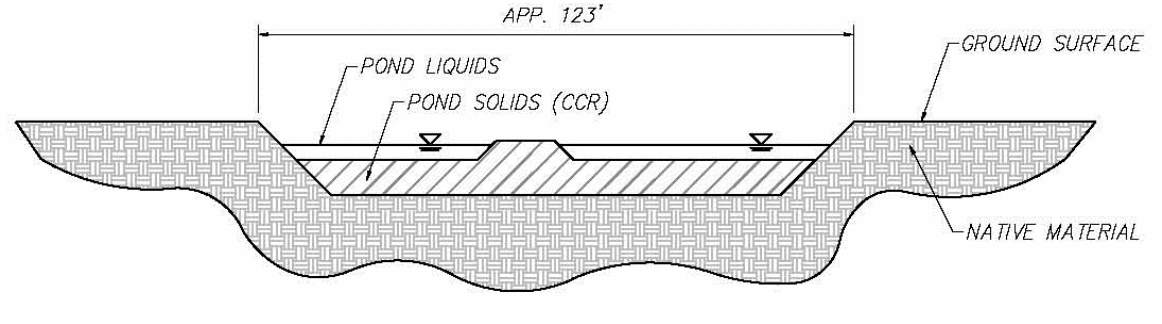
Operating History

Lacey's Lake was originally constructed in 1979 to serve as a settling and evaporation pond with a design volume of approximately four acre feet (ac ft). Waste streams with high suspended and dissolved solids concentrations are routed to the pond prior to flowing to the on-site waste water collection pond for treatment and reuse.

Currently, wastewater streams from the plant discharging to Lacey's Lake include RCC blowdown water, coal conveyor wash water, wash water associated with the fly ash loadout area (both Pug Mill wash water and water used to clean spills of ash in the loadout area), pump seal water, and truck wash water. Figure 1 shows the location of these wastestreams and flows measured during site observations recorded January 2011. In addition to the above plant process wastewater streams, Lacey's Lake receives stormwater runoff from the south coal pile area and the south area of the plant upgradient from the pond.

The waste streams entering Lacey's Lake contain high solids concentrations, both dissolved and suspended. Suspended solids are primarily ash or coal combustion residuals (CCR). As the solid material settles out and accumulates in Lacey's Lake periodic removal is required. Currently, this is accomplished using a long arm reach excavator capable of dredging sludge from all but the center of the pond. Removal is conducted approximately every six weeks and dredged material is staged adjacent to the pond for drying prior to transport to the on-site Ash Landfill for disposal. The schematic below depicts the current cross section configuration of Lacey's Lake.

Schematic 1. Cross Section View of Lacey's Lake



PROPOSED ACTION

Closure of Lacey's Lake is understood, conceptually, to include identification and rerouting of all inputs, sampling and removal of all waste material including surface water and sludge, and site restoratation including excavation, backfill and site grading. This section provides a description of the proposed actions necessary to close Lacey's Lake. Waste streams to Lacey's Lake are identified below along with Huntington's conceptual plan for rerouting the waste streams. Huntington's approach to removal of residual waste from Lacey's Lake and elements of site restoration through final grading are described below.

2.1 Identify and Reroute Waste Streams

An objective of this project is to dispose of or redirect these current and future wastewater streams such that none of them enter Lacey's Lake, thus permitting closure of the lake. The following is a summary of actions proposed to accomplish this objective.

1. Dewatering Facility wastewater streams. Completion of the new Dewatering Facility at Huntington will create an additional future wastestream (chloride purge water) of up to 120 gallons-per-minute (gpm) that, if not redirected, would discharge to Lacey's Lake based on the current facility configuration. The future chloride purge water will be conveyed to the RCC® for concentration. The RCC® blowdown water will be pumped to the former Unit 1 Thickener for storage. Water from the Thickener will be pumped (using existing pump system) to the Pug Mill for mixing with fly ash. The wetted fly ash will be transported to the on-site ash landfill for disposal.
2. Fly ash loadout water. Water decanted from the existing fly ash loadout area will be collected and pumped to the former Unit 1 Thickener for storage. Water from the Unit 1 Thickener will be pumped to the Pug Mill for mixing with fly ash. Solids will be excavated and deposited on the new Dewatering Facility drying pad (aka Gypsum Stack out pad).
3. Coal conveyor washwater will be commingled with the fly ash loadout area water (Item 2) and pumped to the Unit 1 Thickener for subsequent mixing with fly ash in the Pug Mill.
4. Pump seal water. Recirculating pump seals will replace the existing raw water seal water to the maximum extent possible. Any remaining pump seal water that discharges

to Lacey's Lake will be rerouted at the existing Lacey's Lake Pump Station to the existing wastewater collection system. The waste water collection system currently conveys water decanted from Lacey's Lake to the existing Pond 7 Holding Pond for subsequent reuse as agricultural irrigation water.

5. Truck wash area. The water and solids from the truck wash area currently drain to a concrete trough near the RCC®, and water decanted from the trough flows to the Lacey's Lake Pump Station. A new concrete pad will be constructed at the wash area to improve sediment control and provide a drying pad. Dried material will be hauled and disposed of separately from the fly ash disposal.

6. Coal pile runoff. Runoff from the coal pile will be detained in a new stormwater detention basin. Low flows (less than the 25-year, 24-hour storm) will be discharged by pipe to the existing wastewater collection system. Higher flows (greater than the 25-year storm) will overflow and discharge by ditch to an expanded existing detention basin south of Lacey's Lake.

7. South Area runoff. Stormwater runoff from the south area of the plant, including the reclaimed Lacey's Lake area, will be collected in an enlarged stormwater detention facility. Refer to Figure 2.

8. Coal Pile Runoff Detention Basin. The location and footprint of the proposed coal pile runoff detention basin are shown on Figure 2. The basin will be sized to detain a 25-year storm with a storage volume of 1.2 acre-feet at a depth of 4 feet. Runoff at or less than the 25-year event will be conveyed by an 18-inch polyvinyl chloride (PVC) pipeline from the basin to the existing wastewater collection system. Flows greater than the 25-year event will overflow the basin in a controlled armored section and discharge to an existing drainage channel. This channel will convey this overflow water to an enlarged detention basin south of Lacey's Lake, shown on Figure 2.

9. Lower Detention Basin Enlargement. The existing stormwater detention basin south of Lacey's Lake will serve as the lower detention basin. The basin will be enlarged to retain a 25-year, 24-hour storm event from the area delineated on Figure 2 for the south plant area. This 2.3 acre-feet basin will be approximately 5 feet deep. In addition, the basin will retain the overflow from the 25-year event at the coal pile runoff basin. This enlarged basin will have a 5x5x5 feet precast concrete box outlet and will be gated with the same features as the coal pile runoff basin outlet. Releases from this detention basin will be gate-controlled to allow for water quality measurements before releasing to the down-gradient channel. This channel will discharge to the Duck Pond.

10. Catch Basin near RCC. There is currently a catch basin near the RCC that drains a very small area. Stormwater flows from the catch basin to the Lacey's Lake Pump Station and is discharged to the lake. In the future, the pump station discharge line will be rerouted to the wastewater collection system. Because this catch basin receives runoff from a small drainage area, Huntington intends to reroute this water directly to the existing wastewater collection system.

Sampling and Residual Waste Removal

This section describes Huntington's approach to residual waste characterization and removal.

Sampling and Analysis

Surface water will be characterized by collecting a single grab sample from Lacey's Lake prior to final waste removal activity. Huntington intends to collect this sample during routine semi-annual ground water monitoring to be conducted in mid-April 2011. The sample will be collected and handled in accordance with the quality considerations and procedures specified in the PacifiCorp Huntington Power Plant Ground Water Discharge Permit Number 150002 (UDEQ, 2009). The sample will be analyzed for the parameters listed in Section I,E,2,(b) of the permit and identified below reference:

- Field Measurements: water level, pH, specific conductance, temperature.
- Laboratory Analysis: TDS, Major Ions (Na, K, Mg, Ca, Cl, SO4, CO3, HCO3), nitrate + nitrite as N, boron.

The purpose of this sample is to determine the expected contaminant concentrations in Lacey's Lake at the time of closure. Sample results will be reported along with results of the routine semiannual groundwater monitoring. Upon completion of the actions described in Section 2.1 and collection of a surface water sample, residual waste material will be removed from Lacey's Lake.

Waste Removal

Huntington intends to remove residual waste from Lacey's Lake in three basic steps. First, accessible surface water impounded in Lacey's Lake will be pumped or otherwise routed to the on-site waste water treatment pond for treatment and reuse. In subsequent waste removal steps water recovery will be optimized to limit contaminant transport through the subsurface.

Next, solids (primarily ash) will be dredged from Lacey's Lake following routine pond maintenance procedures. This will entail removal of solids using a long arm reach excavator. This material will be temporarily staged adjacent to Lacey's Lake prior to transport to the on-site Class III B Industrial Waste Landfill for disposal.

Remaining solids will then be removed using appropriately sized excavation equipment. This will entail preparation of access ramps and removal using a front end loader and dump trucks. This final step in residual waste removal will include excavation of ash from waste handling areas adjacent to Lacey's Lake historically used to manage solids dredged from the pond.

Upon reaching the underlying native material the approximate elevation will be noted. Huntington intends to remove a portion of the underlying native material (approximately two feet) to serve as an additional conservative measure. The waste material (sludge) and underlying soil have different color and texture characteristics which will allow for visual confirmation of removal. Once residual waste material and a portion of the underlying native material have been removed, a final inspection will be conducted based on visual confirmation.

Site Restoration

This section describes Huntington's approach to backfilling the excavated area and elements of site restoration.

Following the removal of residual waste and approximately two feet of underlying native soils, the excavation will be backfilled with a well graded soil (bank run) to establish the proposed final grade depicted in Drawing C-6.1. This will include placement of approximately ten feet or more of well graded soil (bank run). While the total volume of waste material to be removed from Lacey's Lake and adjacent waste handling areas will vary based on maintenance activity prior to closure, Huntington anticipates importing approximately 20,000 cubic yards of soil to complete this action. The proposed final grade is intended to follow the general surface topography of the surrounding area as depicted in Drawing C-6.1. This will result in a finished surface slope of approximately 2.1 percent and will shed surface water from the site. The area will then be reseeded to inhibit erosion. This site restoration is intended return the area to a safe condition suitable for continued industrial use.

SCHEDULE

Huntington has established an internal goal for completing closure of Lacey's Lake through submission of a Closure Report by November 7, 2011. Huntington proposes to complete the actions described above within the general time frames specified below:

1. Huntington intends to submit the Closure Plan Lacey's Lake Pond Area (this document) to DWQ for review and approval by April 23, 2011.

2. Huntington intends to collect the surface water grab sample described in Section 2.2.1 concurrent with routine semi-annual ground water monitoring scheduled for mid-April 2011.

3. Huntington intends to complete advance construction activity to reroute key waste streams and cease all inputs to Lacey's Lake by May 15, 2011.

4. Huntington intends to complete removal of waste material from Lacey's Lake and adjacent waste handling areas by October 10, 2011.

5. Huntington will complete final site grading of the former Lacey's Lake area by November 2, 2011.

6. Huntington will submit a Closure Report to DWQ by November 7, 2011.

REPORTING

Completion of the proposed actions described in this Closure Plan will be documented in a Closure Report and submitted to DWQ. The report will include a brief description of closure activities including any deviations from the approved plan or anomalies encountered during implementation of the Plan. Analytical results of the surface water sample described in Section 2.2.1 will be reported. Estimated quantities of material removed from Lacey's Lake and adjacent waste handling areas will be reported and disposal location noted. Field observations including site photographs of the extent of excavation and final site conditions will be reported.