

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) – REGION III**  
**UNDERGROUND INJECTION CONTROL PERMIT NUMBER PAS2D219BWAR**  
**AUTHORIZATION TO OPERATE CLASS II-D INJECTION WELL**  
EFFECTIVE: OCTOBER 31, 2016 / EFFECTIVE UNTIL: OCTOBER 31, 2026



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

**UNDERGROUND INJECTION CONTROL PERMIT NUMBER PAS2D219BWAR**  
**AUTHORIZATION TO OPERATE CLASS II-D INJECTION WELL**

In compliance with provisions of the Safe Drinking Water Act, as amended, 42 U. S. C. §§ 300f et seq. (SDWA) and the SDWA implementing regulations promulgated by the U. S. Environmental Protection Agency at Parts 144 -147 of Title 40 of the Code of Federal Regulations, this permit authorizes

Bear Lake Properties, LLC  
3000 Village Run Road, Unit 103, #223  
Wexford, Pennsylvania 15090

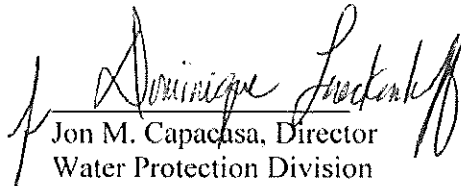
to convert the Smith-Ras #1 well into a Class II-D commercial brine disposal Injection Well (hereinafter, "Injection Well" or "Facility") and to operate the Injection Well for the purpose of injecting fluids produced in association with oil and gas production operations in accordance with the provisions of this permit. The Injection Well will be located in Columbus Township, Warren County, Pennsylvania. The coordinates for the Injection Well are: Latitude 41° 59' 33.8" and Longitude -79° 32' 01.9".

All references to Title 40 of the Code of Federal Regulations (C.F.R.) are to all regulations that are in effect on the date that this permit is effective.

This permit shall become effective on OCTOBER 31, 2016.

This permit shall remain in effect until midnight OCTOBER 31, 2026.

Signed this 31<sup>st</sup> day of OCTOBER, 2016.

  
Jon M. Capacasa, Director  
Water Protection Division

## PART I

## A. Effect of a Permit

Bear Lake Properties, LLC (the "Permittee") is allowed to engage in underground injection at the Injection Well in accordance with the conditions of this permit. The Permittee shall not allow the underground injection activity, otherwise authorized by this permit, to cause or contribute to the movement of fluid containing any contaminant into any underground source(s) of drinking water (USDW), if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 C.F.R. Part 141 or if it may otherwise adversely affect the health of persons. Any underground injection activity not authorized in this permit or otherwise authorized by permit or rule is prohibited. Issuance of this permit does not convey property rights or mineral rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of State or local law or regulations. Compliance with the terms of this permit does not constitute a defense to any action brought under Part C or D of the SDWA, 42 U.S.C. §§ 300f-300j-11, or any other common or statutory law for any breach of any other applicable legal duty.

## B. Permit Actions

This permit can be modified, revoked and reissued, or terminated for cause or upon request as specified in 40 C.F.R. §§ 144.12, 144.39 and 144.40. Also, the permit is subject to minor modifications as specified in 40 C.F.R. § 144.41. The filing of a request for a permit modification, revocation and reissuance, or termination, or the notification of planned changes, or anticipated noncompliance on the part of the Permittee shall not stay the applicability or enforceability of any permit condition.

## C. Severability

The provisions of this permit are severable, and if any provision of this permit or the Permittee's application, dated March 24, 2015, and the supplemental submission dated July 17, 2015, collectively referred to as the "Application", is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

## D. General Requirements

1. Duty to Comply. The Permittee shall comply with all applicable UIC regulations, including 40 C.F.R. Parts 124, and 144-147, and with the conditions of this permit, except to the extent and for the duration that EPA authorizes any noncompliance in an emergency permit issued under 40 C.F.R. §144.34. Any permit noncompliance constitutes a violation of the SDWA and is grounds for

enforcement action, permit termination, revocation and reissuance or modification, or for denial of a permit renewal application.

2. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for the 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.
3. Duty to Mitigate. The Permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.
4. 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 includes effective performance, adequate funding, adequate operator staffing and training, adequate security to prevent unauthorized access and operation of the Injection Well and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this permit.
5. Duty to Provide Information. The Permittee shall furnish to the Director of the Water Protection Division ("Director"), within a time specified by the Director, any information which the Director 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 Director, upon request, copies of records required to be kept by this permit. If the Permittee becomes aware of any incomplete or incorrect information in the Permit Application or subsequent reports, the Permittee shall promptly submit information addressing these deficiencies.
6. Inspection and Entry. The Permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by the law to:
  - a. Enter upon the Permittee's premises where the Facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
  - b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

- c. Inspect, at reasonable times, the Facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
  - d. Sample or monitor at reasonable times any substances or parameters at any location for the purposes of assuring permit compliance or as otherwise authorized by the SDWA.
- 7. Penalties. Any person who violates a requirement of this permit is subject to administrative or civil penalties, fines and other enforcement actions under the SDWA. Any person who willfully violates conditions of this permit is subject to criminal prosecution.
- 8. Transfer of Permits. This permit is not transferable to any person except after notice is sent on EPA Form 7520-7, approval is received from the Director, and the requirements of 40 C.F.R. § 144.38 are satisfied. The Director may require modification or revocation of the permit to change the name of the Permittee and incorporate such other requirements as may be necessary under the SDWA or its implementing regulations. The transferee is not authorized to inject under this Permit unless and until the Director notifies the transferee that the transferee is so authorized through issuance of a revised permit identifying the transferee as the permittee.
- 9. Signatory Requirements.
  - a. The Permittee shall sign all reports required by this permit and other information requested by the Director as follows:
    - (1) for a corporation, by a responsible corporate officer of at least the level of vice-president;
    - (2) for a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
    - (3) for a Municipality, State, Federal, or other public agency by either a principal executive officer or a ranking elected official.
  - b. A duly-authorized representative of the person designated in paragraph a. above may also sign only if:
    - (1) the authorization is made in writing by a person described in paragraph a. above;

- (2) the authorization specifies 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, or a position of equivalent responsibility. A duly authorized representative may thus be either a named individual or any individual occupying a named position; and
- (3) the written authorization is submitted to the Director.
- c. If an authorization under paragraph b. of this section 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 paragraph b. of this section must be submitted to the Director prior to or together with any reports, information or applications to be signed by an authorized representative.
- d. Any person signing a document under paragraph a. or b. of this section shall make the following certification:

"I certify under the 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(s) 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."

10. Confidentiality of Information.

- a. In accordance with 40 C.F.R. Parts 2 (Public Information), and § 144.5, any information submitted to the Director pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted at the time of submission by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of submission, EPA may make the information available to the public without further notice. If a claim is asserted, the information will be treated in accordance with the procedures in 40 C.F.R. Part 2.
- b. EPA will deny any claims of confidentiality for the following information:
  - (1) The name and address of any permit applicant or permittee.

- (2) Information which deals with the existence, absence, or level of contaminants in drinking water.
- 11. Reapplication. If the permittee wishes to continue an activity regulated by this permit after the expiration date of the permit, the permittee must submit a complete application for a new permit at least 100 days before this permit expires.
- 12. 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, or penalties established pursuant to any applicable State law or regulation.

## PART II

### A. General

The Permittee shall sign and certify copies of all reports and notifications required by this permit in accordance with the requirements of paragraph I.D.9 of this Permit and shall submit such information to the Director at the following address:

Ground Water & Enforcement Branch (3WP22)  
Office of Drinking Water and Source Water Protection  
U. S. Environmental Protection Agency  
Region III  
1650 Arch Street  
Philadelphia, Pennsylvania 19103

### B. Record Retention

- 1. The Permittee shall retain records of all monitoring and other information required by this permit, including the following (if applicable), for a period of at least five years from the date of the sample, measurement, report or application, unless such records are required to be retained for a longer period of time under paragraph II. B.2 below. This period may be extended by the Director at any time. If the period is extended, the Permittee shall comply with the new period.
  - a. All data required to complete the Permit Application form for this permit and any supplemental information submitted under 40 C.F.R. § 144.31;
  - b. Calibrations and maintenance records and all original strip chart recordings for continuous monitoring instrumentation;
  - c. Copies of all reports required by this permit;

2. The Permittee shall retain records concerning the nature and composition of all injected fluids, as listed in paragraphs II.C.4 and C.5 of this permit, until at least three years after the plugging and abandonment procedures are complete. The Permittee shall continue to retain these records after the three year retention period unless he or she delivers the records to the Director or obtains written approval from the Director to discard the records.
3. Records of monitoring information shall include:
  - a. The date, exact place, and the time of sampling or measurements;
  - b. The individual(s) who performed the sampling or measurements;
  - c. A precise description of both sampling methodology and the handling (custody) of samples;
  - d. The date(s) analyses were performed;
  - e. The individual(s) who performed the analyses;
  - f. The analytical techniques or methods used;
  - g. The results of such analyses.

C. Monitoring Requirements

1. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The Permittee shall obtain representative sample(s) of the fluid to be analyzed and conduct analysis(es) of the sample(s) in accordance with the approved methods and test procedures provided in 40 C.F.R. § 136.3 and EPA's SW-846 Compendium, or methods and test procedures otherwise approved by the Director. The Permittee shall identify in its monitoring records the types of tests and methods used to generate the monitoring data.
2. The Permittee shall continuously monitor and record surface injection pressure, annular pressure, flow rate and cumulative volume in the Injection Well beginning on the date the Injection Well commences operation and concluding when the Injection Well is plugged and abandoned. The Permittee shall compile the monitoring data monthly to complete the Annual Report referenced in paragraph II.D.8 of this permit.
3. The Permittee shall also monitor and record semi-annually the fluid level of all of the following depleted gas production wells identified in the Application:



- a. R. Trisket #1, located approximately 4200 ft. northwest of the Injection Well;
- b. R. Trisket #2, located approximately 3700 ft. to the west of the Injection Well;
- c. T. Reed #4, located approximately 1500 ft. to the southwest of the Injection Well;
- d. D. Wright #1, located approximately 2,000 ft. to the east of the Injection Well;  
and
- e. R. Craker #1, located approximately 3700 ft. northeast of the Injection Well.

In the event that in the future the T. Reed #4 is converted from a monitoring well to a UIC-Permitted well, upon issuance of the UIC permit for T. Reed #4, the Permittee will use both the W.W. Hammond #1 and the T. Reed #2 wells as replacement monitoring wells for the T. Reed #4.

If fluid levels in any of the monitoring wells listed above is observed to rise within 100 feet of the base of the USDW, the Permittee shall stop disposal operations immediately, and shall notify the EPA orally (phone numbers: (215) 814-5469 or (215) 814-5498) within 24 hours of the observation and shall send written notification to EPA within 5 days of the observation. EPA will evaluate the operating conditions in order to instruct the Permittee on how to control the fluid level.

If the fluid level in a monitoring wells is observed to rise within 100 feet of the top of cement of the long-string casing, that is, it rises to the depth listed in the table below, the permittee shall stop injection operations immediately, and shall notify the EPA orally (phone numbers: (215) 814-5469 or (215) 814-5498) within 24 hours of the observation and shall send written notification to EPA within 5 days of the observation. The permittee shall demonstrate mechanical integrity of the monitoring well where fluid reached the trigger depth prior to resuming injection. The MIT test will be required on that monitoring well every two years thereafter.

Monitor Well	Depth of Well (ft)	Top of Cement (Depth - Thickness) (ft)	MIT Trigger Depth(ft)
Craker 1	4584	3418	3318
Hammond 1	4676	3510	3410
Reed 2	4553	3387	3287
Reed 4	4566	3530	3430
Trisket 1	4432	2956	2856
Trisket 2	4429	3082	2982
Wright 1	4479	3313	3213

4. The Permittee shall monitor the nature and composition of the injected fluid by sampling, analyzing and recording the injected fluid for the parameters listed below, at the initiation of the injection operation and every two years thereafter, and whenever the operator anticipates a change in the injection fluid (e.g., from different geologic formations, geographic regions, different customers, etc.).

- pH
- Specific Gravity
- Manganese
- Total Dissolved Solids

- Specific Conductance
- Sodium
- Chloride
- Iron
- Magnesium
- Total Organic Carbon (TOC)
- Barium
- Hydrogen Sulfide
- Alkalinity
- Dissolved Oxygen
- Hardness

5. The Permittee shall measure the specific gravity of each truckload prior to unloading.
6. The Permittee shall verbally report to the Director analytical results for specific gravity that are greater than 1.218 or for TOC greater than 250 mg/l within twenty-four hours of obtaining the results.
7. The Permittee shall make a demonstration of mechanical integrity in accordance with 40 C.F.R. § 146.8, after the initial demonstration, at least once every two (2) years. Subsequent two (2) year demonstrations shall be conducted no more than thirty (30) days prior to the anniversary date of the issuance of this permit. In addition to the above requirement, the Permittee shall conduct a mechanical integrity test demonstration on the Injection Well when the protective casing or tubing is removed from the well, the packer is resealed, or a well failure is likely, or as requested by the Director. The Permittee may continue operation of the Injection Well only if the Permittee has demonstrated the mechanical integrity of the Injection Well to the Director's satisfaction. The Permittee shall cease injection operations if a loss of mechanical integrity becomes evident or if the Permittee cannot demonstrate mechanical integrity. The Injection Well shall be equipped with an automatic shut-off device which would be activated in the event of a mechanical integrity failure.
8. The Permittee shall perform all environmental measurements required by the permit, including, but not limited to: measurements of pressure, temperature, mechanical integrity (as applicable) and chemical analyses in accordance with EPA guidance on quality assurance.
9. The Permittee shall maintain a record of every load of fluid received. The record shall include the hauler's name, the producing well operator's name, and the location from which the load was obtained, the volume of the load and whether the load of fluid delivered was a split load. If the load was a split load, each operator's name and location shall be listed and the volumes from each operator documented.

D. Reporting and Notification Requirements

1. Report on Permit Review. Within 30 days of receipt of this permit, the Permittee shall ensure the person designated pursuant to paragraph I.D.9 of this permit

reports to the Director that he or she has read and is personally familiar with all terms and conditions of this permit.

2. Commencing Injection. The Permittee shall not commence injection until construction or well rework is complete and all of the following conditions have been satisfied:
  - a. The Permittee has submitted notice of completion of construction (EPA Form 7520-10) to the Director;
  - b. The Permittee has demonstrated to EPA that the Injection Well has mechanical integrity in accordance with 40 C.F.R. § 146.8 and the Permittee has received written notice from the Director that such demonstration is satisfactory; and
    - (1) The Director has inspected or otherwise reviewed the Injection Well and finds it is in compliance with the conditions of this permit; or
    - (2) The Permittee has not received notice from the Director of his or her intent to inspect or otherwise review the Injection Well within 13 days of the date of the notice in paragraph II.D.2.a of this permit, in which case, prior inspection or review is waived and the Permittee may commence injection.
3. Twenty-four Hour Reporting.
  - a. The Permittee shall report to the Director any noncompliance which may endanger, or has endangered, health or the environment. The Permittee shall provide such report orally (phone numbers: (215) 814-5469 or (215) 814-5498) within 24 hours from the time the Permittee becomes aware of the circumstances. The Permittee shall include the following information in the oral report:
    - (1) Any monitoring or other information which indicates that any contaminant may endanger, or has endangered an underground source of drinking water.
    - (2) Any noncompliance with a permit condition, malfunction of the injection system which may cause, or has caused, fluid migration into or between underground sources of drinking water, or failure of mechanical integrity test demonstrations.

- b. The Permittee shall provide a written submission within five days of the time the Permittee becomes aware of the circumstances described above. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
- 4. Anticipated Noncompliance. The Permittee shall give advance notice to the Director of any planned changes in the permitted Facility or activity which may result in noncompliance with permit requirements.
- 5. Other Noncompliance. The Permittee shall report all other instances of noncompliance to the Director in writing within ten (10) days of the time the Permittee becomes aware of the circumstances. The report shall contain the information listed in paragraph II.D.3 of this permit.
- 6. Planned Changes. The Permittee shall provide written notice to the Director as soon as possible of any planned physical alterations or additions to the permitted Facility.
- 7. Conversion. The Permittee shall provide written notice to the Director 30 days prior to the conversion of the Injection Well to an operating status other than an injection well.
- 8. Annual Report. The Permittee shall submit a written Annual Report to the Director summarizing the results of the monitoring required in Permit Condition C of Part II of this permit. This report shall include monthly monitoring records of injected fluids, the results of any mechanical integrity test(s), and any major changes in characteristics or sources of injected fluids. The report shall list the additives used in the operation of the well. The Permittee shall complete and submit this information with its Annual Report EPA Form 7520-11 (Annual Disposal Injection Well Monitoring Report). The Permittee shall submit the Annual Report to the Director no later than January 31st of each year, summarizing the activity of the calendar year ending the previous December 31st.
- 9. Plugging and Abandonment Reports and Notifications.
  - a. The Permittee shall notify the Director in writing at least 45 days before plugging and abandonment of the Injection Well as described in condition in Part III.C of this permit. The Director may allow a shorter notice period upon written request.

- b. The Permittee shall submit any revisions to the Plugging and Abandonment Plan attached to and incorporated into this permit (Attachment 1) to the Director no less than 45 days prior to plugging and abandonment on EPA Plugging and Abandonment Form 7520-14. The Permittee shall not commence plugging and abandonment until it receives written approval of the revisions to the Plan from the Director.
  - c. To the extent that any unforeseen circumstances occur during plugging and abandonment of the Injection Well that cause the Permittee to believe the Plugging and Abandonment Plan should be modified, the Permittee shall obtain written approval from EPA of any changes to the Plugging and Abandonment Plan prior to plugging the Injection Well.
  - d. Within 60 days after plugging the Injection Well, the Permittee shall submit a Plugging and Abandonment Report to the Director which shall consist of either:
    - (i) A statement that the Injection Well was plugged in accordance with the EPA approved Plugging and Abandonment Plan; or
    - (ii) Where actual plugging differed from the Plugging and Abandonment Plan previously submitted, the Permittee shall provide to the Director an updated version of form 7520-14 specifying the different procedures used.
  - e. The Permittee shall ensure that the Plugging and Abandonment Report is certified as accurate by the person who performed the plugging operation.
10. Compliance Schedules. The Permittee shall submit reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit no later than 30 days following each schedule date.
11. Mechanical Integrity Tests. The Permittee shall notify the Director in writing at least 30 days prior to conducting Mechanical Integrity Testing on the Injection Well.
12. Cessation of Injection Activity. Two years after the Permittee has ceased injection into the Injection Well, the Permittee shall plug and abandon the Injection Well in accordance with the Plugging and Abandonment Plan unless the Permittee:
- a. Provides written notice to the Director describing actions and/or procedures, necessary to ensure that the Injection Well will not endanger

any USDW during the period of temporary abandonment. These actions and procedures shall include compliance with the requirements of this permit applicable to active injection wells unless waived, in writing, by the Director;

- b. Receives approval from the Director that the actions and/or procedures described in the notice are satisfactory; and
- c. Implements such EPA approved actions and/or procedures.

E. Mechanical Integrity

- 1. Standards. The Permittee shall maintain the mechanical integrity of the permitted Injection Well pursuant to 40 C.F.R. § 146.8.
- 2. Request from Director. The Director may by written notice require the Permittee to demonstrate mechanical integrity at any time during the term of this permit and the Permittee shall comply with the Director's request.

Part III

A. Construction Requirements

- 1. Confining Zone. Notwithstanding any other provision of this permit, the Permittee shall inject through the Injection Well only into a formation which is separated from any Underground Source of Drinking Water by a confining zone, as defined in 40 C.F.R. § 146.3, that is free of known open faults or fractures within the Area of Review as required in 40 C.F.R. § 146.22.
- 2. Casing and Cementing. The Permittee shall:
  - a. ensure the Injection Well is cased and cemented to prevent the movement of fluids into or between underground sources of drinking water and in accordance with 40 C.F.R. §§ 146.22 and 147.1955(b);
  - b. ensure the casing and cement used in the Injection well are designed for the life expectancy of the well;
  - c. ensure the Injection Well has surface casing installed from the surface to 406 feet below land surface and cemented back to the surface;
  - d. ensure the Injection Well has long string casing installed from the surface to 4493 feet and cemented back to approximately 2959 feet below land surface to isolate the injection zone; and

e. install in the Injection Well a tubing string set on a packer placed above the injection zone's perforated interval at approximately 4182 feet.

3. Logs and Tests. In accordance with 40 C.F.R. § 146.22(f), the Permittee shall prepare logs and perform tests as follows during the construction or rework of the Injection Well: electric, gamma ray and caliper logs in the open hole, a cement bond, temperature or density log on the surface casing (if cement returns are not achieved), and a cement bond log/variable density log on the long string casing. The Permittee shall submit to the Director, for the Injection Well, cement records, a narrative report that interprets the well log(s) and test results, which specifically relate to the results of the cementing operation, and a detailed description of the rationale used to make these interpretations. The narrative report shall be prepared by a knowledgeable log analyst and submitted to the Director. The Director may prescribe additional logs or waive logging requirements in the future should field conditions so warrant.
4. Mechanical Integrity. The Permittee is prohibited from conducting injection operations in the Injection Well until it (i) demonstrates the mechanical integrity of the Injection Well in accordance with 40 C.F.R. § 146.8 and (ii) receives notice from the Director that such a demonstration is satisfactory in accordance with paragraph II.D.2 of this permit.
5. Corrective Action. The Permittee is prohibited from conducting injection operations in the Injection Well until it has plugged all abandoned wells identified within the area of review. If an abandoned well is discovered within the one-quarter mile area of review as identified in the Permit Application, the permittee shall notify the Director upon discovery and within five (5) days of discovery submit to the Director for approval a plan for corrective action and implement the approved plan.
6. Completion Reports. The Permittee shall prepare a written Completion Report that summarizes the activities and the results of the testing required in Condition A.1 through 5 of Part III of this permit and submit the Completion Report to the Director prior to the commencement of injection operations.

B. Operating Requirements

1. Injection Formation. The Permittee shall inject only into the Grimsby, Power Glen, and Whirlpool sandstone of the Medina Group located in the subsurface interval between approximately 4222 feet and 4396 feet below surface elevation.
2. Injection Fluid. The Permittee shall not inject any hazardous waste as defined in 40 C.F.R. Part 261 or any fluid, other than fluids produced solely in association

with oil and gas production operations and additives necessary to maintain the integrity of the well.

3. Injection Volume Limitation. Injection volume shall not exceed 22,500 barrels per month. A barrel consists of 42 gallons.
4. Injection Pressure Limitation. The Permittee shall not exceed a surface injection pressure maximum of 1716 psi and a bottom-hole injection pressure maximum of 4032psi. These pressures were calculated based on a maximum injection fluid specific gravity of 1.218. If the specific gravity of the injection fluid exceeds 1.218, then the Permittee shall reduce the surface injection pressure by an amount necessary to avoid exceeding the bottom-hole pressure maximum. The Permittee shall not inject fluid at a pressure which initiates fractures in the confining zone, as defined in 40 C.F.R. § 146.3, adjacent to underground sources of drinking water (USDW) or causes the movement of injection or formation fluids into an USDW.
5. The Permittee shall inject fluids into the well through the tubing string installed inside the long string casing. The Permittee is prohibited from injecting between the outermost casing protecting the USDW and the well bore, and also from injecting into any USDW.

C. Plugging and Abandonment.

1. Plugging and Abandonment. The Permittee shall plug and abandon the Injection Well as provided in the EPA approved Plugging and Abandonment Plan (EPA Form 7520-14) (Attachment 1).
2. The Permittee shall plug and abandon the Injection Well in such a manner that fluids shall not move into or between USDWs.

D. Financial Responsibility

1. The Permittee shall maintain continuous compliance with the requirement to maintain financial responsibility and resources to close, plug and abandon the Injection Well in accordance with 40 C.F.R. § 144.52(a)(7) in the amount of at least \$23,383. The well may not be constructed, reworked or operated if the financial responsibility for that well has not been established. Further, the Permittee must provide documentation to the Director that financial responsibility has been established for the Injection Well prior to construction, rework or operation. The Permittee will provide a Letter of Credit and Standby Trust Agreement assuring the plugging costs for the Injection Well. The Permittee shall not substitute this Letter of Credit with an alternative demonstration of financial responsibility, unless it has previously submitted evidence of that alternative



demonstration to the Director and the Director notifies it that the alternative demonstration of financial responsibility is acceptable. The Director may require the Permittee to submit a revised demonstration of financial responsibility if the Director has reason to believe that the original demonstration is no longer adequate to cover the costs of plugging and abandonment.

2. Insolvency of Financial Institution. In the event of the bankruptcy of the trustee or issuing institution of the financial mechanism, or a suspension or revocation of the authority of the trustee institution to act as a trustee or the institution issuing the financial mechanism to issue such an instrument, the Permittee must immediately notify the Director in writing and submit an alternative demonstration of financial responsibility acceptable to the Director within sixty days after such an event.

**USEPA APPROVED PERMIT APPLICATION AND RELATED DOCUMENTS**



**TETRA TECH**

**BRINE DISPOSAL WELL PERMIT APPLICATION  
SMITH-RAS UNIT #1**

**Bear Lake Properties, LLC**

**February 2015**

complex world

**CLEAR SOLUTIONS™**

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**Section 11 – Plan for Well Failures**

**Appendix A – Surrounding Landowner Information**

<div style="margin-top: 10px;"> <b>United States Environmental Protection Agency</b>  <b>Underground Injection Control</b>  <b>Permit Application</b>  <i>(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)</i> </div>		I. EPA ID Number															
			T/A	C													
Read Attached Instructions Before Starting For Official Use Only																	
Application approved mo    day    year	Date received mo    day    year	Permit Number	Well ID	FINDS Number													
<div style="border: 1px solid black; height: 20px;"></div>	<div style="border: 1px solid black; height: 20px;"></div>	<div style="border: 1px solid black; height: 20px;"></div>	<div style="border: 1px solid black; height: 20px;"></div>	<div style="border: 1px solid black; height: 20px;"></div>													
II. Owner Name and Address		III. Operator Name and Address															
Owner Name Bear Lake Properties, LLC		Owner Name Bear Lake Properties, LLC															
Street Address 3000 Village Run Road, Unit 103, #223		Street Address 3000 Village Run Road, Unit 103, #223															
Phone Number (724) 444-7501		Phone Number (724) 444-7501															
City Wexford	State PA	ZIP CODE 15090	City Wexford	State PA													
ZIP CODE 15090		ZIP CODE 15090															
IV. Commercial Facility		V. Ownership		VI. Legal Contact													
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		<input checked="" type="checkbox"/> Private <input type="checkbox"/> Federal <input type="checkbox"/> Other		<input type="checkbox"/> Owner <input checked="" type="checkbox"/> Operator													
VII. SIC Codes																	
1389 - Oil and Gas Field Services, Not Elsewhere Classified																	
VIII. Well Status (Mark "x")																	
<input type="checkbox"/> A. Operating	Date Started mo    day    year <div style="border: 1px solid black; height: 20px;"></div>		<input checked="" type="checkbox"/> B. Modification/Conversion	<input type="checkbox"/> C. Proposed													
IX. Type of Permit Requested (Mark "x" and specify if required)																	
<input checked="" type="checkbox"/> A. Individual	<input type="checkbox"/> B. Area	Number of Existing Wells <div style="border: 1px solid black; padding: 2px;">1</div>	Number of Proposed Wells <div style="border: 1px solid black; height: 20px;"></div>	Name(s) of field(s) or project(s) Smith-Ras Unit #1													
X. Class and Type of Well (see reverse)																	
A. Class(es) (enter code(s))  II	B. Type(s) (enter code(s))  D	C. If class is "other" or type is code 'x,' explain <div style="border: 1px solid black; height: 40px;"></div>		D. Number of wells per type (if area permit) <div style="border: 1px solid black; height: 40px;"></div>													
XI. Location of Well(s) or Approximate Center of Field or Project				XII. Indian Lands (Mark "x")													
Latitude		Longitude		Township and Range													
Deg	Min	Sec	Deg	Min	Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line				
41	59	33.8	-79	32	01.9												
														<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			
XIII. Attachments																	
(Complete the following questions on a separate sheet(s) and number accordingly; see instructions) For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.																	
XIV. Certification																	
I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32)																	
A. Name and Title (Type or Print)												B. Phone No. (Area Code and No.)					
Karl Kimmich, President												(724) 444-7501					
C. Signature												D. Date Signed					
<div style="border: 1px solid black; height: 20px;"></div>												<div style="border: 1px solid black; height: 20px;"></div>					

## Well Class and Type Codes

**Class I** Wells used to inject waste below the deepest underground source of drinking water.

**Type** "I" Nonhazardous industrial disposal well  
 "M" Nonhazardous municipal disposal well  
 "W" Hazardous waste disposal well injecting below USDWs  
 "X" Other Class I wells (not included in Type "I," "M," or "W")

**Class II** Oil and gas production and storage related injection wells.

**Type** "D" Produced fluid disposal well  
 "R" Enhanced recovery well  
 "H" Hydrocarbon storage well (excluding natural gas)  
 "X" Other Class II wells (not included in Type "D," "R," or "H")

**Class III** Special process injection wells.

**Type** "G" Solution mining well  
 "S" Sulfur mining well by Frasch process  
 "U" Uranium mining well (excluding solution mining of conventional mines)  
 "X" Other Class III wells (not included in Type "G," "S," or "U")

**Other Classes** Wells not included in classes above.  
 Class V wells which may be permitted under §144.12.  
 Wells not currently classified as Class I, II, III, or V.

## Attachments to Permit Application

<b>Class</b>	<b>Attachments</b>
I new well	A, B, C, D, F, H – S, U
existing	A, B, C, D, F, H – U
II new well	A, B, C, E, G, H, M, Q, R; optional – I, J, K, O, P, U
existing	A, E, G, H, M, Q, R, – U; optional – J, K, O, P, Q
III new well	A, B, C, D, F, H, I, J, K, M – S, U
existing	A, B, C, D, F, H, J, K, M – U
Other Classes	To be specified by the permitting authority

## INSTRUCTIONS - Underground Injection Control (UIC) Permit Application

**Paperwork Reduction Act:** The public reporting and record keeping burden for this collection of information is estimated to average 224 hours for a Class I hazardous well application, 110 hours for a Class I non-hazardous well application, 67 hours for a Class II well application, and 132 hours for a Class III well application. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW, Washington, DC 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

This form must be completed by all owners or operators of Class I, II, and III injection wells and others who may be directed to apply for permit by the Director.

- I. **EPA I.D. NUMBER** - Fill in your EPA Identification Number. If you do not have a number, leave blank.
- II. **OWNER NAME AND ADDRESS** - Name of well, well field or company and address.
- III. **OPERATOR NAME AND ADDRESS** - Name and address of operator of well or well field.
- IV. **COMMERCIAL FACILITY** - Mark the appropriate box to indicate the type of facility.
- V. **OWNERSHIP** - Mark the appropriate box to indicate the type of ownership.
- VI. **LEGAL CONTACT** - Mark the appropriate box.
- VII. **SIC CODES** - List at least one and no more than four Standard Industrial Classification (SIC) Codes that best describe the nature of the business in order of priority.
- VIII. **WELL STATUS** - Mark Box A if the well(s) were operating as injection wells on the effective date of the UIC Program for the State. Mark Box B if wells(s) existed on the effective date of the UIC Program for the State but were not utilized for injection. Box C should be marked if the application is for an underground injection project not constructed or not completed by the effective date of the UIC Program for the State.
- IX. **TYPE OF PERMIT** - Mark "Individual" or "Area" to indicate the type of permit desired. Note that area permits are at the discretion of the Director and that wells covered by an area permit must be at one site, under the control of one person and do not inject hazardous waste. If an area permit is requested the number of wells to be included in the permit must be specified and the wells described and identified by location. If the area has a commonly used name, such as the "Jay Field," submit the name in the space provided. In the case of a project or field which crosses State lines, it may be possible to consider an area permit if EPA has jurisdiction in both States. Each such case will be considered individually, if the owner/operator elects to seek an area permit.
- X. **CLASS AND TYPE OF WELL** - Enter in these two positions the Class and type of injection well for which a permit is requested. Use the most pertinent code selected from the list on the reverse side of the application. When selecting type X please explain in the space provided.
- XI. **LOCATION OF WELL** - Enter the latitude and longitude of the existing or proposed well expressed in degrees, minutes, and seconds or the location by township, and range, and section, as required by 40 CFR Part 146. If an area permit is being requested, give the latitude and longitude of the approximate center of the area.
- XII. **INDIAN LANDS** - Place an "X" in the box if any part of the facility is located on Indian lands.
- XIII. **ATTACHMENTS** - Note that information requirements vary depending on the injection well class and status. Attachments for Class I, II, III are described on pages 4 and 5 of this document and listed by Class on page 2. Place EPA ID number in the upper right hand corner of each page of the Attachments.
- XIV. **CERTIFICATION** - All permit applications (except Class II) must be signed by a responsible corporate officer for a corporation, by a general partner for a partnership, by the proprietor of a sole proprietorship, and by a principal executive or ranking elected official for a public agency. For Class II, the person described above should sign, or a representative duly authorized in writing.

## INSTRUCTIONS - Attachments

Attachments to be submitted with permit application for Class I, II, III and other wells.

- A. AREA OF REVIEW METHODS** - Give the methods and, if appropriate, the calculations used to determine the size of the area of review (fixed radius or equation). The area of review shall be a fixed radius of 1/4 mile from the well bore unless the use of an equation is approved in advance by the Director.
- B. MAPS OF WELL/AREA AND AREA OF REVIEW** - Submit a topographic map, extending one mile beyond the property boundaries, showing the injection well(s) or project area for which a permit is sought and the applicable area of review. The map must show all intake and discharge structures and all hazardous waste treatment, storage, or disposal facilities. If the application is for an area permit, the map should show the distribution manifold (if applicable) applying injection fluid to all wells in the area, including all system monitoring points. Within the area of review, the map must show the following:

### **Class I**

The number, or name, and location of all producing wells, injection wells, abandoned wells, dryholes, surface bodies of water, springs, mines (surface and subsurface), quarries, and other pertinent surface features, including residences and roads, and faults, if known or suspected. In addition, the map must identify those wells, springs, other surface water bodies, and drinking water wells located within one quarter mile of the facility property boundary. Only information of public record is required to be included in this map;

### **Class II**

In addition to requirements for Class I, include pertinent information known to the applicant. This requirement does not apply to existing Class II wells;

### **Class III**

In addition to requirements for Class I, include public water systems and pertinent information known to the applicant.

- C. CORRECTIVE ACTION PLAN AND WELL DATA** - Submit a tabulation of data reasonably available from public records or otherwise known to the applicant on all wells within the area of review, including those on the map required in B, which penetrate the proposed injection zone. Such data shall include the following:

### **Class I**

A description of each well's types, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require. In the case of new injection wells, include the corrective action proposed to be taken by the applicant under 40 CFR 144.55.

### **Class II**

In addition to requirement for Class I, in the case of Class II wells operating over the fracture pressure of the injection formation, all known wells within the area of review which penetrate formations affected by the increase in pressure. This requirement does not apply to existing Class II wells.

### **Class III**

In addition to requirements for Class I, the corrective action proposed under 40 CFR 144.55 for all Class III wells.

- D. MAPS AND CROSS SECTION OF USDWs** - Submit maps and cross sections indicating the vertical limits of all underground sources of drinking water within the area of review (both vertical and lateral limits for Class I), their position relative to the injection formation and the direction of water movement, where known, in every underground source of drinking water which may be affected by the proposed injection. (Does not apply to Class II wells.)



- E. NAME AND DEPTH OF USDWs (CLASS II)** - For Class II wells, submit geologic name, and depth to bottom of all underground sources of drinking water which may be affected by the injection.
- F. MAPS AND CROSS SECTIONS OF GEOLOGIC STRUCTURE OF AREA** - Submit maps and cross sections detailing the geologic structure of the local area (including the lithology of injection and confining intervals) and generalized maps and cross sections illustrating the regional geologic setting. (Does not apply to Class II wells.)
- G. GEOLOGICAL DATA ON INJECTION AND CONFINING ZONES (Class II)** - For Class II wells, submit appropriate geological data on the injection zone and confining zones including lithologic description, geological name, thickness, depth and fracture pressure.
- H. OPERATING DATA** - Submit the following proposed operating data for each well (including all those to be covered by area permits): (1) average and maximum daily rate and volume of the fluids to be injected; (2) average and maximum injection pressure; (3) nature of annulus fluid; (4) for Class I wells, source and analysis of the chemical, physical, radiological and biological characteristics, including density and corrosiveness, of injection fluids; (5) for Class II wells, source and analysis of the physical and chemical characteristics of the injection fluid; (6) for Class III wells, a qualitative analysis and ranges in concentrations of all constituents of injected fluids. If the information is proprietary, maximum concentrations only may be submitted, but all records must be retained.
- I. FORMATION TESTING PROGRAM** - Describe the proposed formation testing program. For Class I wells the program must be designed to obtain data on fluid pressure, temperature, fracture pressure, other physical, chemical, and radiological characteristics of the injection matrix and physical and chemical characteristics of the formation fluids.  
  
For Class II wells the testing program must be designed to obtain data on fluid pressure, estimated fracture pressure, physical and chemical characteristics of the injection zone. (Does not apply to existing Class II wells or projects.)  
  
For Class III wells the testing must be designed to obtain data on fluid pressure, fracture pressure, and physical and chemical characteristics of the formation fluids if the formation is naturally water bearing. Only fracture pressure is required if the program formation is not water bearing. (Does not apply to existing Class III wells or projects.)
- J. STIMULATION PROGRAM** - Outline any proposed stimulation program.
- K. INJECTION PROCEDURES** - Describe the proposed injection procedures including pump, surge, tank, etc.
- L. CONSTRUCTION PROCEDURES** - Discuss the construction procedures (according to §146.12 for Class I, §146.22 for Class II, and §146.32 for Class III) to be utilized. This should include details of the casing and cementing program, logging procedures, deviation checks, and the drilling, testing and coring program, and proposed annulus fluid. (Request and submission of justifying data must be made to use an alternative to packer for Class I.)
- M. CONSTRUCTION DETAILS** - Submit schematic or other appropriate drawings of the surface and subsurface construction details of the well.
- N. CHANGES IN INJECTED FLUID** - Discuss expected changes in pressure, native fluid displacement, and direction of movement of injection fluid. (Class III wells only.)
- O. PLANS FOR WELL FAILURES** - Outline contingency plans (proposed plans, if any, for Class II) to cope with all shut-ins or wells failures, so as to prevent migration of fluids into any USDW.
- P. MONITORING PROGRAM** - Discuss the planned monitoring program. This should be thorough, including maps showing the number and location of monitoring wells as appropriate and discussion of monitoring devices, sampling frequency, and parameters measured. If a manifold monitoring program is utilized, pursuant to §146.23(b)(5), describe the program and compare it to individual well monitoring.
- Q. PLUGGING AND ABANDONMENT PLAN** - Submit a plan for plugging and abandonment of the well including: (1) describe the type, number, and placement (including the elevation of the top and bottom) of plugs to be used; (2) describe the type, grade, and quantity of cement to be used; and (3) describe the method to be used to place plugs, including the method used to place the well in a state of static equilibrium prior to placement of the plugs. Also for a Class III well that underlies or is in an exempted aquifer, demonstrate adequate protection of USDWs. Submit this information on EPA Form 7520-14, Plugging and Abandonment Plan.

- R. **NECESSARY RESOURCES** - Submit evidence such as a surety bond or financial statement to verify that the resources necessary to close, plug or abandon the well are available.
- S. **AQUIFER EXEMPTIONS** - If an aquifer exemption is requested, submit data necessary to demonstrate that the aquifer meets the following criteria: (1) does not serve as a source of drinking water; (2) cannot now and will not in the future serve as a source of drinking water; and (3) the TDS content of the ground water is more than 3,000 and less than 10,000 mg/l and is not reasonably expected to supply a public water system. Data to demonstrate that the aquifer is expected to be mineral or hydrocarbon production, such as general description of the mining zone, analysis of the amenability of the mining zone to the proposed method, and time table for proposed development must also be included. For additional information on aquifer exemptions, see 40 CFR Sections 144.7 and 146.04.
- T. **EXISTING EPA PERMITS** - List program and permit number of any existing EPA permits, for example, NPDES, PSD, RCRA, etc.
- U. **DESCRIPTION OF BUSINESS** - Give a brief description of the nature of the business.

## **Section 1 – Area of Review Methods/Calculations**



45610 Woodland Road, Suite 400, Sterling, VA 20166 703-444-7000 703-444-1685 (FAX)

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## TECHNICAL MEMORANDUM

**TO:** Dale Skoff, Tetra Tech OGA

**FROM:** Jeffrey Benegar

**DATE:** February 4, 2015

**RE:** Area of Review/Zone of Endangerment Analysis for Bittering #3 and Smith-Ras #1 Wells – Bear Lake Properties

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## EXECUTIVE SUMMARY

This technical memorandum (TM) summarizes the analytical modeling we have performed for the area of review/zone of endangerment analysis for the Bittering #3 and Smith-Ras #1 wells. The scenarios involved injecting simultaneously at existing Bear Lake Properties UIC Class IID brine disposal wells Bittering #1, #4, and #2, all of which are located in Columbus Township, Warren County, Pennsylvania (the Bittering #1 and Bittering #4 wells received their final UIC Class IID (Commercial) well permits in November 2012 and Bittering #2 in late 2014). The relevant parameters for our analysis were obtained from Bear Lake Properties, LLC or estimated in the absence of any information. Our analysis is described in more detail below.

## OVERVIEW AND METHODOLOGY

There are several methods proposed for calculating the zone of endangerment of an injection well. The most simplistic method is the use of a fixed radius, based on the type of injection well being permitted. Other methods involve calculation of the radius based on well and formation properties. Most regulatory agencies require the use of calculations to determine the zone of endangerment. The method used here is the graphical method first used by US EPA Region 6. It involves the calculation of the increase of pressure in the formation due to injection, then converting that pressure into equivalent feet of head. The increase in head in the formation due to injection is then compared to the equivalent head of the lowest most underground source of drinking water (USDW). When plotted graphically, the intersection of those two curves at some distance,  $r$ , determines the radius of the zone of endangerment.

The increase in pressure in the formation due to injection depends on the properties of the injection fluid and the formation, the rate of fluid injection, and the length of time of injection. The most common mathematical expression to describe this increase in pressure was developed

by Matthews and Russell (1967). Matthews and Russell assume that, for a single well injecting into an infinite, homogeneous and isotropic, non-leaking formation, the increase in pressure (delta p) can be described as:

$$\Delta p = 162.6 \frac{Q\mu}{kh} * [\log(kt / \Phi\mu Cr^2) - 3.23] \text{ where:}$$

$\Delta p$  = pressure change (psi) at radius, r and time, t

Q = injection rate (barrels/day)

$\mu$  = injectate viscosity (centipoise)

k = formation permeability (millidarcies)

h = formation thickness (feet)

t = time since injection began (hours)

C = compressibility (total, sum of water and rock compressibility) ( $\text{psi}^{-1}$ )

r = radial distance from wellbore to point of investigation (feet)

$\Phi$  = average formation porosity (decimal)

### PARAMETERS USED IN THE ANALYSIS

The following parameters were used in the zone of endangerment analysis. For injection rate, we used the average daily rate based on the permitted monthly rate for the three existing permitted Bear Lake Properties UIC Class IID wells, which is 30,000 bbls/month for each well, which averages approximately 1,000 bbls/day per well. For permeability, we used a value of 50 md, which we feel is conservative based on the injection rate sustainable for existing disposal wells at the site and the substantial volume of natural gas produced from the reservoir, both of which indicate significant permeability. The initial pressure at the top of the injection formation was based upon measurements taken prior to injection at the Bittinger #4 well.

#### Bittinger #3 Medina Group Well

Q = 1000 barrels/day

t = 10 years = 87,600 hours

$\mu$  = 1 centipoise

k = 50 md

h = 61 feet

C =  $3.0\text{e-}06 \text{ psi}^{-1}$

$\Phi$  = 0.08

Specific gravity of injectate = 1.218

Surface elevation = 1638 feet

Depth to injection formation = 4260 feet

Base of lowest most USDW (MSL) = 1338 feet

Initial pressure at top of injection formation = 128 psi

#### Smith-Ras #1 Medina Group Well

Q = 1000 barrels/day

t = 10 years = 87,600 hours

$\mu$  = 1 centipoise

k = 50 md

h = 61 feet

$C = 3.0\text{e-}06 \text{ psi}^{-1}$   
 $\Phi = 0.08$   
Specific gravity of injectate = 1.218  
Surface elevation = 1575 feet  
Depth to injection formation = 4222 feet  
Base of lowest most USDW (MSL) = 1275 feet  
Initial pressure at top of injection formation = 128 psi

Bittinger #2 Medina Group Well

$Q = 1000 \text{ barrels/day}$   
 $t = 10 \text{ years} = 87,600 \text{ hours}$   
 $\mu = 1 \text{ centipoise}$   
 $k = 50 \text{ md}$   
 $h = 61 \text{ feet}$   
 $C = 3.0\text{e-}06 \text{ psi}^{-1}$   
 $\Phi = 0.08$   
Specific gravity of injectate = 1.218  
Surface elevation = 1621 feet  
Depth to injection formation = 4279 feet  
Base of lowest most USDW (MSL) = 1321 feet  
Initial pressure at top of injection formation = 128 psi

Bittinger #1 Medina Group Well

$Q = 1000 \text{ barrels/day}$   
 $t = 10 \text{ years} = 87,600 \text{ hours}$   
 $\mu = 1 \text{ centipoise}$   
 $k = 50 \text{ md}$   
 $h = 61 \text{ feet}$   
 $C = 3.0\text{e-}06 \text{ psi}^{-1}$   
 $\Phi = 0.08$   
Specific gravity of injectate = 1.218  
Surface elevation = 1518 feet  
Depth to injection formation = 4210 feet  
Base of lowest most USDW (MSL) = 1218 feet  
Initial pressure at top of injection formation = 128 psi

Bittinger #4 Medina Group Well

$Q = 1000 \text{ barrels/day}$   
 $t = 10 \text{ years} = 87,600 \text{ hours}$   
 $\mu = 1 \text{ centipoise}$   
 $k = 50 \text{ md}$   
 $h = 61 \text{ feet}$   
 $C = 3.0\text{e-}06 \text{ psi}^{-1}$   
 $\Phi = 0.08$   
Specific gravity of injectate = 1.218  
Surface elevation = 1561 feet

Depth to injection formation = 4285 feet  
Base of lowest most USDW (MSL) = 1261 feet  
Initial pressure at top of injection formation = 128 psi

## RESULTS

The Matthews and Russell equation was solved for various distances from the wellbore based on the parameters listed above. The distance between each of the wells is:

Wells	Distance (ft)
Bitteringer #3 to Bitteringer #2	2,052
Bitteringer #3 to Bitteringer #4	3,566
Bitteringer #3 to Bitteringer #1	3,779
Smith-Ras #1 to Bitteringer #2	1,714
Smith-Ras #1 to Bitteringer #4	2,584
Smith-Ras #1 to Bitteringer #1	2,180
Smith-Ras #1 to Bitteringer #3	1,980
Bitteringer #1 to Bitteringer #4	1,300
Bitteringer #1 to Bitteringer #2	2,000
Bitteringer #2 to Bitteringer #4	1,600

The Matthews and Russell equation was used to calculate the increase in pressure in the formation with only one well injecting. This was done for all five wells. Then, the calculated pressures for each well were added together and this sum was added to the value of existing pressure in the injection formation to obtain the total pressure in the formation when all five wells are injecting.

These values were then converted to feet of head of formation brine. The values are plotted against distance from the wellbore and are shown in Figure 1 for the Bitteringer #3 well and Figure 2 for the Smith-Ras #1 well. The plot shows the calculated pressure surface within the injection formation, measured as feet of head of formation brine above the top of the injection formation. Also shown is the head of the lowest most USDW. Where the two lines intersect, the radius of the zone of endangerment can be estimated. The results indicate that the increase in head in the formation due to injection will intersect the elevation of the lowestmost USDW at a distance of approximately 4 feet for the Bitteringer #3 well and approximately 60 feet for the Smith-Ras #1 well. These distances are well within the ¼ mile standard fixed radius for area of review/zone of endangerment.

## CONCLUSIONS

Our analysis of the area of review/zone of endangerment for the Bitteringer #3 and Smith-Ras #1 wells (injecting together with the Bitteringer #2, #4, and #1 wells) is based on a methodology typically used by US EPA. Based on the results, we believe the Bitteringer #3 and Smith-Ras #1 wells are excellent candidates for use as brine disposal wells. The increase in head in the formation due to injection intersects the elevation of the lowestmost USDW well within ¼ mile

for each well. The standard fixed radius of  $\frac{1}{4}$  mile can be used for the area of review/zone of endangerment for the Bittinger #3 and Smith-Ras #1 wells.

### **REFERENCES**

Matthews, C.S., Russell, D.G., (1967) Pressure Buildup and Flow Tests in Wells, SPE Monograph Series, Volume 1, New York.



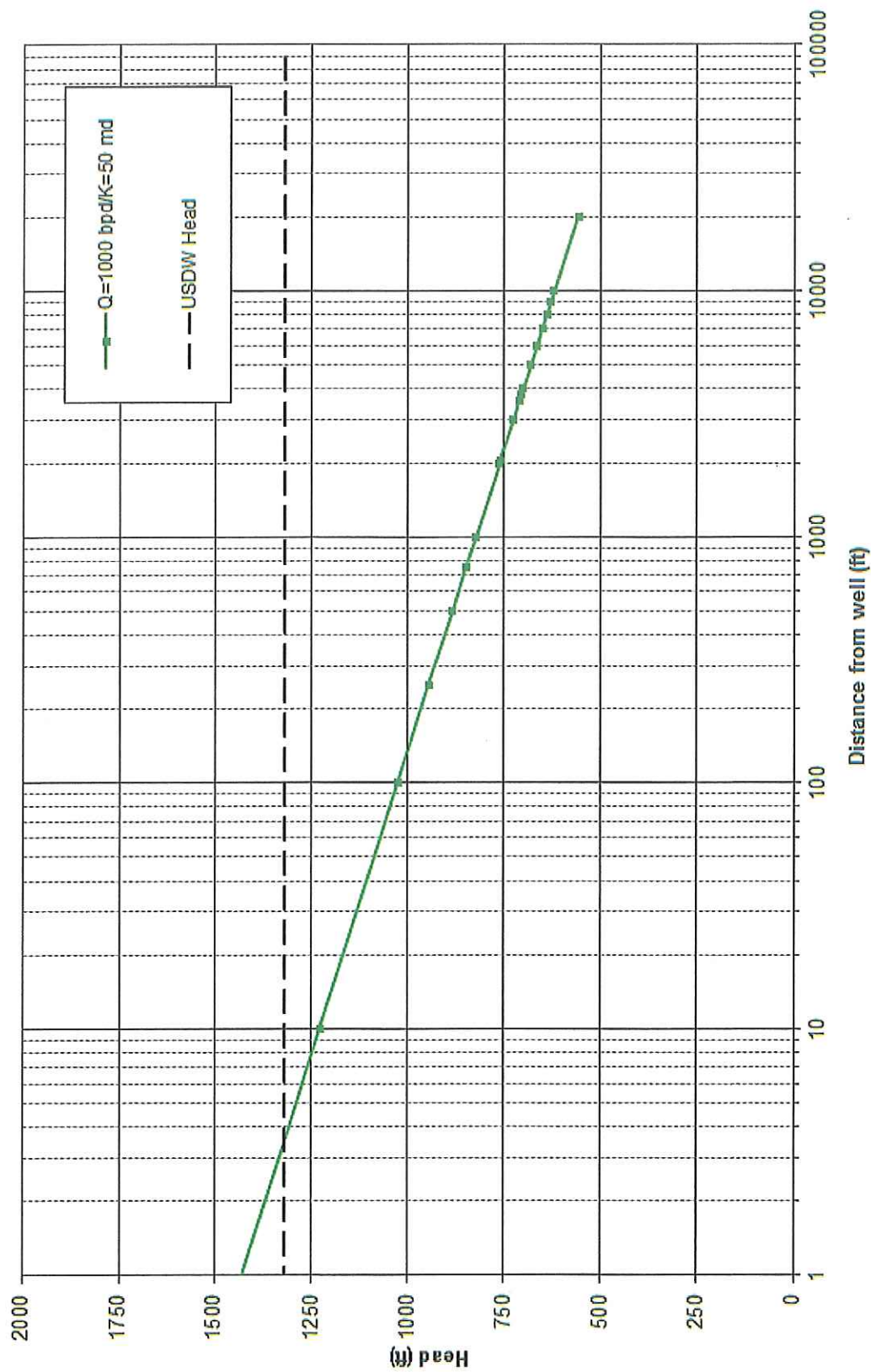


Figure 1. Feet of head of injection formation and USDW vs. distance for Bittinger #3 when all wells (Bittinger #2, #1, #4 and Smith-Ras #1) are injecting,  $K = 50 \text{ md}$

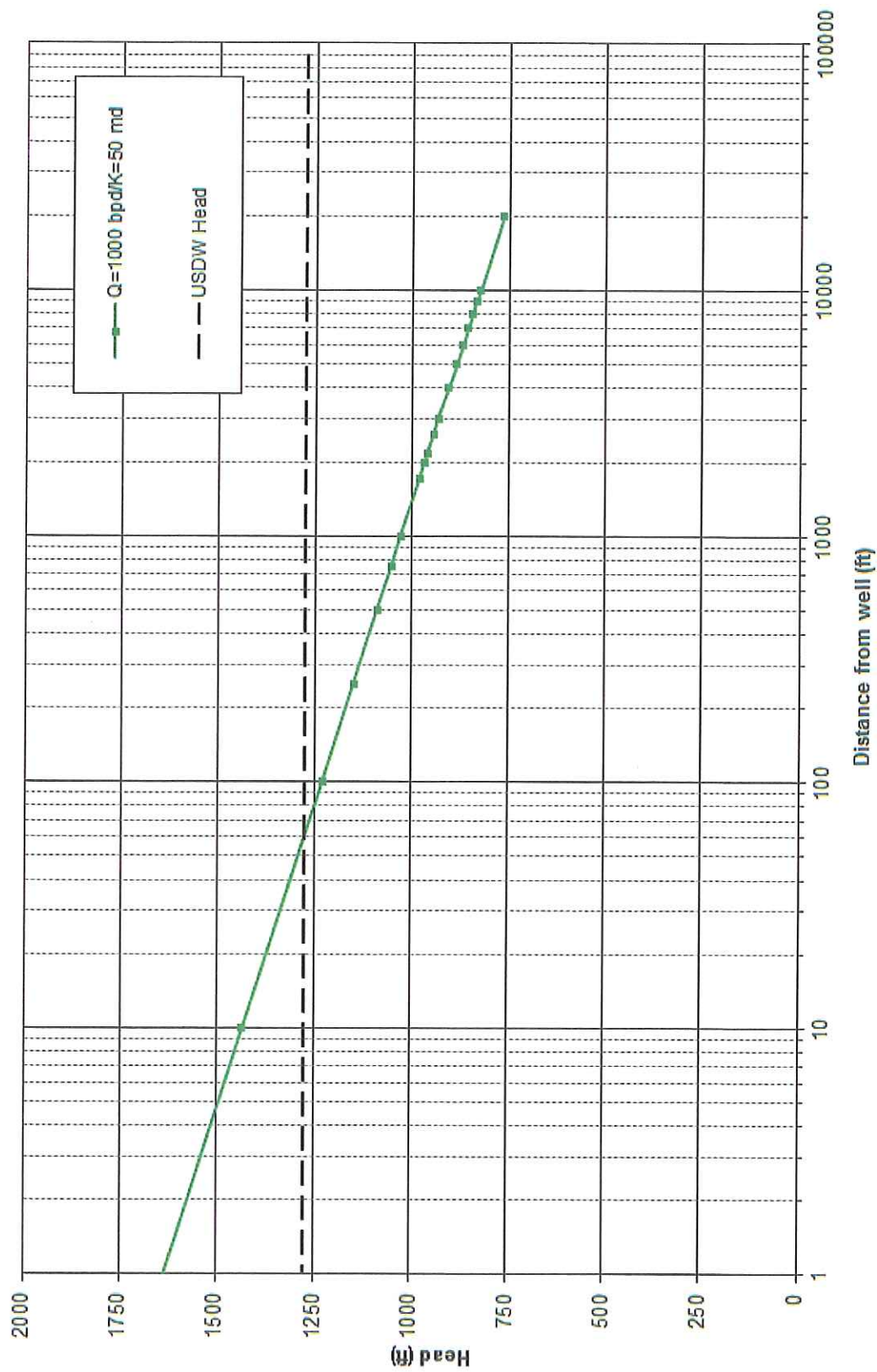


Figure 2. Feet of head of injection formation and USDW vs. distance for Smith-Ras #1 when all wells (Bittering #2, #1, #4 and #3) are injecting,  $K = 50 \text{ md}$

**Section 2 – Maps of Well Area and Area of Review**

## **Section 2 – Maps of Well Area and Area of Review**

According to publicly available records in the area, there are no intake or discharge structures, hazardous waste treatment, storage, or disposal facilities, mines, or quarries within one mile of the Smith-Ras Unit #1 well. An intermittent unnamed tributary (UNT) to Tamarack Swamp is located approximately 0.5 mile west of the Smith-Ras Unit #1 well. Tamarack Swamp is located approximately 0.75 mile southwest, Brokenstraw Creek is located approximately 1 mile northwest, and an UNT to Pine Valley Creek is located approximately 0.25 miles east of the Smith-Ras Unit #1.

The Pennsylvania Geologic Survey "Ground Water Inventory System" (GWIS) database was accessed to determine whether there were any water wells listed for the site area. The review found that there were no water wells listed within the quarter mile AOR. It is noted that the well reporting requirement was established in 1968 and is not considered to be a complete record of water wells and other wells may be present. (Pennsylvania Topographic and Geologic Survey, September 15, 2010). One well was identified within the AOR based on public input and a foot survey by Bear Lake Properties staff. Attached are a map showing the location of the above-referenced well and a table summarizing information on the well.

The names and addresses of residents located within ¼ mile of the proposed injection well are provided in Appendix A.

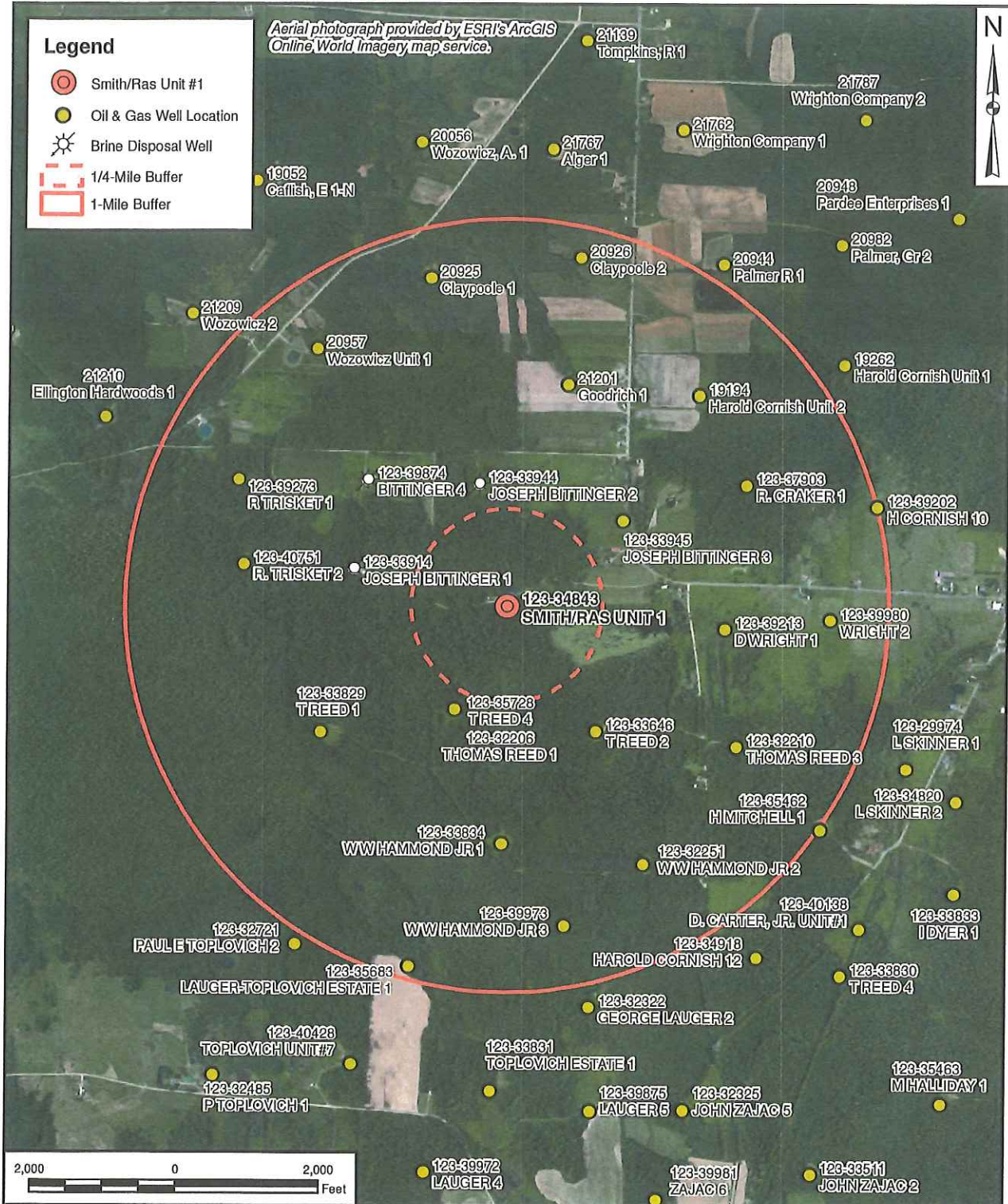
Wells Located Within the 1/4 Mile Radius Area of Review (AOR) For The Smith-Ras Unit #1 Well

Well Owner / Name	API #	Lat	Long	TD	Drilling Completed	Last Csg	Csg depth	Completion
Oil and Gas and Proposed Injection Wells								
Bear Lake Properties Smith-Ras Unit #1 (Proposed InjectionWell)	123-34843	41.992727	41.992727	4516 ft	3/26/1984	4.5 in	4493 ft	Perf'd and frac'd
Water Wells								
Jack McCoy	N/A	41.992867	-79.534883					

**AREA OF REVIEW MAPS**

**OIL AND GAS WELLS**





OIL & GAS WELL LOCATIONS  
SMITH/RAS UNIT 1 WELL  
BEAR LAKE PROPERTIES, LLC  
WARREN COUNTY, PENNSYLVANIA

DRAWN BY: S. PAXTON 01/27/15  
CHECKED BY: D. SKOFF 02/03/15  
APPROVED BY:

CONTRACT NUMBER: 212C-PB-00103

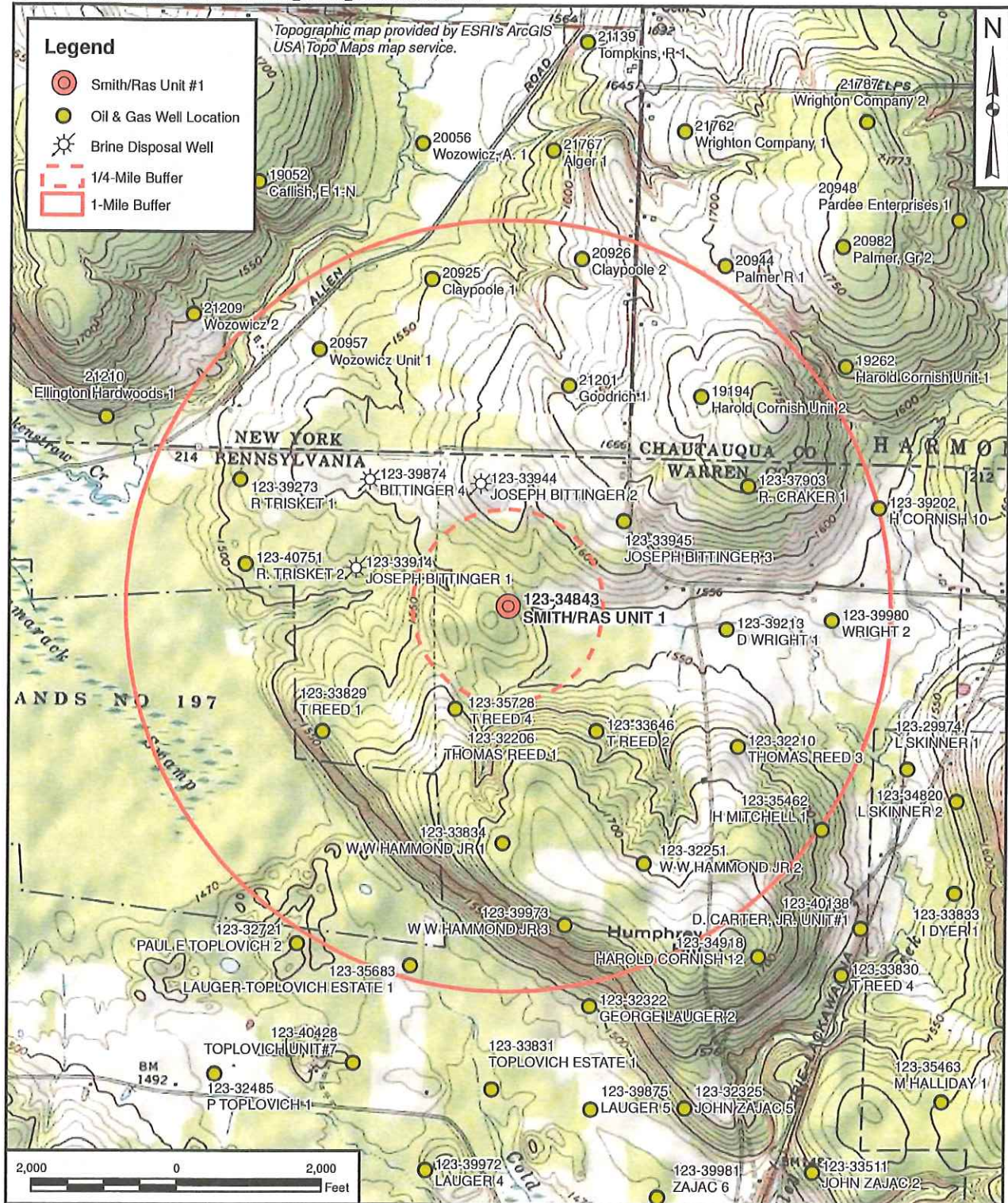
FIGURE NUMBER

1

REV

0





OIL & GAS WELL LOCATIONS  
SMITH/RAS UNIT 1 WELL  
BEAR LAKE PROPERTIES, LLC  
WARREN COUNTY, PENNSYLVANIA

DRAWN BY: S. PAXTON 01/27/15  
CHECKED BY: D. SKOFF 02/03/15  
APPROVED BY:

CONTRACT NUMBER: 212C-PB-00103

FIGURE NUMBER

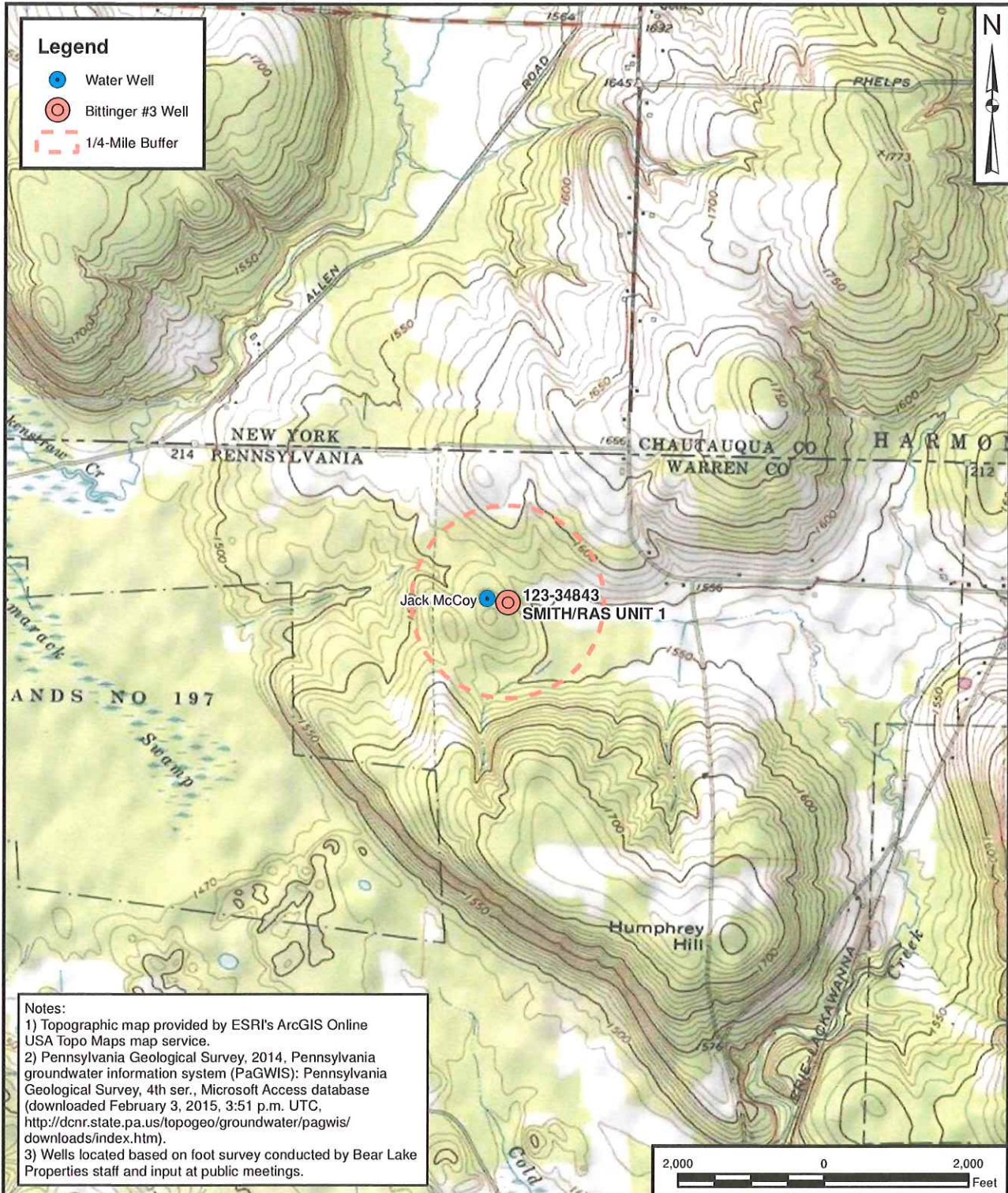
2

REV

0



**AREA OF REVIEW MAPS**  
**GROUNDWATER WELLS**



WATER WELL LOCATIONS WITHIN AOR  
SMITH/RAS UNIT 1 WELL  
BEAR LAKE PROPERTIES, LLC  
WARREN COUNTY, PENNSYLVANIA

DRAWN BY: S. PAXTON 02/03/15  
CHECKED BY: D. SKOFF 02/05/15  
APPROVED BY:

CONTRACT NUMBER: 212C-PB-00103

FIGURE NUMBER

2

REV

0

### Section 3 – Corrective Action Plan and Well Data

### **Section 3 - Corrective Action Plan and Well Data**

According to publicly available records of oil and gas wells and a survey conducted by foot, there are no existing, or plugged and abandoned wells within a ¼ mile radius AOR for the Smith-Ras Unit #1 well. The D. Wright #1 and the T. Reed #4 will be used as monitoring wells. If the fluid level in either monitoring well is observed to rise up to within 100 feet of the base of the USDW, disposal operations in the Smith-Ras Unit #1 well will be stopped immediately, EPA will be notified, and operating conditions will be evaluated in order to control the fluid levels.

#### **Existing Oil and Gas Wells within the Area of Review**

Well completion records are required to be submitted for all wells located within the area of review in order to evaluate the need for corrective action specific to each well. As mentioned above, there are no oil and gas wells located with the AOR.

#### **Plugged and Abandoned Wells**

No plugged and abandoned wells have been identified within the ¼ mile AOR for the Smith-Ras Unit #1 well.

#### **Section 4 – Name and Depth of USDWs**

#### **Section 4 - Underground Sources of Drinking Water (USDW)**

The site lies within the Glaciated Plateau section of the Appalachian Plateaus Physiographic province. Both unconsolidated glacial units and bedrock are used for potable water. The uppermost unit at the site is mapped as Wisconsin age glacial kame deposits. Kame deposits consist primarily of sand and gravel interbedded with minor amounts of silt and clay (Pennsylvania Topographic and Geologic Survey, 1959). The well log for Smith-Ras #1 indicates that unconsolidated gravel is present from the surface to a depth of 120 feet below ground surface.

The uppermost bedrock beneath the site is mapped as the Devonian age Venango formation. The Venango formation consists of interbedded pebble conglomerate, crossbedded sandstone, siltstone, and shale. This unit is up to 330 feet thick in Venango County; however, only a portion of the unit is present in the site area. This unit is used as an aquifer throughout Warren County. The well log for Smith-Ras #1 indicates that Devonian age shale is present from 120 ft to a depth of 2,768 ft below ground surface. This is believed to include the Venango Formation, the Chadokoin formation, and the underlying Bradford Group. Wells deeper than approximately 100 feet deep usually encounter salt water, which is supported by the generally shallow well depths in Columbus Township. (PADER, 1982, US Geologic Survey, 2007)

The Devonian age Chadokoin formation underlies Venango formation and consists of fine-grained marine clastics (siltstone and shale) and includes a purplish pink sequence which is often used as a marker unit. This unit is up to 450 thick in Warren County.

The Pennsylvania Geologic Survey "Ground Water Inventory System" (GWIS) database was accessed to determine whether there were groundwater wells included for the site area. This database did not contain any groundwater wells within a one-quarter mile radius of Smith-Ras #1 well. Although there are no wells listed, the well reporting requirement was established in 1968 is not considered to be a complete record of water wells and other wells may be present. (Pennsylvania Topographic and Geologic Survey, September 15, 2010). One water well was identified within the AOR based on public input and a foot survey by Bear Lake Properties staff. Section 2 of this application includes a map showing the location of the above-referenced well and a table summarizing information on the well.

Based on the available information, the glacial units and the top 100 feet of bedrock is considered the underground sources of drinking water in the site area. The well logs indicate that the glacial material is approximately 120 feet thick beneath the site. Freshwater is expected to be encountered to a depth of approximately 100 feet with increasing salinity beyond that depth. The Smith-Ras #1 well has 8 5/8 inch surface casing cemented to a depth of 406 feet below ground surface, providing a buffer of approximately 300 feet beyond the base of the underground sources of drinking water based on the well data in Columbus Township (maximum well depth of 130 feet) and the references indicating brine being encountered at depths over 100 feet within the bedrock units. In addition, production casing extends several thousands of feet below the drinking water source and is cemented approximately 1300 feet above the injection interval. (Injection well construction is described in detail in the "Well Construction" section.)

In calculating the depth to the base of the lowermost USDW, the depth of the deepest well in the area 130 feet (it is believed that the generally shallow well depth in the area was related to water quality issues based on the available literature) was doubled and rounded upward to the nearest

100 feet, providing a conservative maximum depth estimate of the underground source of drinking water of 300 feet.

References:

Pennsylvania Topographic and Geologic Survey, 1959. " Glacial Geology of Northwestern, PA." Bulletin G 32.

Pennsylvania Topographic and Geologic Survey, 1981. " Atlas of Preliminary Quadrangle Maps of Pennsylvania, PA." Map 61.

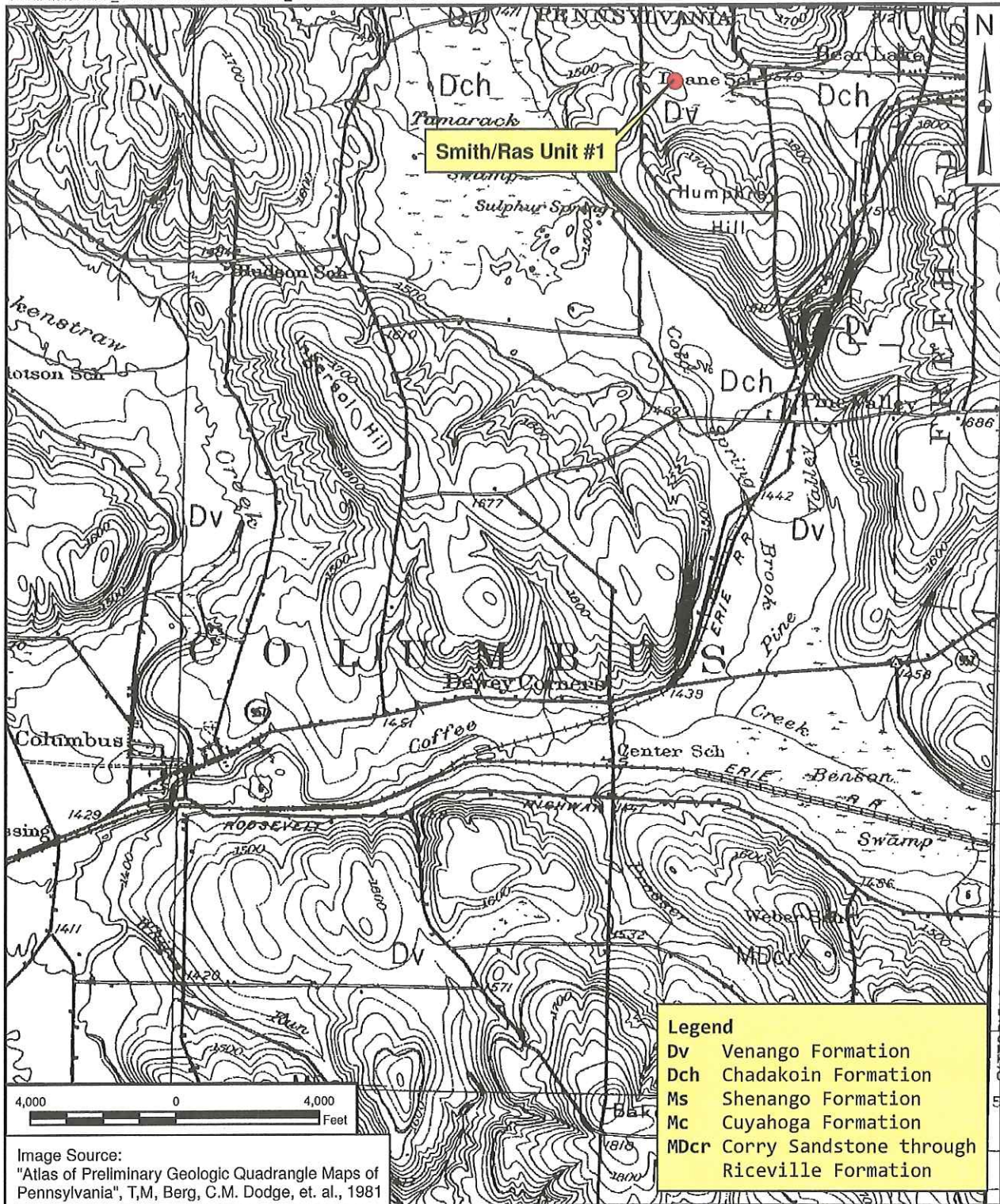
PADER, 1982. "Engineering Characteristics of the Rocks of Pennsylvania". Environmental Geology Report 1.


Pennsylvania Topographic and Geologic Survey, September 15/20, 2010. "Ground Water Inventory System". [www.dcnr.state.pa.us/topogeo/groundwater/PAGWIS](http://www.dcnr.state.pa.us/topogeo/groundwater/PAGWIS)

US Geologic Survey, 2007. "Ground-Water Resources and the Hydrologic Effects of Petroleum Occurrence and Development, Warren County, Northwestern Pennsylvania." Scientific Investigations Report 2006-5263.

**UNDERGROUND SOURCES OF DRINKING WATER**  
**BEDROCK MAP**

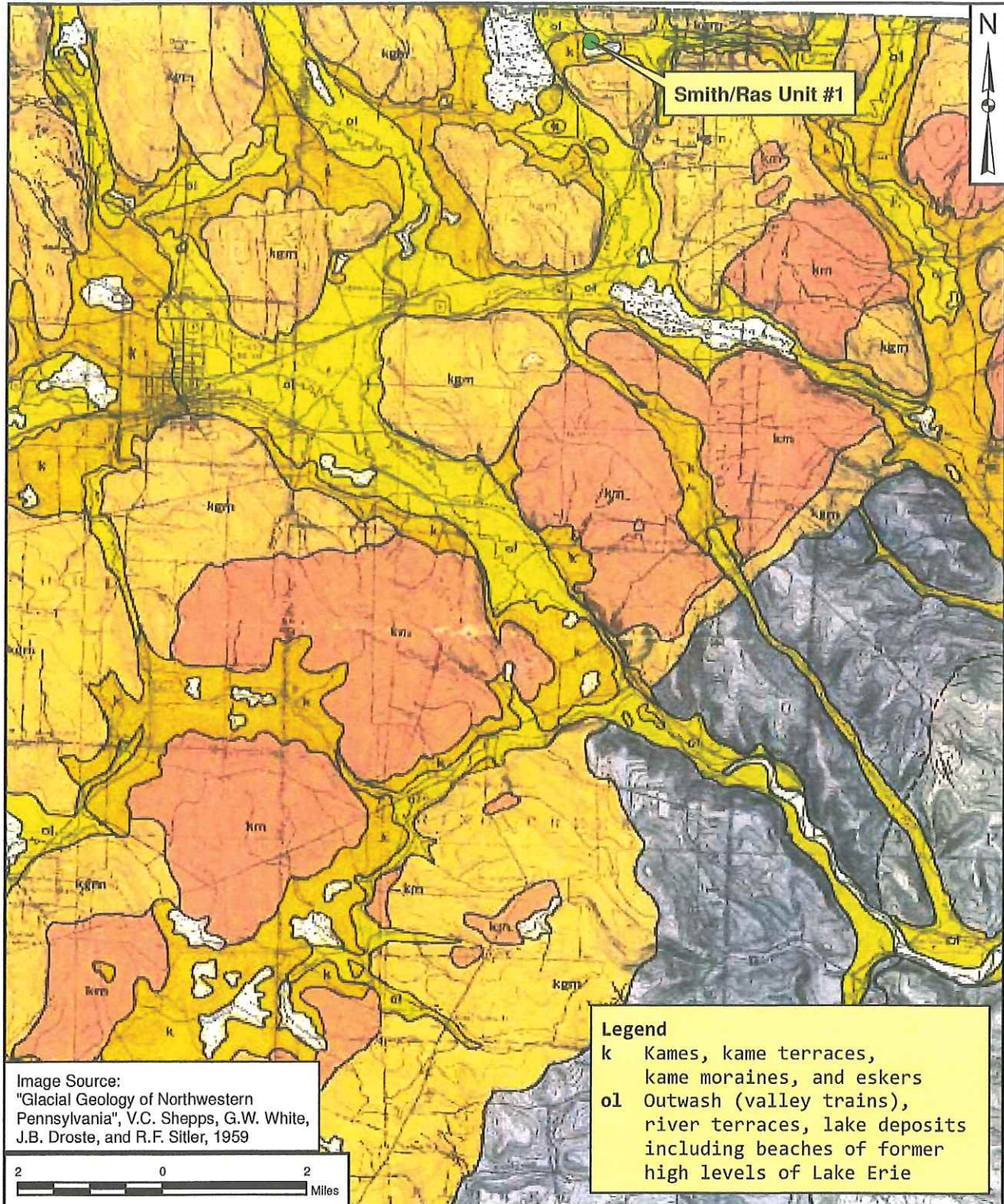





 <b>TETRA TECH</b>	<b>BEDROCK MAP</b> <b>SMITH/RAS UNIT 1 WELL</b> <b>BEAR LAKE PROPERTIES, LLC</b> <b>WARREN COUNTY, PENNSYLVANIA</b>		DRAWN BY: S. PAXTON 01/28/15 CHECKED BY: D. SKOFF 01/28/15 APPROVED BY:
			CONTRACT NUMBER: 212C-PB-00103
		FIGURE NUMBER	REV 0

**UNDERGROUND SOURCES OF DRINKING WATER**  
**GLACIAL MAP**





 <b>TETRA TECH</b>	GLACIAL MAP SMITH/RAS UNIT 1 WELL BEAR LAKE PROPERTIES, LLC WARREN COUNTY, PENNSYLVANIA	DRAWN BY: S. PAXTON 01/28/15 CHECKED BY: D. SKOFF 01/28/15 APPROVED BY:  CONTRACT NUMBER: 212C-PB-00103	
		FIGURE NUMBER  —	REV  0

## **Section 5 – Geologic Data On Injection and Confining Zones**



## **Section 5 – Geologic Data on Injection and Confining Zones**

The well is designed to inject into the Grimsby and Whirlpool sandstone units of the Medina Group which occurs at depths between 4,222 and 4,396 feet below grade in the Smith-Ras Unit #1 well. The Medina is a depleted reservoir in this area.

As seen on the generalized stratigraphic column (attached), most of the geologic “groups” and “formations” overlying the Medina can be considered confining units totaling approximately 2,000 feet. Although many of these units are predominantly shale, they also contain reservoir rock and are shown with shading in confining unit column. Therefore, the Lockport and the Salina are seen as the most significant confining units and have a combined thickness of over 600 feet in the site area. As indicated, these units provide only a portion of the confining capacity and there are numerous other units that provide further protection.

The characteristics of the Medina Group formations including the Grimsby and Whirlpool are described in the attached report prepared by Billman Geologic Consultants entitled, “Geologic Review of the Bittering Area, Planned SWD Site”, dated August 2, 2010, and the cover letter dated April 5, 2014 discussing the Bittering #2 well geologic characteristics. The subject report includes cross-sections in the vicinity of the Smith-Ras Unit #1 well. As demonstrated by the cross-sections, the formation characteristics (lithology, thickness, porosity, etc.) of the Medina Group rocks in the Smith-Ras Unit #1 well are very similar to those of the nearby wells including the three permitted brine disposal wells (Bittering #1, #2 and #4 wells) operated by Bear Lake Properties.

Also attached are the following:

- Smith-Ras Unit #1 completion record and geophysical log,
- Maximum Injection Pressure (MIP) calculations based on Instantaneous Shut-In Pressure (ISIP) data for the Smith-Ras Unit #1 well
- Smith-Ras Unit #1 treatment reports.

### **Potential for Faults and Seismicity**

As discussed in the attached Billman Geologic Consultants Report, geologic mapping performed at the Bear Lake Properties site as part of natural gas exploration and development in the Medina Group sandstone units has not identified evidence of significant faulting (e.g., duplicated intervals evident in log analysis, unusual thickening or thinning of intervals, etc.). Likewise the production of large volumes of natural gas from the Medina Group indicates the lack of significant faults which would allow for migration of the entrapped gas out of the Medina.

It is also noted that the Medina Group wells at the site are largely depleted resulting in lower than natural rock pressures. Production data for the Smith-Ras Unit #1 are summarized on the attached table along with six other nearby wells. Cumulative gas production from the Smith-Ras Unit #1 well is approximately 217 MMCF. Total production from all seven wells is over 1.75 BCF. The impact of removal of this large volume of gas is, as expected, a decrease in reservoir pressure. Injecting brine at or below the proposed maximum injection pressure would therefore not likely result in “overpressuring” faults (if any do exist in the area) and causing movement.

Finally, it is highly unlikely that injection at the site would engage any deep, Pre-Cambrian basement faults. According to the PA DCNR “Precambrian Basement Map of the Appalachian Basin and Piedmont Province in Pennsylvania” [http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr\\_016250.pdf](http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_016250.pdf) the depth to

basement in the site vicinity is estimated at approximately 2,500 meters (or 8,200 feet) below sea level. The base of the Medina Group at the Bear Lake Properties site is approximately 2,800 ft. below sea level, or approximately a mile above Pre-Cambrian basement.

A review of the PA DCNR "Earthquake Epicenters in and Near Pennsylvania" (attached) indicates that there have been no recorded seismic events within 25 miles of the disposal project area since 1724, the start of the reporting period.

In summary, a detailed review of the zone of injection and data on geologic strata surrounding the zone of injection for the proposed brine disposal well, indicates the following supporting evidence that seismicity is highly unlikely: 1) The detailed geologic cross-sections (Appendix 2 of the Billman Geologic Consultants Report) and isopach and structural mapping completed by Billman Geologic Consultants show no evidence of faulting in the study area. 2) Historic production of over 1.75 billion cubic feet of gas among the Bittinger #1, #2, #3 and #4, Smith Ras #1 and Trisket #1 and #2 wells and unknown volumes of formation brine from the proposed zone of injection near the Bittinger #3 has depleted the zone of almost 90% of its original reservoir pressure. The disposal operations will re-fill this void space over the life of the project. 3) There have been no recorded seismic events within 25 miles of the disposal project area since 1724, the start of the reporting period referenced in the PA DCNR earthquake epicenters map.

**GEOLOGIC DATA**  
**BILLMAN GEOLOGIC CONSULTANTS REPORT**

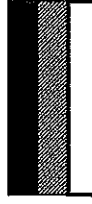
**GEOLOGIC DATA**  
**GENERALIZED STRATIGRAPHIC COLUMN**



Generalized Stratigraphic Column  
Smith-Ras Unit #1  
Warren County, PA

Age	Group	Formation	Predominant Rock Type	Total Depth to Base(Feet)	Thickness Feet	Confining Zone
Glacial Units				120	120	
Upper Devonian	Venango		Shale/sandstone			
Upper Devonian		Chadakoin	Shale			
Upper Devonian	Bradford		Shale			
Upper Devonian	Elk		Shale			
Upper Devonian		Java	Shale			
Upper Devonian		West Falls	Shale			
Upper Devonian		Sonyea	Shale			
Upper Devonian		Genesee	Shale			
Upper Devonian		Tully Limestone	Limestone	2877	109	
Upper Devonian	Hamilton	Mahantango	Shale, some sandstone			
Upper Devonian	Hamilton	Marcellus Shale	Shale	3049	172	
Middle Devonian		Onondaga	Limestone	3218	169	
		Unconformity Interval		3233	15	
Upper Silurian		Salina - including Akron-Berite, Camillus, Syracuse, Vernon	Evaporites/Dolomite	3785	552	
Upper Silurian		Lockport Dolomite	Dolomite	3861	76	
Lower Silurian	Clinton	Rochester Shale, Irondequoit-Reynales Dolomite	Sandstone	4222	122	
Lower Silurian		Medina, including the Grimsby and Whirlpool Sandstones	Sandstone/Shale	4396	174	

Notes



**GEOLOGIC DATA**  
**SMITH-RAS UNIT #1 COMPLETION RECORD**

ER-OG-4 Rev. 2/80

COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF ENVIRONMENTAL RESOURCES  
DIVISION OF OIL AND GAS REGULATION  
PITTSBURGH, PENNSYLVANIA 15222

Office Use Only

## WELL RECORD

PERMIT NO.

WAR-34843

PROJECT NO.

TYPE OF WELL

Gas

WELL OPERATOR

U.S. Energy Development Corporation

TELEPHONE NO.

(716)856-9764

ADDRESS

670 Statler Building, Buffalo, NY

ZIP 14202

FARM NAME

Smith/Ross Unit

FARM NO.

#1

SERIAL NO.

ACRES

72

TOWNSHIP

Columbus

COUNTY

Warren

DRILLING COMMENCED

3/22/84

DRILLING COMPLETED

3/26/84

ELEVATION

1575

QUADRANGLE

Columbus

☒ 7 1/2'☐ 15'

## CASING AND TUBING RECORD

PIPE SIZE	AMOUNT IN WELL	MATERIAL BEHIND PIPE		PACKER		DATE RUN
		CEMENT (SKS.)	GEL (SKS.)	TYPE	SIZE	
8 5/8"	406'	150				3/22/84
4 1/2"	4253'	75	150			3/26/84

## PERFORATION RECORD

## STIMULATION RECORD

DATE	INTERVAL PERFORATED		DATE	INTERVAL TREATED	AMOUNT FLUID	AMOUNT SAND	INJECTION RATE
	FROM	TO					
6/27/84	4269'	4383'	6/27/84	4269'- 4383'	674 bbls	50,000#	21 BPM

NATURAL OPEN FLOW

N/A

NATURAL ROCK PRESSURE

Not Taken

HRS.

DAYS

AFTER TREATMENT OPEN FLOW

5,208 MMCF

AFTER TREATMENT ROCK PRESSURE

1240 PSI

HRS.

DAYS

REMARKS:

Driller's ID 4525'

Logger's ID 4518'

(FORMATION ON REVERSE SIDE)

8424

FORMATIONS						
NAME	TOP	BOTTOM	GAS AT	OIL AT	WATER AT (FRESH OR SALT WATER)	SOURCE OF
Unconsolidated Gravel	0'	120'			Fresh @ 105'	Drillers' records & geophysical logs
Devonian Shale	120'	2768'				
"Tully" Limestone	2768'	2877'				
Hamilton Shales	2877'	3049'				
Onondaga	3049'	3218'				
Unconformity Interval	3218'	3233'				
Akron-Bertie	3233'	3317'				
Camillus	3317'	3389'				
Syracuse	3389'	3597'				
Vernon	3597'	3861'				
Salt Zone	3579'	3785'			Salt @ 3910'	
Lockport	3861'	4065'				
Rochester	4065'	4184'				
Irondequoit-Reynales	4184'	4222'				
Grimsby	4222'	4351'				
Power Glen	4351'	4383'				
Whirlpool	4383'	4396'				
Queenston	4396'	TD				
TD	4516'					

July 17, 1984  
DATE

Douglas K. Walch  
APPROVED BY

Douglas K. Walch, Geophysicist  
TITLE

Well Name & No. SMITH/BAS #1 Loc.                       
 Permit No.                      COLUMBUS Twp.,                      Co.,                     

PERFORATION RECORD

Company K. J. McElough Formation Willamette Date 6/26/84

Pumped in 500 gal. acid and 500 gal. water; ran Gamma Ray and collar log.  
 PSTD 4487 ft. Perf. as follows:

<u>4279</u>	-	<u>4316</u>	w/	shots	-	<u>4387</u>	-	<u>4387</u>	w/	shots
<u>4305</u>	-	<u>4318</u>	w/	shots	-	<u>4308</u>	-		w/	shots
<u>4308</u>	-	<u>4334</u>	w/	shots	-	<u>4391</u>	-		w/	shots

Size of shots .42

Total Shots 10

FRAC JOB

Company Dowell Schlumberger Date 6/27/84  
 Loaded hole. Broke formation @ 2100 # Back to 950 #. Pumped in 500 gals.  
 15% HCL Acid @ 20 BPM @ 3300 #, waited 5 min. & fraced as follows:

	BBLS./MIN.	# Per Gal.	SAND Size	BPM	Press.
1.	<u>0-144</u>	<u>0.00</u>	<u>---</u>	<u>20</u>	<u>3400</u>
2.	<u>144-339</u>	<u>24</u>	<u>20/50</u>	<u>21</u>	<u>3330</u>
3.	<u>339-420</u>	<u>30</u>	<u>20/50</u>	<u>21</u>	<u>3250</u>
4.	<u>420-611</u>	<u>40</u>	<u>20/50</u>	<u>20</u>	<u>3500</u>
5.	<u>611-675</u>	<u>Flush</u>	<u>---</u>	<u>14.5</u>	<u>3500</u>
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

ISIP 2200 # 5 MIN. 1950 # Job complete 12:35 P.M.

Open to pit 1:26 P.M. Flowed back 24 hrs. Total water 675 bbls.

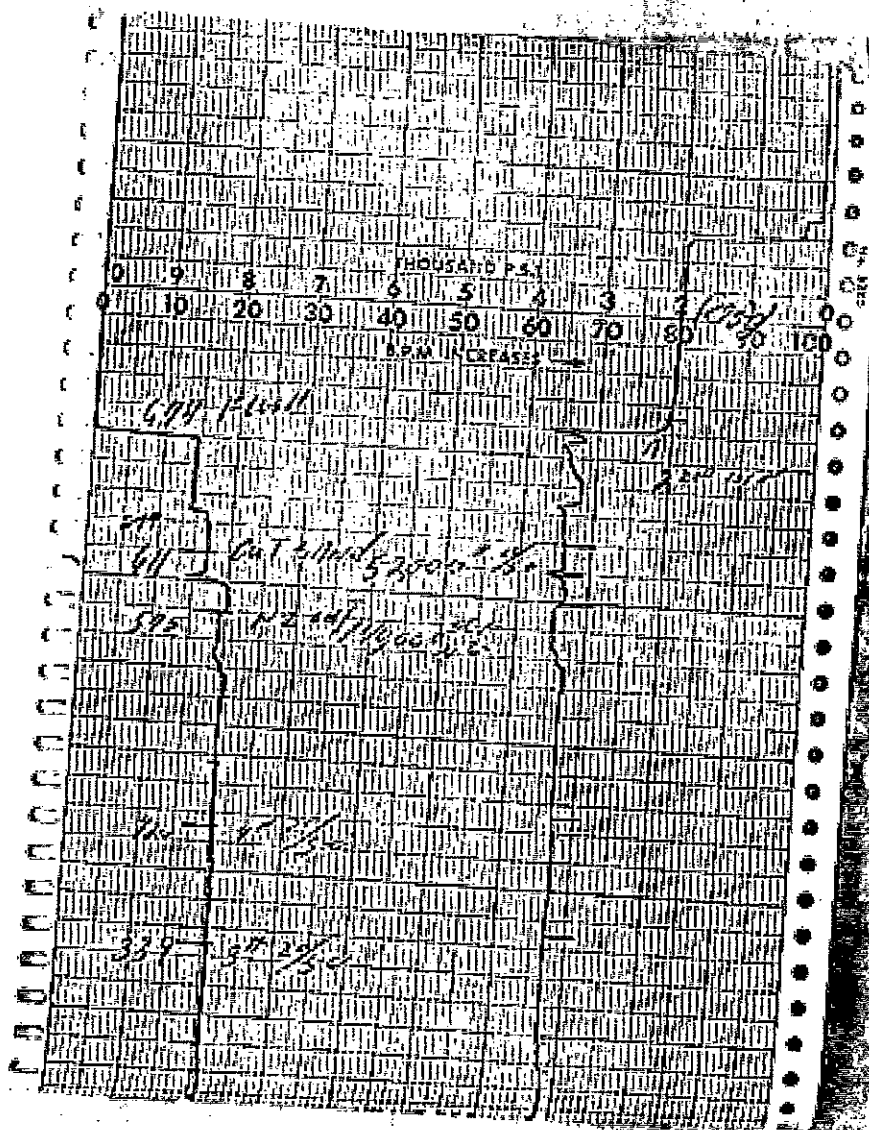
52,000 # 20/50 & --- # 80/100. Avg. pump rate 21 BPM @ 3369 # Press

HHP used 1734. Nitrogen used 100,000.

REMARKS: At 340 BBLs out N. Gey to high pressure - at 611 BBLs out sand due to high pressure - well screened off - 4 BBLs short of flush to perf.

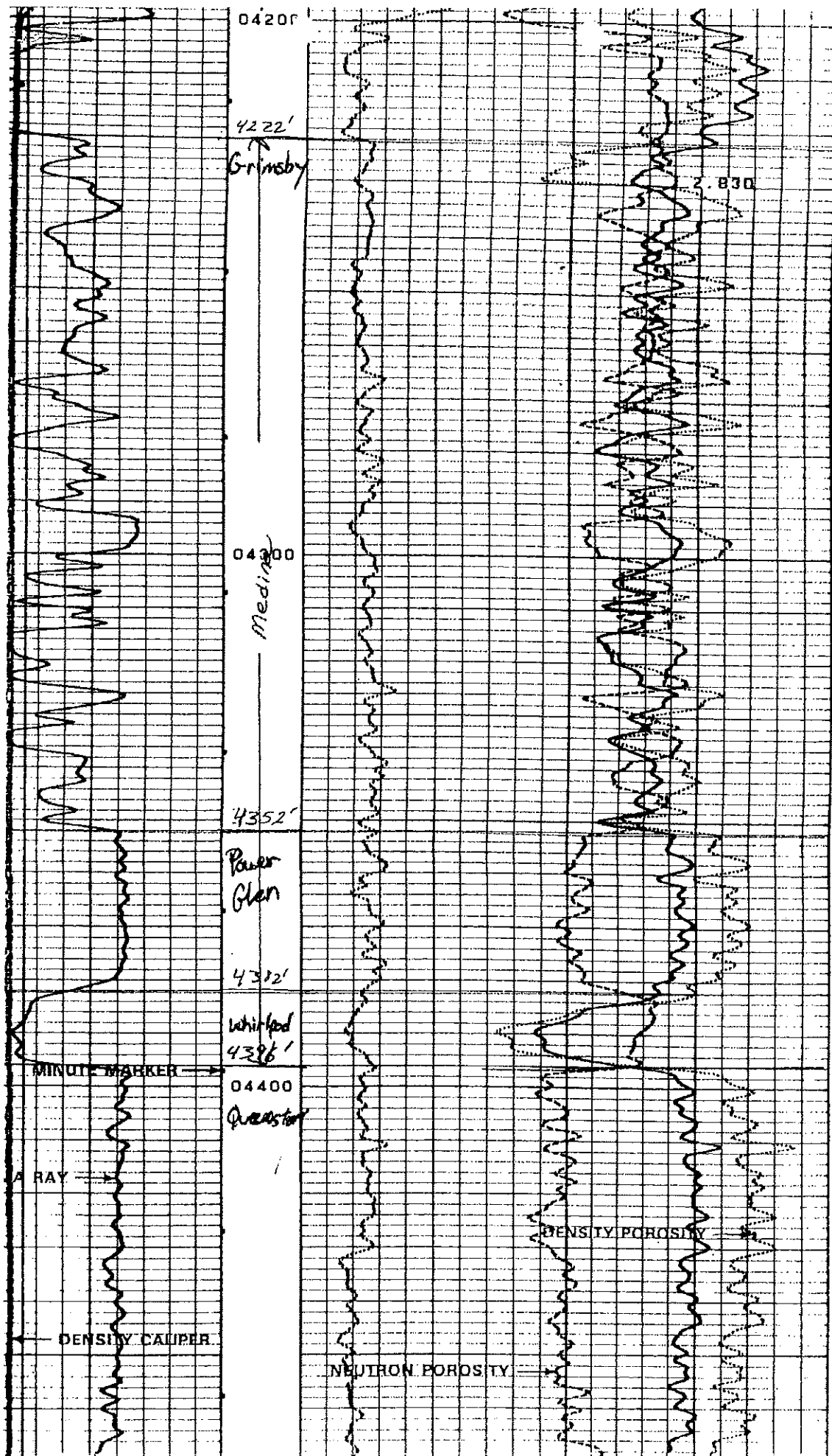
W. J. MacRae  
 ENGINEER

7-6-84





Smith Geo  
Unit #1





**GEOLOGIC DATA**

**MAXIMUM INJECTION PRESSURE CALCULATIONS**

**Maximum Injection Pressure (MIP) Calculations for Bear Lake Properties Smith-Ras Unit #1 Well**  
 Warren County, PA

**1) Frac Gradient (FG) Based on Smith-Ras Unit #1 Well Frac**

$$FG = [ISIP + (.433 \times SG \times D)] / D$$

Where:

ISIP = 2200 psi

SG = 1.0 (frac fluid)

D = 4391

ISIP (psi)	Hydrostatic Factor (psi/ft)	SG	D (ft)	Fracture Gradient (psi/ft)
2200	0.433	1	4391	0.934

**2) Maximum Injection Pressure (MIP) Calculation for Smith-Ras Unit #1 Well**

$$MIP = [FG - (.433 \times SG)] \times D$$

FG = 0.934

SG = 1.218 (brine)

Depth:

Medina Top                      4222

Hydrostatic Factor (psi/ft)	SG	D (ft)	Fracture Gradient (psi/ft)	MIP (Surface)
0.433	1.218	4222	0.934	1717

**GEOLOGIC DATA**  
**MEDINA WELL GAS PRODUCTION SUMMARY**

Permit	Company	Year	Product	Quantity (MCF)	Brine	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-33944	US ENERGY DEV CORP	1984	GAS	5,812		0	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1985	GAS	22,275		0	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1986	GAS	30,101		336	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1987	GAS	23,479		336	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1988	GAS	47,976		347	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1989	GAS	50,332		352	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1990	GAS	39,609		346	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1991	GAS	21,121		347	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1992	GAS	6,351		323	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1993	GAS	3,039		339	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1994	BRINE		22		WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	US ENERGY DEV CORP	1994	GAS	1,402		319	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	BELDEN & BLAKE CORP	2000	GAS	698		366	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	BELDEN & BLAKE CORP	2001	GAS	67		365	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	BELDEN & BLAKE CORP	2002	GAS	0		0	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	BELDEN & BLAKE CORP	2002	OIL	0		0	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	RANGE RESOURCES APPALACHIA LLC	2002	GAS	5		31	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	RANGE RESOURCES APPALACHIA LLC	2003	GAS	701		334	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	RANGE RESOURCES APPALACHIA LLC	2004	GAS	718		365	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	RANGE RESOURCES APPALACHIA LLC	2005	GAS	670		334	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	RANGE RESOURCES APPALACHIA LLC	2006	GAS	374		334	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	TRINITY ENERGY CORP	2007	GAS	102		122	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	LION ENERGY CO LLC	2008	GAS	193		365	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
123-33944	LION ENERGY CO LLC	2009	GAS	30		30	WARREN	COLUMBUS	JOSEPH BITTINGER	2	COLUMBUS	DEWEY CORNERS	29-Jan-84
			Total	255,055		22							

Permit	Company	Year	Product	Quantity	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-33945	US ENERGY DEV CORP	1986	GAS	32,248	336	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1987	GAS	36,330	336	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1988	GAS	48,995	345	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1989	GAS	42,806	332	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1990	GAS	26,642	343	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1991	GAS	13,848	347	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1992	GAS	5,278	315	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1993	GAS	4,826	360	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	1994	BRINE		73							
123-33945	US ENERGY DEV CORP	1994	GAS	1,810	363	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	US ENERGY DEV CORP	2001	GAS	66	365	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2002	GAS	40	365	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2002	OIL	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2005	GAS	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2005	OIL	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2006	GAS	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2006	OIL	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2008	GAS	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
123-33945	BELDEN & BLAKE CORP	2008	OIL	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	3	COLUMBUS	DEWEY CORNERS	19-Oct-84
			Total	212,890	73							

Permit	Company	Year	Product	Quantity	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-39273	US ENERGY DEV CORP	1985	GAS	23,500	0	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84



Permit	Company	Year	Product	Quantity	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-39273	US ENERGY DEV CORP	1986	GAS	29,581	308	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1987	GAS	26,012	322	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1988	GAS	34,866	307	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1989	GAS	60,104	352	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1990	GAS	29,211	335	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1991	GAS	6,338	293	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1992	GAS	3,309	321	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	1993	GAS	1,474	165	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2000	GAS	519	240	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2001	GAS	1,166	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	BELDEN & BLAKE CORP	2001	GAS	15	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2002	GAS	684	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2003	GAS	527	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2004	GAS	1,073	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2005	GAS	1,485	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2006	BRINE		5	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2006	GAS	1,068	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2007	BRINE		5	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2007	GAS	398	240	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	US ENERGY DEV CORP	2008	GAS	201	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	LION ENERGY CO LLC	2009	GAS	596	365	WARREN	COLUMBUS	R TRISKET	1	COLUMBUS	DEWEY CORNERS	14-Dec-84
123-39273	LION ENERGY CO LLC		Total	222,127	10							

Permit	Company	Year	Product	Quantity	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-39874	US ENERGY DEV CORP	1987	GAS	11,653	112	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1988	GAS	100,800	352	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1989	GAS	100,330	355	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1990	GAS	60,844	342	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1991	GAS	35,401	324	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1992	GAS	13,041	315	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1993	GAS	6,946	360	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1994	BRINE		137	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	US ENERGY DEV CORP	1994	GAS	5,778	361	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	BELDEN & BLAKE CORP	2000	GAS	92	365	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	BELDEN & BLAKE CORP	2001	GAS	21	365	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	BELDEN & BLAKE CORP	2002	GAS	551	273	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	BELDEN & BLAKE CORP	2002	OIL	0	0	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	RANGE RESOURCES APPALACHIA LLC	2003	GAS	5	62	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	RANGE RESOURCES APPALACHIA LLC	2004	GAS	79	242	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	RANGE RESOURCES APPALACHIA LLC	2005	GAS	308	214	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	TRINITY ENERGY CORP	2007	GAS	32	122	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	LION ENERGY CO LLC	2008	BRINE		38	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	LION ENERGY CO LLC	2008	GAS	388	365	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	LION ENERGY CO LLC	2009	GAS	219	180	WARREN	COLUMBUS	BITTINGER	4	COLUMBUS	DEWEY CORNERS	20-Aug-87
123-39874	LION ENERGY CO LLC		Total	336,487	175							

Permit	Company	Year	Product	Quantity	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-40751	US ENERGY EXPLORATION CORP	1990	GAS	41,981	315	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	US ENERGY DEV CORP	1991	GAS	47,292	357	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	US ENERGY DEV CORP	1992	GAS	25,943	322	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	US ENERGY DEV CORP	1993	GAS	17,584	359	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90



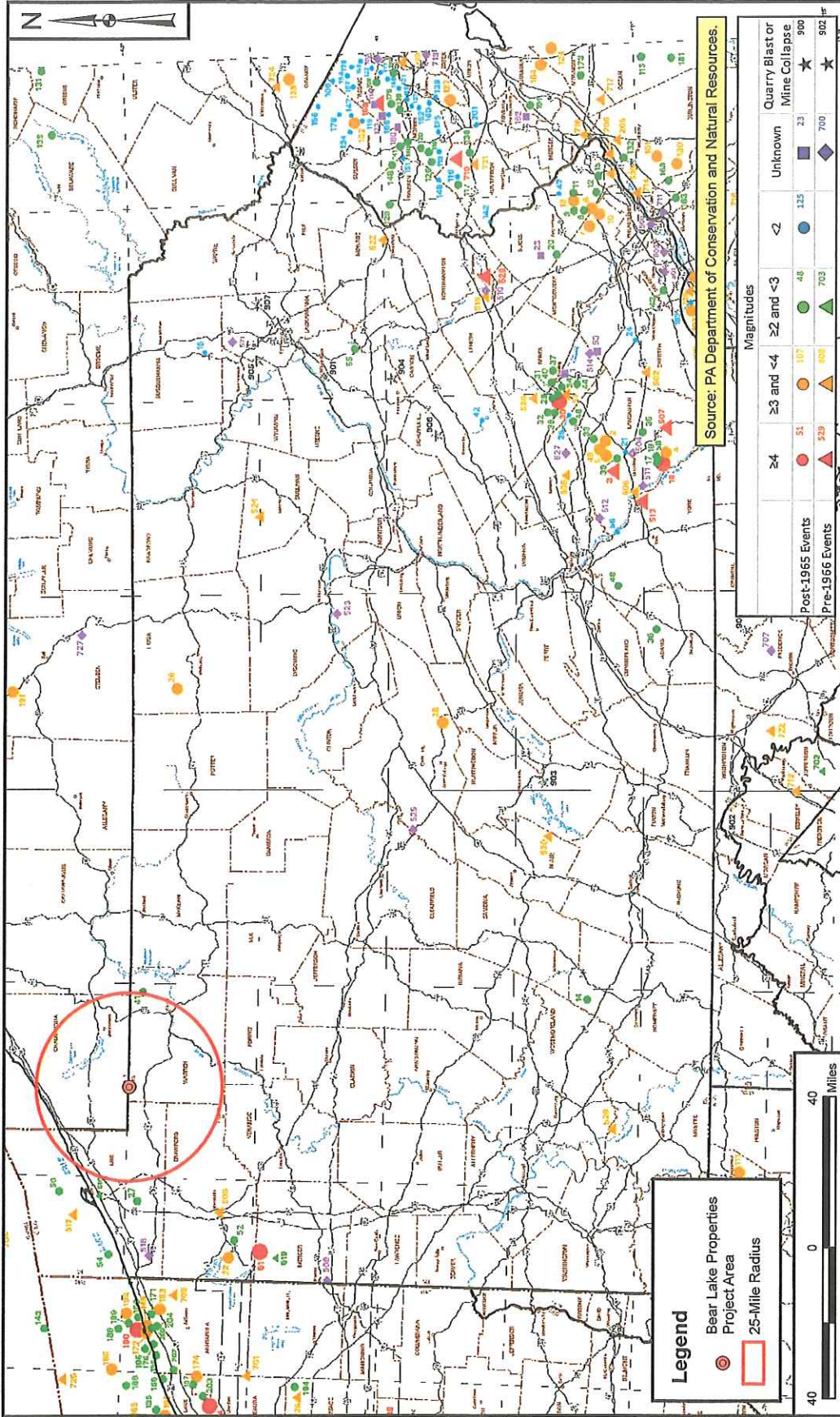
123-40751	US ENERGY DEV CORP	1994	BRINE	137	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90	
123-40751	US ENERGY DEV CORP	1994	GAS	19,177	363	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
2000	BELDEN & BLAKE CORP	2000	BRINE	5	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90	
123-40751	BELDEN & BLAKE CORP	2000	GAS	5,514	366	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	BELDEN & BLAKE CORP	2001	BRINE	17	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90	
123-40751	BELDEN & BLAKE CORP	2001	GAS	4,531	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	BELDEN & BLAKE CORP	2002	GAS	2,340	273	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	BELDEN & BLAKE CORP	2002	OIL	0	0	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	RANGE RESOURCES APPALACHIA LLC	2002	GAS	205	31	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	RANGE RESOURCES APPALACHIA LLC	2003	BRINE	45	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	RANGE RESOURCES APPALACHIA LLC	2004	GAS	1,594	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	RANGE RESOURCES APPALACHIA LLC	2004	GAS	1,422	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	RANGE RESOURCES APPALACHIA LLC	2005	GAS	1,554	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	RANGE RESOURCES APPALACHIA LLC	2006	GAS	1,414	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	TRINITY ENERGY CORP	2007	GAS	278	122	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	LION ENERGY CO LLC	2008	GAS	869	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
123-40751	LION ENERGY CO LLC	2009	GAS	1,506	365	WARREN	COLUMBUS	R. TRISKET	2	COLUMBUS	DEWEY CORNERS	5-Jan-90
Total				204								
				173,205								
Permit	Company	Year	Product	Quantity	Days	County	Municipality	Farm_Name	Farm_Well_No	Field	Pool	Completion Date
123-34843	US ENERGY DEV CORP	1985	GAS	17,683	0	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1986	GAS	31,402	336	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1987	GAS	29,357	322	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1988	GAS	50,639	338	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1989	GAS	52,016	344	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1990	GAS	21,148	330	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1991	GAS	8,423	327	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1992	GAS	1,513	291	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1993	GAS	2,088	268	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	US ENERGY DEV CORP	1994	GAS	1,781	363	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	LION ENERGY CO LLC	2008	GAS	270	365	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
123-34843	LION ENERGY CO LLC	2009	GAS	644	365	WARREN	COLUMBUS	SMITH- RAS	1	COLUMBUS	DEWEY CORNERS	26-Mar-84
Total				216,965								
123-33914	US ENERGY DEV CORP	1984	GAS	5893	0	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1985	GAS	14431.49	0	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1986	GAS	44172.28	336	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1987	GAS	21594.73	336	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1988	GAS	51243.65	356	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1989	GAS	67741.18	364	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1990	GAS	66748.67	352	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1991	GAS	38209	350	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1992	GAS	13492	320	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1993	GAS	6206	352	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	US ENERGY DEV CORP	1994	GAS	2570	341	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	BELDEN & BLAKE CORP	2000	GAS	559	366	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	BELDEN & BLAKE CORP	2001	GAS	438	365	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	BELDEN & BLAKE CORP	2002	GAS	372	273	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	BELDEN & BLAKE CORP	2002	OIL	0	0	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	RANGE RESOURCES APPALACHIA LLC	2002	GAS	46	31	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	RANGE RESOURCES APPALACHIA LLC	2003	GAS	257.85	182	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83

123-33914	RANGE RESOURCES APPALACHIA LLC	2004	GAS	313.84	244	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	RANGE RESOURCES APPALACHIA LLC	2005	GAS	47.28	212	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	RANGE RESOURCES APPALACHIA LLC	2006	GAS	4.33	151	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	TRINITY ENERGY CORP	2007	GAS	64	365	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	LION ENERGY CO LLC	2008	BRINE		38	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	LION ENERGY CO LLC	2008	GAS	392	365	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
123-33914	LION ENERGY CO LLC	2009	GAS	90	120	WARREN	COLUMBUS	JOSEPH BITTINGER	1	COLUMBUS	DEWEY CORNERS	29-Dec-83
			Total	334,886	38							

Total All 7 wells 1,751,614

**GEOLOGIC DATA**  
**EARTHQUAKE EPICENTERS MAP (PA DCNR)**





# EARTHQUAKE OCCURRENCES IN PENNSYLVANIA

BEAR LAKE PROPERTIES, LLC  
WARREN COUNTY, PENNSYLVANIA

DRAWN BY: J. ENGLISH 03/19/14  
CHECKED BY: D. SKOFF 03/21/14  
APPROVED BY:

CONTRACT NUMBER: 112C02984

FIGURE NUMBER  
FIGURE 1

REV  
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**TETRA TECH**