A. Manufacture of Polyethylene Geomembrane

The Geomembrane Manufacturer shall provide documentation that the material meets the requirements of the design specifications and that adequate quality control measures have been implemented during the manufacturing process.

1. Resin Quality

Prior to the shipment of polyethylene geomembrane material, the Geomembrane Manufacturer shall provide the Project Manager and the QA/QC Consultant with the following information:

- The origin (Resin Supplier's name and resin production plant), identification (brand name, number), and production date of the resin;
- A copy of the quality control certificates issued by the Resin Supplier;
- Reports on the tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls and extrudate rods and
- A statement that no reclaimed polymer is added to the resin (however, the use of polymer recycled during the manufacturing process may be permitted if done with appropriate cleanliness and if recycled polymer does not exceed 2 percent by weight).

At the Owner's discretion and cost, testing may be carried out on the resin by the Geosynthetics QA/QC Laboratory for purposes of verifying conformance. If the results of the Manufacturer and the Geosynthetics QA/QC Laboratory testing differ, the testing will be repeated by the Geosynthetics QA/QC Laboratory, and the Geomembrane Manufacturer will be permitted to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

2. Certification of Property Values

In addition to information regarding the raw material, the Geomembrane Manufacturer shall provide the Project Manager and the QA/QC Consultant with the following prior to shipment of the geomembrane:

- A properties sheet certification including, at a minimum, guaranteed values for all properties specified in GRI GM 13.
- A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane.

- Rolls that have minor repairable flaws; and
- Rolls without proper identification.

Rolls without proper identification shall be rejected by the Project Manager.

C. Conformance Testing of Geomembrane
Conformance testing is not specified for the Comp Dairy project.

D. Storage
The Installer shall be responsible for the storage of the geomembrane on site. Storage space should protect the geomembrane from theft, vandalism, passage of vehicles, water, and weather. The QA/QC Consultant shall document that storage of the geomembrane provides adequate protection against dirt, vehicle impact, and other sources of damage.

2.0 Geomembrane Installation
The installation of the geomembrane involves three primary tasks; earthwork, placement of geomembrane field panels, and seaming the field panels.

A. Earthwork
The earthwork supporting the geomembrane and anchoring it in place is crucial to the performance of the geomembrane. The Contractor shall inform the Construction Quality Assurance (CQA) Inspector when the surface on which the geomembrane will be installed is suitable for installation. Geomembrane placement may not commence until both the CQA Inspector and the Installer inspect the subgrade and agree that the area under consideration is acceptable.

It is the Installer's responsibility to protect the supporting soil after it has been accepted. After the supporting soil has been accepted by the Installer, it shall be the responsibility of the Installer and the QA/QC Consultant to indicate to the Project Manager any change in the supporting soil condition that may require repair work.

B. Geomembrane Placement
The placement of field panels of geomembrane is the responsibility of the Installer and shall be performed in accordance with the approved layout and the following sections. The geomembrane shall be placed in direct and uniform contact with the underlying recompacted soil or barrier layer.

1. Panel Layout
If requested, prior to installation, the Geomembrane Installer shall provide to the Project Manager and the QA/QC Consultant, a drawing of the facility to be lined showing the proposed panel layout. The QA/QC Consultant shall review the panel layout drawing and verify it is consistent with the accepted state of practice and the QA/QC Plan. The panel layout drawing shall be approved by the QA/QC Consultant's Engineer (QA/QC Engineer).

5. Weather Conditions

Geomembrane placement shall not proceed when sheet temperature measured by placing a thermometer on the surface of the sheet is below 41°F (5°C) or above 104°F (40°C) for extrusion welding and 140°F (60°C) for fusion welding. Deviations from the above temperature criteria shall only occur when authorized by the Project Manager and with the concurrence of the QA/QC Consultant. Geomembrane placement shall not be done during any precipitation, fog, snow, in an area of ponded water, or in the presence of excessive winds.

The QA/QC Consultant shall verify that the above conditions are fulfilled and shall inform the Project Manager if the conditions are not fulfilled.

6. Anchorage System

Anchor trenches shall be excavated by the Earthwork Contractor (unless otherwise specified) to the lines and widths shown on the plans prior to geomembrane placement. The QA/QC Consultant shall verify that anchor trenches have been constructed according to the plans.

Slightly rounded corners will be provided in trenches where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane. Loose soil shall not underlie the geomembrane in the trenches. Seaming shall continue through the anchor trench.

7. Method of Placement

The following is the responsibility of the Geomembrane Installer; the QA/QC Consultant shall document that these conditions are satisfied:

- Equipment used does not damage the geomembrane by handling, traffic, excessive heat, leakage of liquids, or other means;
- The prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;
- Geosynthetic material immediately underlying the geomembrane is clean and free of debris;
- Personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane;
- The method and equipment used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;

At the Pre-Construction Meeting, the Geomembrane Installer will provide the QA/QC Consultant with a list of proposed seaming personnel and their professional records. This document will be reviewed and approved by the Project Manager and QA/QC Consultant. Seaming personnel shall meet the requirements listed in Section 1.0 of this QA/QC Plan.

2. Seaming Equipment and Products

Approved processes for field seaming are extrusion seaming and fusion seaming. Proposed alternate processes shall be documented and submitted to the Owner for approval. Only seaming equipment which has been specifically approved by make and model shall be used. The Installer shall submit seaming equipment documentation to the Project Manager and the QA/QC Consultant for approval.

The following is the responsibility of the Installer; the QA/QC Consultant shall verify that these conditions are met:

- The Installer maintains on-site the number of spare operable seaming apparatus decided at the Pre-Construction Meeting;
- Equipment used for seaming is not likely to damage the geomembrane;
- The extruder is purged prior to beginning a seam until heat-degraded extrudate has been removed from the barrel;
- For cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to seaming;
- The electric generator is placed on a flat smooth base and a rub sheet such that no damage occurs to the geomembrane; and
- A smooth insulating plate, scrub sheet or fabric is placed beneath the hot seaming apparatus after usage.

4. Weather Conditions for Seaming
The required weather conditions for seaming are as follows:

- The sheet temperatures shall be measured with the thermometer on the surface of the geomembrane sheet.

- Unless authorized in writing by the Project Manager, no seaming shall be attempted at a sheet temperature below 41° F (5°C) or above 104°F (40°C) for extrusion welding and 140°F (60°C) for fusion welding.

- The geomembrane shall be dry and protected from wind.

If the Installer wishes to use methods which may allow seaming at sheet temperatures below 41°F (5°C) or above 104°F (40°C) for extrusion welding and 140°F (60°C) for fusion welding, the Installer shall provide adverse weather welding procedures which shall be reviewed and approved by the QA/QC Consultant, and certify in writing that the installation crew has been trained to perform adverse weather welding. The installer shall also demonstrate through trial welding that the overall quality of the geomembrane is not adversely affected.

5. Overlapping and Temporary Bonding
The following shall be the responsibility of the Installer and verified by the QA/QC Consultant:

- As a general guidance, the panels of geomembrane have a finished overlap of a minimum of 3 inches (75 mm) for extrusion seaming and 4 inches (100 mm) for fusion seaming, but in any event sufficient overlap will be provided to allow peel tests to be performed on the seam;

- No solvent or adhesive is used unless the product is approved in writing by the Owner (samples will be submitted to the Owner for testing and evaluation); and

- The procedure used to temporarily bond adjacent panels together does not damage the geomembrane (in particular, the temperature of hot air at the nozzle of any spot seaming apparatus is controlled such that the geomembrane is not damaged).

The QA/QC Consultant shall log all appropriate temperatures and conditions, and shall log and report to the Project Manager any deviation.

Unless otherwise specified, the general seaming procedure used by the Installer shall be as follows:

- For fusion seaming, a movable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to help prevent any moisture build-up between the sheets to be seamed.

- If required, a firm substrate will be provided by using a flat board or similar hard surface directly under the seam overlap to achieve proper support.

- Wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut wrinkles will be seamed and any portion where the overlap is inadequate will then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches (150 mm) beyond the cut in all directions.

- Seaming will extend to the outside edge of panels to be placed in the anchor trench.

- No field seaming shall take place without the Master Seamer being present.

The QA/QC Consultant shall verify that the above seaming procedures are followed, and shall inform the Project Manager if they are not.

8. Non-Destructive Seam Continuity Testing
The Installer shall non-destructively test field seams over their full length using a vacuum test unit (for extrusion seams only), air pressure test, or other approved method. The testing shall be carried out to the accepted standards of the industry. The purpose of non-destructive tests is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be carried out on 100 percent of the seams as the seaming work progresses, not at the completion of all field seaming, unless otherwise approved by the Project Manager. The Installer shall complete any required repairs in accordance with Subsection 2.D.

a. Air Pressure Testing:
Unless otherwise specified, the general air pressure testing procedure used by the Installer shall be as follows:

- Seal both ends of the test channel with a heat gun or other acceptable clamping method.

- All sections shall be retested and repaired in accordance with Subsection 2D.

c. Vacuum Testing
Unless otherwise specified, the general vacuum testing procedure used by the Installer shall be as follows:

- Turn on the vacuum pump to reduce the vacuum box to approximately 5 psi (0.35 kg/cm3).
- Apply a generous amount of liquid soap and water solution to the area to be tested.
- Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.
- Close the bleed valve and open the vacuum valve.
- Ensure that a leak tight seal is created.
- For a period of not less than 5 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
- If no bubbles appear after 5 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch (75 mm) overlap, and repeat the process.

d. Non-Complying Vacuum Test
In the event of a non-complying vacuum test, the following procedure shall be followed:

- Mark all areas where soap bubbles appear and repair the marked areas.
- Retest repaired areas.

e. QA/QC Responsibilities
The QA/QC Consultant shall:

- Document all continuity testing;
- Record location, date, test unit number, name of tester, and outcome of all testing; and,

The Installer will not be informed in advance of the locations where the seam samples will be taken.

b. Sampling Procedure
Samples shall be cut by the Installer as the seaming progresses in order to have passing test results before the geomembrane is covered by another material. The QA/QC Consultant shall:

- Observe sample cutting;
- Assign a number to each sample, and mark it accordingly;
- Record the sample location on the layout drawing; and
- Record the reason for taking the sample at this location, if not taken due to statistical routine.

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Subsection 2.D.2 of this Plan. The continuity of the new seams in the repaired area will be tested according to Subsection 2.C.8.

c. Size of Samples
At a given sampling location, samples shall be taken by the Installer. The sample shall be cut into three parts and distributed as follows:

- One portion to the QA/QC Consultant for archive storage, 12 inches x 12 inches (30 cm x 30 cm);
- One portion for peel and shear testing in the field, 12 inches x 18 inches (30 cm x 45 cm); and
- At the discretion of the QA/QC engineer and CQA Consultant, one portion for shipment to an independent testing laboratory, 12 inches x 12 inches (30 cm x 30 cm) assuming passing field testing results.

Final determination of the sample sizes shall be made at the Pre-Construction Meeting.

d. Field Testing
Ten (10) one-inch (25 mm) wide specimens shall be removed from the field sample and tested in the field with a tensiometer. Five (5) specimens shall be tested in peel and five (5) in shear; all specimens

- The Installer can trace the seaming path to an intermediate location (at least 10 ft (3 m) from the point of the failed test in each direction) and take a small sample for an additional field test at each location. If these samples pass destructive testing, then the seam is reconstructed between these locations (see Subsection 2.D.2 for repair procedures). If the additional testing fails, then the process shall be repeated to establish the zone to be reconstructed.

All acceptable seams must be bounded by two passing destructive tests. In cases exceeding 150 feet of reconstructed seam length, a sample shall be taken from the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined here must be repeated. The QA/QC Consultant shall document all actions taken in conjunction with destructive test failures.

D. Defects and Repairs

Seams and non-seam areas of the geomembrane shall be examined by the QA/QC Consultant for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The geomembrane surface shall be swept or washed by the Installer if the amount of dust or mud inhibits examination.

1. Evaluation

Each suspect location both in seam and non-seam areas shall be non-destructively tested using the methods described in Subsection 2.C.8 as appropriate. Each location that fails the non-destructive testing shall be marked with an identification code by the QA/QC Consultant and repaired by the Installer. Work shall not proceed with any materials which will cover locations which have been repaired until laboratory test results with passing values are available.

2. Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive test, or non-destructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be approved by the Project Manager and QA/QC Consultant. The procedures available include:

- Patching

  - Apply a new piece of geomembrane sheet over, and at least 6 inches (150 mm) beyond the limits of a defect. The patch shall be extrusion seamed to the underlying geomembrane. This method should be used to repair large holes, tears,

test is achieved. The QA/QC Consultant shall observe non-destructive testing of repairs and shall record the date of the repair and test outcome.

4. Large Wrinkles
When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the QA/QC Consultant shall observe the geomembrane wrinkles. The QA/QC Consultant will indicate to the Project Manager which wrinkles should be cut and reseamed by the Installer. The seam thus produced will be tested like any other repair.

5. Backfilling of Anchor Trench
Anchor trenches will be adequately drained, to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Anchor trenches shall be backfilled and compacted as soon as possible. Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The QA/QC Consultant shall observe the backfilling operation and advise the Project Manager of any problems.

6. Liner System Certification/Acceptance
The Installer and the Manufacturer shall retain ownership and responsibility for the geosynthetics in the facility until acceptance by the Owner. The liner system shall be accepted by the Owner when:

- The installation is finished;
- Verification of the adequacy of seams and repairs, including associated testing, is complete;
- Installer's representative furnishes the Project Manager with certification that the geomembrane was installed in accordance with the Manufacturer's recommendations as well as the design plans and specifications; and
- All documentation of installation is completed including the QA/QC Consultant's final report.

The QA/QC Consultant shall provide certification that installation was performed in accordance with this QA/QC Plan for the project except as noted to the Permit Engineer or Project Manager. If material availability allows, the QA/QC Consultant may collect a material sample for inclusion in the certification report.

7. Materials in Contact with the Geomembranes
The quality assurance procedures indicated in this Subsection are only intended to verify that the installation of these materials does not damage the

TABLE 2-1

FIELD SEAM STRENGTH REQUIREMENTS

HDPE Geomembrane

	PROPERTY	TEST METHOD	VALUE (see note 1)	UNITS
1.	Bonded Seam Shear Strength (see note 1)	ASTM D4437	80	ppi
2.	Peel Adhesion (Fusion)	ASTM D4437	60	ppi
3.	Peel Adhesion (Extrusion)	ASTM D4437	52	ppi

LLDPE Geomembrane

	PROPERTY	TEST METHOD	VALUE (see note 1)	UNITS
1.	Bonded Seam Shear Strength (see note 1)	ASTM D4437	60	ppi
2.	Peel Adhesion (Fusion)	ASTM D4437	50	ppi
3.	Peel Adhesion (Extrusion)	ASTM D4437	44	ppi

Notes:

1. Sample must fail in Film Tear Bond (FTB); PI < 25% (as applicable). If manufacturer standards are more restrictive, they shall supersede the specified values noted herein

3.0 Execution

A. Shipment and Storage

During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, snow or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Geotextile rolls shall be wrapped in plastic sheets or otherwise protected. Wrappings protecting the geotextile rolls should be removed less than one hour prior to unrolling the geotextile. Geotextiles shall not be exposed to precipitation prior to being installed. Wet geotextiles are heavy which makes them difficult to deploy and can also effect liner welding when the geomembrane is adjacent to the geotextile. During cold weather, geotextiles must be protected from freezing.

The QA/QC Consultant shall observe rolls upon delivery and prior to installation, any deviation from the above requirements shall be reported to the Project Manager. Any damaged rolls shall be rejected and replaced at no cost to the Owner.

The Owner will only accept rolls delivered by flatbed trailer.

A. Installation and Handling

The Installer shall handle geotextiles in such a manner as to minimize damage and shall comply with the following:

1. After the wrapping has been removed, a geotextile shall not be exposed to sunlight for more than the time specified by the Geotextile Manufacturer.

2. On slopes, the geotextiles shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geotextile panel in tension.

3. In the presence of wind, geotextiles shall be weighted with sandbags or the equivalent. Sandbags shall be installed during the placement and shall remain until replaced with the appropriate overlying material.

4. Sandbags shall be filled with the fine grained material and must be handled with care to prevent rupture.

5. Geotextiles shall be kept continually under tension to minimize the presence of wrinkles in the geotextile.

6. Geotextiles shall be cut using an approved geotextile cutter only (i.e., an upward cutting hook blade). If in place, special care must be taken to protect other materials from damage which could be caused by the cutting of the geotextiles.

7. The Installer shall take necessary precautions to prevent damage to the underlying layers during placement of the geotextile.

2. Allow minimal slippage of the geotextile on underlying layers;

3. Equipment used for placing the overlying material shall not be driven directly on the geotextile;

4. A minimum thickness of 1 foot (30 cm) of soil must be maintained between a light, low ground pressure equipment and the geotextile;

5. A minimum thickness of 2 feet (61 cm) of soil must be maintained between rubber-tired vehicles and the geotextile unless approved by the Design Engineer and Owner; and,

6. In heavily trafficked areas such as access ramps, soil thickness shall be at least 3 feet (1 m).

Any deviation shall be noted by the QA/QC Consultant and reported to the Project Manager.

SECTION 4.0

GEOCOMPOSITES

1.0 General

A. Description

The work covered in this section shall consist of furnishing the labor, materials, tools, equipment, and incidentals necessary to perform all work required to install geocomposite layer in the storage and containment system.

B. Definitions

1. Geosynthetic Quality Assurance Laboratory - the individual or firm responsible for conducting tests on samples of geosynthetics taken from the site. The Geosynthetic Quality Assurance Laboratory must be independent from the Owner, Manufacturer, Resin Supplier, and Installer, and cannot be provided by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components. The Geosynthetic Quality Assurance Laboratory shall be selected by the Owner and approved by the QA/QC Consultant.

2. Installer - the individual or firm responsible for the unloading, field handling, inspection, sampling, storage, protection, placement, seaming, repair, and all other site aspects of the geonet and geocomposite installation.

3. Manufacturer - the individual or firm responsible for production of geonet, geotextile and/or geocomposite.

4. Resin Supplier - the individuals or firms who produce and deliver HDPE resin to the Manufacturer.

C. Manufacturing Quality Control

Testing shall be carried out by the Manufacturers and Resin Supplier to demonstrate that the raw material, geonet and geocomposite meet the product specification. The Manufacturers shall provide the following information:

1. Copies of the QC certificates issued by the Resin Supplier, including the origin, identification and production dates of the resin.
2. Copies of the QC certificates issued by the geotextile Manufacturer.
3. A list of guaranteed minimum average roll values for the geotextile used in the production of the geocomposite.
4. Copies of the QC certificates issued by the geonet and geocomposite Manufacturer.
5. A list of the guaranteed minimum physical properties for the geonet and geocomposite to be supplied.

accordance with Sections 3.E.3 and 3.F.3. All flawed materials shall be stored in a separate location to insure that they are not inadvertently installed.

Any material damaged during shipment to the site shall be replaced by the Manufacturer at no cost to the Owner. Any material damaged by Installer's failure to properly handle, store and/or protect the material shall be replaced by the Installer at no cost to the Owner.

B. Storage

The Owner will provide a storage location for the material as close as possible to the area of deployment. Geonets shall be stored in their original, unopened, wrapped covers in a clean, dry area. Geonet materials will be unwrapped no more than one hour prior to installation and will not be exposed to ultraviolet light for more than 30 days.

Geocomposites shall also be stored in their original, unopened, wrapped covers such that they are protected from precipitation and ultraviolet light exposure and are free of dirt, dust or cuttings when they are installed. Geocomposite drainage materials shall be adequately pliable to allow for proper deployment.

D. Pre-Installation Inspection

Immediately prior to installation, the QA/QC Consultant shall verify that the geocomposites are free of dirt and dust. If the materials are judged to be dirty or dusty, they shall be cleaned by the Installer prior to installation.

E. Installation of Geocomposites

1. The Installer shall comply with the following:

   a. On slopes, the geocomposites shall be secured at the top of the slope as shown on the Drawings. The geocomposites shall then be rolled down the slope in such a manner as to continually keep the geocomposite sheet in tension to minimize folds and wrinkles.

   b. In the presence of wind, all geocomposites shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with other material.

   c. The Installer shall take all necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

   d. During placement and joining of geocomposites, care shall be taken not to entrap stones, mud or dirt that could cause clogging of the drainage system and/or damage any adjacent geosynthetic materials.

   e. Geocomposites shall be cut with an approved cutter, i.e., hook blade. Care shall be taken to prevent damage to underlying materials.

3. Repairs

The damaged portion of the geocomposite will be inspected by the QA/QC Consultant. If the damaged area exceeds 3 feet by 3 feet, the roll will be cut, the damaged area removed, and a butt joint formed (where permitted) or the entire roll will be replaced. Unless otherwise approved by the QA/QC Consultant, the geocomposite will be repaired as follows if the damaged area is smaller than 3 feet by 3 feet:

a. If the geonet is undamaged, a geotextile patch extending 12 inches beyond the edges of the damaged area shall be thermally bonded in place.

b. If the geonet is damaged, the damaged geonet shall be removed. A section of geonet shall be cut to replace the removed geonet. The geonet patch shall be tied to the existing geonet using plastic fasteners secured at 6-inch intervals, with a staggered double row formation (i.e., the first row of fasteners shall be spaced at 12-inch intervals; the second set of fasteners shall be offset a maximum of 12 inches deep and spaced at 12-inch intervals, staggered in relation to the first row). A geotextile patch extending 12 inches beyond the edges of the damaged area shall be thermally bonded in place.

G. Placement of Cover Materials

The composite liner system must be protected from the intrusion of objects during construction and operation. The Earthwork Contractor shall place all cover materials in such a manner to ensure:

1. the geocomposite, underlying liner materials, and overlying geotextiles are not damaged.

2. there is minimal slippage of the geocomposite on underlying layers.

3. no excess tensile stresses develop in the geocomposite.

MEMORANDUM OF LEASE

Made as of the 14th day of December, 2011, by and between GEARMAR PROPERTIES, INC., an Ohio corporation, as landlord ("Landlord") and AMERICAN WATER MANAGEMENT SERVICES, LLC, an Ohio limited liability company, as tenant ("Tenant").

WITNESSETH:

WHEREAS, as of the date hereof, Landlord and Tenant entered into a certain Lease Agreement (the "Lease"); and

WHEREAS, Landlord and Tenant desire to enter into this Memorandum of Lease to set forth certain terms and conditions of the Lease.

NOW THEREFORE, intending to be legally bound hereby, Landlord and Tenant set forth the following information with respect to the Lease:

1. Landlord: The name of the Landlord is GEARMAR PROPERTIES, INC.

2. Tenant: The name of the Tenant is AMERICAN WATER MANAGEMENT SERVICES, LLC.

3. Addresses: The addresses set forth in the Lease as addressed of the parties are:

LANDLORD: Gearmar Properties, Inc.
PO 209
Portersville, PA 16051

RECEIVED
DEC 27 2011

TENANT: One American Way
Warren Ohio , 44484

4. Date: The Lease is dated as of the December 14, 2011 (the "Effective Date").

5. Term Commencement: The term of the Lease commences on the Effective Date, and continues thereafter until the injection well(s) on the Leased Premises is legally closed.

6. Premises: Tenant has the exclusive right to operate one or more Class II salt water disposal wells on the property of Landlord described on Exhibit "A". Tenant shall have exclusive surface rights over only that portion of the Property as is described or depicted on Exhibit B as the Operations Areas, attached hereto and incorporated by reference herein plus the exclusive area for Rail Lines, Rail Access and Pipelines all as provided in the Lease (the "Leased Premises"), together with the non-exclusive easements and licenses granted to Lessee in the Lease including but not limited to Rail Lines, Siding and Switches, all road ways and other areas for ingress and egress and parking. The Leased Premises shall comprise approximately 5.2 acres for both Wells plus the exclusive area of the Rail Lines,

Rail Access and Pipelines.

WITNESS the due execution hereof.

WITNESSES:

William L Deeds
Dean Gearhart

LANDLORD:

GEARMAR PROPERTIES, INC.

By: William E. Mastteller
Print Name: WILLIAM E MASTELLER
Title: PRESIDENT

TENANT:

AMERICAN WATER MANAGEMENT SERVICES, LLC.

By: Kenneth J. McMahon
Print Name: Kenneth J. McMahon
Title: PRESIDENT

This instrument prepared by:
Jay M. Skolnick, Esq.
Nadler, Nadler & Burdman Co., LPA
20 Federal Plaza West, Suite 600
Youngstown, Ohio 44503

STATE OF OHIO)
) SS:
COUNTY OF Trumbull)

BEFORE ME, a Notary Public, in and for said County and State, personally appeared the above named William E. Marshall known to me to be the President, of GEARMAR PROPERTIES, INC. which executed the foregoing instrument, who acknowledged that he did sign said instrument for and on behalf of said corporation, being thereunto duly authorized by said corporation; that the same is his free act and deed and the free act and deed of said corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and official seal at American Water Mng., this 19th day of December, 2011.

My Commission expires:
Nov. 20, 2013

Judith M. Styka
Notary Public

JUDITH M. STYKA, NOTARY PUBLIC
State of Ohio
My Commission Expires November 20, 2013

STATE OF OHIO)
) SS:
COUNTY OF Trumbull)

BEFORE ME, a Notary Public, in and for said County and State, personally appeared the above named Kenneth J. Miller known to me to be the President of AMERICAN WATGER MANAGEMENT SERVICES, LLC, the company which executed the foregoing instrument, who acknowledged that he did sign said instrument for and on behalf of said company, being thereunto duly authorized by said company; that the same is his free act and deed and the free act and deed of said company.

IN TESTIMONY WHEREOF, I have hereunto set my hand and official seal at American Water Mng., this 19th day of December, 2011.

My Commission expires:
Nov. 20, 2013

Judith M. Styka
Notary Public

JUDITH M. STYKA, NOTARY PUBLIC
State of Ohio
My Commission Expires November 20, 2013

Exhibit "A"

Parcel One:

Situated in the Township of Weathersfield, County of Trumbull and State of Ohio, and being known as Permanent Parcel No. 24-310900 by the Auditor of the County of Trumbull, State of Ohio, the same consisting of 22.8935 acres.

Parcel Two:

Situated in the Township of Weathersfield, County of Trumbull and State of Ohio, and being known as Permanent Parcel No. 24-311300 by the Auditor of the County of Trumbull, State of Ohio, the same consisting of 101.7372 acres.

Geologic Review for Class II Wells

Application No. aPATT020309

SWIW: (Salt Water Injection Well)

Proposed Well Depth: 9100 feet

Proposed Injection Zone: Knox – Mt. Simon

Trumbull County, Weathersfield Twp.

Study area investigated ~ 15 mile radius centered on the proposed well location for all maps except the gravity and magnetic, which have a 30 mile radius.

Gravity Bouguer Anomaly

- The gravity Bouguer Anomaly map shows a NE-SW trending gravity low approximately 16 miles SE of the permit application.

Gravity Free Air

- The free air map shows a NE-SW trending gravity low approximately 20 miles SE of the permit application.

Magnetic First Derivative

- Nothing of note.

Magnetic Second Derivative

- Nothing of note.

Magnetic Reduce Dipole

- The Magnetic Reduce Dipole map shows a NW-SE trending low approximately 24 miles to the NW of the permit application.

Precambrian Structure from PG-23

- Nothing of note.

Knox Structure

- Nothing of note.

Trenton Structure

- Nothing of note.

EGSP Onondaga Structure

- The permit application is situated within a NE-SW trending closed low on the Onondaga structure map.

MRCSP Onondaga Structure

- Nothing of note.

EGSP Berea Structure

- The permit application is located adjacent to a NE-SW trending closed low. A N-S trending structural nose is also present approximately 6 miles SE of the permit application. The North Star #1 well is located over this feature. A NE-SW trending high is present approximately 2 miles east of the permit application.

Mississippian/Pennsylvanian Unconformity Surface

- The Mississippian-Pennsylvanian unconformity is not contoured at the permit application, but numerous irregularities on this unconformity surface are present in the study area.

Middle Kittanning Coal Structure

- Unit not present.

Upper Freeport Coal Structure

- Unit not present.

Pittsburgh Coal Structure

- Unit not present.

Bedrock Geology

- The top of bedrock for the permit application is the Mississippian Logan and Cuyahoga Formations.

Bedrock Topography

- The bedrock topography map shows the permit application is located within a bedrock topographic high surrounded by 3 valleys. Thus, the proposed location is immediately adjacent to the intersection of three strong bedrock topographic valleys – oriented N-S, NE-SW, and NW-SE. The North Star #1 is located is located within one of these NW-SE trends approximately 6 miles south.

EGSP Aerial Photo Lineament

- Numerous lineaments generally less than 1 mile in length have been interpreted from aerial photos by Gray and others (1982) throughout the study area of the permit application with 2 dominant directions oriented northwest-southeast and northeast-southwest.

EGSP LANDSAT Lineament

- A N-S trending lineament is present about 1 mile east of the permit application.

Mason Lineament

- A NW-SE trending lineament is present approximately 1 ½ miles south of the permit application. This lineament named the Blairsville-Broadtop lineament by Mason (1999) is adjacent to the Northstar #1 well.
- A NW-SE trending lineament parallel to the Blairsville-Broadtop lineament is present 11 miles NE of the permit application.
- Three other lineaments are present west of the permit application.

Oil and gas fields

- Production in the study area is in the Berea, Devonian Shale, "Big Lime" and Clinton. The permit application is within the North Ellsworth Cons. Field that produces from the Clinton.

Earthquakes

- There have been 13 earthquake epicenters that have occurred within the 30 mile study area. The nearest is about 5 miles SE of the permit application. All of these earthquake epicenters occurred in 2011 and 2012. The largest had a magnitude of 4.

Injection Wells

- There are 12 SWD (active salt water disposal) wells within the 30 mile study area that are injecting in the Clinton, "Newburg," and Cambrian-Ordovician. The nearest SWD well is approximately 12 miles to the NW of the permit application.

This well is of concern because the location is to the north and on trend with the strong Mahoning River Valley lineament, named the Blairsville-Broadtop lineament by Mason (1999). A linear bedrock valley is used to define this lineament. This lineament is adjacent to the North Star #1 well. The proposed location is also adjacent to three other linear bedrock valleys. Thirteen earthquakes have occurred within the study area since 2010, the nearest is about 5 miles to the SE. Existing deep structure maps indicate no faults in the study area. It should be noted that there is limited deep (Cambrian-Ordovician) well control in this area to define deep structures. This permit application has a proposed TD in the Cambrian basal sandstone (Mt. Simon equivalent).

American Water Management Services, LLC

One American Way • Warren, OH 44484-5555 • Phone: (330) 856-8800 • Fax: (330) 856-8480

December 23, 2011

Mr. Tom Tomastik, Geologist
Division of Mineral Resources Management
Ohio Department of Natural Resources
Fountain Square, 2045 Morse Road
Columbus, Ohio 43229-6693

Re: Submittal of Salt Water Injection Well Permit Application
AWMS No. 2 - Niles Injection Site
American Water Management Services, LLC - Owner Number 8905

Dear Tom:

Enclosed please find the subject application for Salt Water Injection Well AWMS No. 2 proposed to be located in Section No. 9, Weathersfield Township, Trumbull County, Ohio, by American Water Management Services, LLC (AWMS). Concurrent with the submittal of this application, AWMS is submitting an application for a second salt water injection well, AWMS No. 1, at the same site. The two proposed injection wells will share above ground unloading, storage, treatment, and other necessary facilities.

The application includes the required forms, exhibits, figures, maps, affidavits, and other information that we believe is required, along with the application fee of $1000.

Thank you for your time and assistance during our preparation of this application. Please contact me at 330-856-8876 or skilper@avalonholdings.com with any questions.

Stephen G. Kilper, PE
Vice President

SGK:akm\2247

cc: Ken McMahon, AWMS (w/encl)
Gearmar Industries (w/encl)
Dwight Williams, KU Resources

Application

Proposed Saltwater Injection Well AWMS No. 2

Niles Injection Site

Weathersfield Township, Trumbull County

American Water Management Services, LLC

December 23, 2011

Application Package Contents

- Application Fee (original only)
- Form 1 - Application for Permit
- Form 210 - Supplement to Application for Salt Water Injection
- Exhibits 1 and 2 to Form 210
- Well Construction Detail
- Saltwater Injection Well Affidavit
- Form 4 - Restoration Plan (duplicate)
- Figure 1 - Area of Review Map
- Figure 2 - Niles Injection Site Proposed Layout
- Figure 3 - Layout and Construction Details, Storage Impoundment
- Figure 4 – Layout and Construction Details, Unloading Pad and Storage Tank Containment
- Plat Map (original plus two copies)
- Geosynthetic Materials Quality Assurance/Quality Control Plan
- Memorandum of Lease

American Water Management Services, LLC

One American Way • Warren, OH 44484-5555 • Phone: (330) 856-8800 • Fax: (330) 856-8480

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Weathersfield Township, Trumbull County

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APPLICATION FOR A PERMIT (Form 1)
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL AND GAS RESOURCES MANAGEMENT
2045 Morse Road, Building H-3
COLUMBUS, OHIO 42229-6693
(614) 265-6633

SEE INSTRUCTIONS ON PAGE 2 (BACK)

1. I, We (applicant) American Water Management Services LLC — 2. Owner #: 8905
(address) One American Way, Warren, Ohio, 44484 — Phone #: 330-856-8800
Hereby apply this date December 23, 2011 for a permit to:

- ☐ Reissue (check appropriate blank)
- ☒ Drill New Well
- ☐ Drill Directionally
- ☐ Drill Horizontally
- ☐ Revised Location
- ☐ Plug Back
- ☐ Plug and Abandon
- ☐ Orphan Well Program
- ☐ Convert
- ☐ Deepen
- ☐ Reopen
- ☐ Temporary Inactive

3. TYPE OF WELL:
- ☐ Oil & Gas
- ☐ Stratigraphic test
- ☐ Annular Disposal
- ☐ Gas Storage
- ☒ Saltwater Injection
- ☐ Other (explain): _____
- ☐ Solution Mining *
- ☐ Input/Injection
- ☐ Enhanced Recovery *
- ☐ Water Supply

* if check, select appropriate box below:
- ☐ Observation
- ☐ Production/Extraction

4. MAIL PERMIT TO: American Water Management Services LLC
c/o Mr. Steve Kilper
One American Way
Warren, Ohio 44484

20. TYPE OF TOOLS:
- ☐ Cable
- ☐ Cable/Air Rotary
- ☐ Cable/ Fluid Rotary
- ☐ Cable/Air/Fluid Rotary
- ☐ Air Rotary
- ☒ Air/Fluid Rotary
- ☐ Fluid Rotary
- ☐ Service Rig

5. COUNTY:	Trumbull
6. CIVIL TOWNSHIP:	Weathersfield
7. SECTION: 9	8. LOT:
9. FRACTION:	10. QTR TWP:
11. TRACT/ALLOT:	
12. WELL #:	2
13. LEASE NAME:	AWMS-2
14. PROPOSED TOTAL DEPTH	9,100'

21. PROPOSED CASING PROGRAM:
20" Conductor minimum of 60'(if air); 13-3/8" surface casing minimum 1,100' (cement circulated to surface); 9-5/8" production casing minimum 7,300' (casing cement to 4,000'); 4-1/2" tubing set at 7,250'; "Blow out Preventor Required" Hazardous Conditions may be encountered; All due precautions should be taken.

15. PROPOSED GEOLOGIC FORMATION:
Knox Dolomite and the Mt. Simon Sandstone

16. DRILLING UNIT IN ACRES (must be same as acres indicated on plat):
101 Acres

22. FIRE AND MEDICAL DEPARTMENT TELEPHONE NUMBERS (closest to well site):
Fire: 911
Medical: 911

17. IF PERMITTED PREVIOUSLY:

API #:	
OWNER:	
WELL #:	
LEASE NAME:	
TOTAL DEPTH:	
GEOLOGICAL FORMATION:	

23. MEANS OF INGRESS & EGRESS:
Township Road: N Main Street
County Road: _____
Municipal Road: _____
State Highway: 169

18. IF SURFACE RIGHTS ARE OWNED BY THE OHIO DEPARTMENT OF NATURAL RESOURCES
Division Name: _____
Division Phone: _____

24. IS THE WELL LOCATION OR THE PRODUCTION FACILITIES WITHIN AN URBANIZED AREA AS DEFINED BY 1509.01(Y)?
☒ Yes ☐ No

19. LANDOWNER ROYALTY INTEREST:
Is There An Attached List? ☐ Yes ☒ No
Name: Gearmar Properties, Inc.
Address: PO Box 209, Portersville, PA 16051
Name: _____
Address: _____
Name: _____
Address: _____

I, the undersigned, being first duly sworn, depose and state under penalties of law, that I am authorized to make this application, that this application was prepared by me or under my supervision and direction, and that the facts stated herein are true, correct, and compete, to the best of my knowledge.

I, the undersigned, further depose and state that i am the person who has the right to drill on the tract or drilling unit and to drill into and produce from a pool and to appropriate the oil or gas that I produce therefrom either for myself or others as described in this application. And furthermore, I, the undersigned, being duly sworn, depose and state at this time that I am not liable for any final nonappealable order of a court for damage to streets, roads, highways, bridges, culverts, or drainage ways pursuant to Section 5577.12 of the Ohio Revised Code (ORC). I, the undersigned, further depose and state that all notices required by 1509.06 (A) (9) ORC for this application have been duly provided by me. If applying for a permit to plug and abandon a well, I hereby certify that the written notices, as required by Section 1509.13, ORC, have been given.

That I hereby agree to conform with all provisions of Chapter 1509., ORC, and chapter 1501., ORC, and all orders and conditions issued by the chief, division of Oil and Gas Resources management.

Signature of Owner/ Authorized Agent: Kenneth J. McMahon

Name (Type or Print): Kenneth J. McMahon — Title: President

If signed by Authorized Agent, a certificate of appointment of agent must be on file.

Sworn to and subscribed before me this the 23rd day of December, 20 11

Angela K. Marimpietri
(Notary Public)

9/26/2015
(Date Commission Expires)

DNR 5619 (Rev. 10/2011)

NOTARY PUBLIC STATE OF OHIO

ANGELA K. MARIMPIETRI
Notary Public - State of Ohio
My Commission Expires 9/26/2015

SUPPLEMENT TO APPLICATION
PERMIT FOR A SALTWATER INJECTION WELL (Form 210)

Ohio Department of Natural Resources, Division of Oil and Gas Resources Management
2045 Morse Road, Bldg H3
Columbus, OH 43229-6693

AREA OF REVIEW. An application for a saltwater injection well (SWIW) will be evaluated on the basis of an "area of review" surrounding the proposed well. The area of review for wells in which injection of greater than two hundred barrels per day is proposed shall be the area circumscribed by a circle with the center point at the location of the injection well and a radius of one-half mile. The area of review for wells in which a maximum injection of two hundred barrels per day or les is proposed shall be the area circumscribed by a circle with the center point at the location of the injection well and a radius of one-quarter mile.

31. **PROPOSED INJECTION ZONE**

Geologic Formation: Knox Dolomite and the Mt. Simon Sandstone
Injection Interval: From: 7,300 feet to 9,100 feet
Geologic description of injection zone: Dolomite and Sandstone

32. **WELL CONSTRUCTION AND OPERATION**

A. Description of the proposed casing and cement program for new wells, or of the casing, cementing or sealing with prepared clay for existing wells to be converted.
Casing and Cement Program: See Attached Well Detail for AWMS No. 2. Casing sizes, types, set depths, cement quantities and cement tops are described.

B. Proposed method for testing the casing:

See attached "Exhibit 1" Supplement to Application.

C. Description of the proposed method for completion and operation of the injection well:

See attached "Exhibit 1" Supplement to Application.

D. Description of the proposed unloading, surface storage, and spill containment facilities:

See "Exhibit 2" for diagrams and descriptions.

33. **PROPOSED INJECTION VOLUMES**

A. Indicate the estimated amount of saltwater to be injected into the proposed injection well per day:

AVERAGE: 2,200 bbl/day MAXIMUM: 4,000 bbl/day

B. Indicate the method to be used to measure the actual amount of saltwater injected into the well:

Electronic monitoring will be installed at the discharge of the injection pump. This volume along with the injection pressure at the pump, wellhead, and annular pressure will be monitored (see attached "Exhibit 1").

34. **PROPOSED INJECTION PRESSURES**

A. Indicate the estimated pressure to be used for injection of saltwater into the proposed injection well:

AVERAGE: 1,050 psi MAXIMUM: 1,680 psi

B. Indicate the method to be used to measure the actual daily injection pressure:

Pressure transducers and transmitters will be installed at the wellhead on the tubing and the tubing casing annulus. They will be continuously monitored and data stored electronically (see attached "Exhibit 1").

35. **PROPOSED CORRECTIVE ACTION**

Explain any corrective action proposed for wells penetrating the proposed injection formation or zone within the area of review:

At the time of this application, there are no known wells currently penetrating and/or producing from the proposed disposal formations within the area of review.

36. MAP. Each application for a permit shall be accompanied by a map or maps showing and containing the following information:

A. The subject tract of land on which the proposed injection well is to be located.

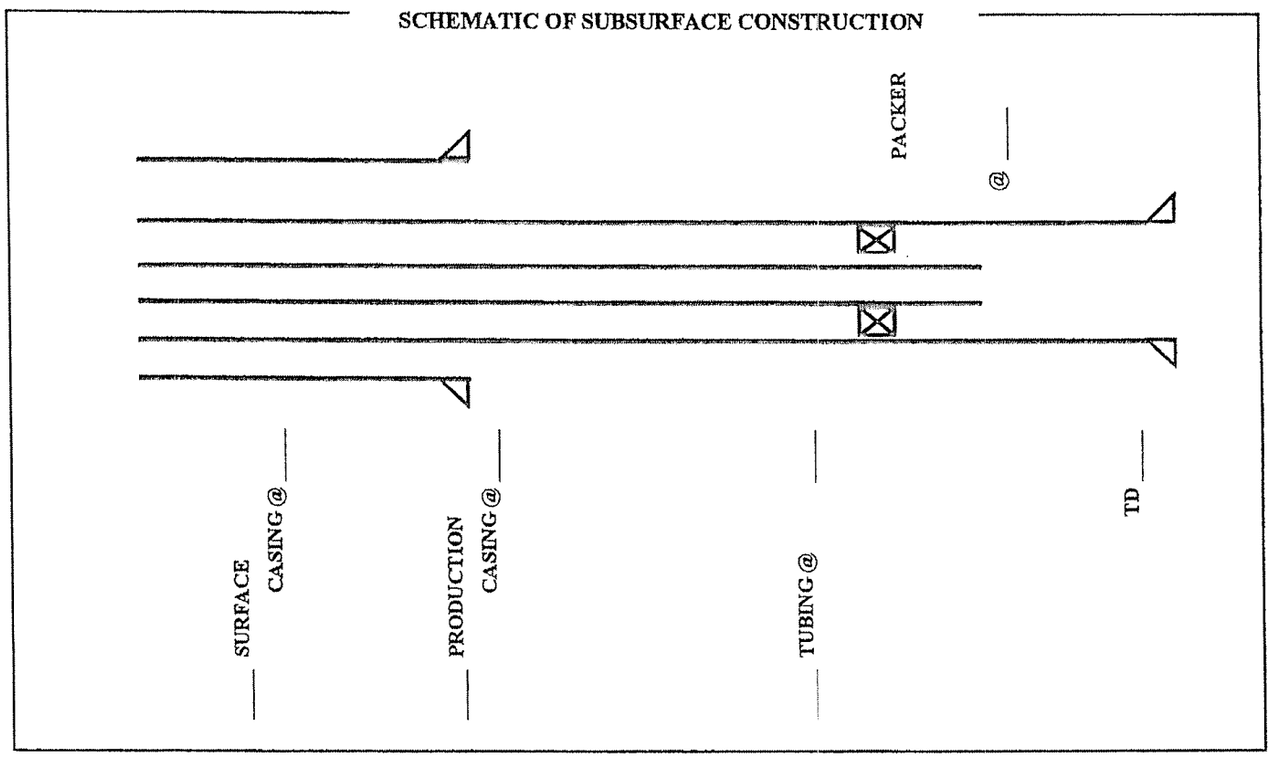
B. The location of the proposed injection well on the subject tract established by an Ohio registered surveyor showing the distances in feet from the proposed well site to the boundary lines on the subject tract;

C. The geographic location of all wells, penetrating the formation proposed for injection regardless of status, within the area of review;

D. All holders of the land owner's royalty interest of record, or holders of the severed oil and gas mineral estates of record in the subject tract;.

E. All owners or operators of wells producing from or injecting into the same formation proposed as the injection formation.

37. SCHEMATIC DRAWING OF SUBSURFACE CONSTRUCTION. Label the schematic drawing below indicating size and setting depth of surface casing, intermediate (if any) and production casings; amount of cement used, measured or calculated tops of cement; size and setting depth of tubing; type and setting depth of packer; geologic name of injection zone showing top and bottom of injection interval. If the proposed input well design is substantially different from the schematic below, attach on a separate sheet a schematic of your proposal labeled with the above information.



38. Public notice of an application for an enhanced recovery project is required by law. In addition, the applicant must submit, on an attached sheet, a list of the names and address of those persons required to receive personal notice in accordance with Rule 1501:9-5-05(E)(1), of the Ohio Administrative Code.

After submitting the application, and after a determination by the Division that it is complete as required by the rules of the Division, a legal notice must be published by the applicant in a newspaper of general circulation in the area of review. The legal notice must contain the information described in Rule 1501:9-5-05(E)(1) of the Ohio Administrative Code. A copy of the notice must be delivered to all owners or operators of wells within the area of review producing from or injecting into the same formation proposed as the injection formation. Proof of publication, publication date, and an oath as to the delivery to those entitled to receive personal notice under this method must be filed with the Division within thirty days after the Division determines that the application is complete.

In addition, notice of all applications for enhanced recovery projects will be published in the Division's Weekly Circular.

The undersigned hereby agrees to comply with all provisions for an enhanced recovery project as required by Chapter 1501:9-5 of the Ohio Administrative Code. In addition, the undersigned deposed and says that he shall conform to all provisions of Section 1509.072 of the Ohio Revised Code, and to all orders and rules issued by the Chief, Division of Mineral Resources Management.

Owner/ Authorized Agent (Type or Print) American Water Management Services, LLC; Kenneth J. McMahon

Signature of Owner/Authorized Agent Kenneth McMahon Title President

Permanent Address of Home Office One American Way, Warren, Ohio 44484

If signed by Authorized Agent, a certificate of appointment of agent must be on file with the Division.

Sworn to and subscribed before me this the 23rd day of December, 20 11

Angela K Marimpietri (Notary Public)

9/26/2015 (Date Commission Expires)

NOTARY PUBLIC STATE OF OHIO

ANGELA K. MARIMPIETRI
Notary Public - State of Ohio
My Commission Expires 9/26/2015

AWMS No. 2

Weathersfield Township

Trumbull County

Location: N 561766.2718/E 2443195.0238

Elevation: Approximately 908' MSL

EXHIBIT 1

SUPPLEMENT TO APPLICATION

PERMIT FOR SALTWATER INJECTION WELL (Form 210)

31) Proposed Injection Zone

Geologic Formation: Knox Dolomite and the Mt Simon

Injection Interval: 7,300' to 9,100'

Geologic Description: Dolomite and Sandstone

32) Well Construction and Operation

Casing and Cement Program: See the attached Well Detail. Casing sizes, types, set depth, cement quantities, and cement tops are described.

Proposed method for testing casing: The 9-5/8" casing will be pressure tested to 1,600 psi at the conclusion of the cementing process. Additionally, there will be a BOP test on the casing to 1,000 psi prior to drilling off the casing shoe into the open borehole. The 9-5/8" casing will be tested to 2,200 psi as a part of a mechanical integrity test. The test will be witnessed by an ODNR Inspector. The annular space between the 4-1/2" tubing and the 9-5/8" casing will be pressurized up to a minimum of 2,200 psi and monitored for a minimum of 30 minutes. A pressure chart and injectivity data will be submitted to the ODNR. The 4.5" injection string will also be equipped to receive a set mechanical plug to allow testing without disturbing the packer. The 4.5" injection string will also be pressurized up to a minimum of 2,200 psi and monitored for a minimum of 30 minutes. This pressure data will be included with the ODNR submittal. The pressure on the annular space will be continually monitored electronically once injection begins to assure the mechanical integrity of this annular space.

Description of the proposed method for completion and operation of the injection well: The well will be equipped with 9-5/8" casing set and cemented above the injection horizon. Approximately 1,800' of 8-1/2" open hole will exist below the 9-5/8" casing. This open hole interval will be acidified with a 15% HCL solution to enhance the porosity and permeability of the injection horizon. Injection into this horizon will be accomplished by pumping filtered and treated water down the 4-1/2" injection tubing into the disposal horizon. This tubing is isolated from the 9-5/8" casing by means of a mechanical packer set. The attached Well Detail illustrates the well configuration.