

A.11 Description of the drilling program, including the drilling fluid and mud program, how the fluids will be handled and ultimate disposition of the drilling fluids. Include a discussion of whether overpressured zones are anticipated and how the mud program will be modified to accommodate such a condition.

The proposed wells (IW-1 and IW-2) will be newly installed Class I non-hazardous wells to be located in Sections 34 and 35, T8N, R14W, in Coopersville, Ottawa County, Michigan. Ground level is estimated to be approximately 676 feet above sea level (ASL) at both well sites, with Kelly Bushing (KB) elevation that will be dependent on type of rig available when the wells are installed. All referenced depths provided below and throughout this application are referenced in feet below ground level (ft BGL). The wells will be drilled to a total depth (TD) of approximately 7,440 ft BGL through the Mt. Simon Sandstone. Ottawa County Landfill, Inc. intends to complete the interval from the top of the Trempealeau through the Mt. Simon as the injection interval. Proposed well schematics for the IW-1 and IW-2 wells are provided on Figures A. 11-1 and A. 11-2, respectively.

Drilling, Casing and Testing Program

Upon preparation of the site and mobilization of required equipment, 24 inch conductor casing will be driven to a depth of approximately 100 feet. If driven casing is not practical due to equipment availability or other factors, the 24-inch, 163.2 lb/ft, J-55 grade, ST&C (short threaded and coupling), or suitable equivalent conductor casing will be cemented to surface in a 28 inch borehole to an anticipated depth of approximately 100 feet for both wells. If a gauge borehole diameter is assumed and 75% excess cement is assumed, approximately 168 sacks (sx) of 1.18 ft³/sx yield Michigan equivalent Class A cement with additives or suitable equivalent would be utilized to cement the string to surface. Site specific conditions will be used to further refine cement volume.

A 21-inch borehole will then be drilled out of conductor casing to a depth of approximately 570 feet. Confirmation of the base of underground source of drinking water (estimated at 470 feet BGL per the assigned maximum base of USDW within the Ottawa County Farms Landfill AOR boundary) will be conducted via geophysical well logging. After the openhole logging/testing program is completed, the hole will be conditioned and 16-inch, 75 lb/ft, J-55 ST&C (or suitable equivalent) casing will be installed from surface to a depth of approximately 570 feet. The cementing program will be determined based on field conditions, but at a minimum will consist of a mixture of Michigan equivalent Class A standard cement with additives or a suitable equivalent. Excess cement (minimum of 75% of the calculated volume) will be available and may be used based on measured hole conditions. It is anticipated that a float shoe will be used with a float collar located one joint off bottom, and that centralizers will be placed at a minimum of one every third joint depending on hole condition. Other than cement volume that may be modified based on well conditions encountered at the time of cementing, advanced notice will be provided to EGLE in the event that cement plans are changed.

After the surface casing string has been cemented and a minimum of 36 hours waiting on cement (WOC) time has elapsed, the remaining cement will be drilled out of the surface casing shoe and a 12-3/4 inch hole will then be drilled to approximately 3,760 feet, 40 feet into the Clinton Group. A cement bond log will be conducted over the surface casing interval to demonstrate cement integrity behind the surface casing. Open hole logging will be conducted from the base of the surface casing to surface prior to running intermediate casing. After the logging/testing program is completed, the hole will be conditioned and 10-3/4 inch 51 lb/ft, J-55 LT&C (or suitable equivalent) intermediate casing will be installed from surface to a depth of approximately 3,760 feet. The cementing program will be determined based on field conditions, but at a minimum will consist of a mixture of Michigan equivalent Class A standard cement with additives or a suitable equivalent. At least 150 sacks of neat cement will be run as a tail. Excess cement (minimum of 25% of the calculated volume) will be available and may be used based on measured hole conditions. It is anticipated that a float shoe will be used with a float collar located one joint off bottom, and that centralizers will be placed at a minimum of one every third joint depending on hole condition. Other than cement volume that may be modified based on well conditions encountered at the time of cementing, advanced notice will be provided to EGLE in the event that cement plans are changed.

After the 10-3/4 inch intermediate casing string has been cemented and a minimum of 36 hours waiting on cement (WOC) time has elapsed, remaining cement will be drilled out of the intermediate casing string shoe and an 9-5/8 inch hole will then be drilled to a depth of approximately 5,460 feet, through the base of the Prairie du Chien Group and into the top of the Trempealeau Formation. A cement bond log will be conducted over the intermediate casing interval to demonstrate cement integrity behind the casing. Openhole logging will be completed from the base of the intermediate casing to the total depth of the 9-5/8 inch hole. It is projected that after the first phase of the deep openhole logging program is complete (see Table A.13-1, Section A.13), the hole will be conditioned and 7-5/8 inch, 26.4 lb/ft, L-80 LT&C (long threaded and coupling), or suitable equivalent, long-string casing will be installed to a depth of approximately 5,460 feet in both wells. The cementing program for the long string will be determined based on field conditions, but is projected to consist of a mixture of Michigan equivalent Class A standard cement with additives or suitable equivalent. Depending on hole conditions and geologic considerations, light-weight cement and/or a two-stage cement job utilizing a DV tool may be utilized. A minimum of 150 sacks of neat cement will be displaced above the shoe. Excess cement (minimum of 25% of the calculated volume) will be available and may be used based on measured hole conditions. Additional excess cement, if any, will be pumped based on field conditions. It is anticipated that a float shoe will be used with a float collar one joint up from the bottom and that centralizers are to be placed a minimum of one every third joint. Other than cement volume that may be modified based on well conditions encountered at the time of cementing, advanced notice will be provided to EGLE in the event that cement plans are changed.

Shoe cement will then be drilled out of the 7-5/8 inch casing and the well will be

deepened using a 6-3/4 inch bit to a depth of up to approximately 7,440 feet, or to the base of the Mt. Simon. A drill stem test (DST) may be conducted to obtain a sample of injection interval fluids prior to reaching total depth; however this testing may be delayed until after drilling operations are completed. After drilling is completed, openhole logging will be conducted to obtain additional data regarding the injection interval. In addition, a cement bond log and baseline casing inspection log will be conducted over the long string casing interval, and a directional survey will be conducted to ascertain the trajectory and bottom hole location of the well. Note that standard site Health and Safety procedures will be implemented during well installation, including daily and task-specific safety meetings. As needed, methane monitoring will be conducted to identify any potential explosion hazards.

The packer in each well will be set to a depth of within 100 feet of the long-string casing shoe. A packer will be set at a depth of approximately 5,360 feet or deeper inside the 7-5/8 inch long string casing of both wells, and 4-1/2 inch OD, 11.6 lb/ft, L-80 LT&C tubing will be run from the packer to surface. As appropriate, coated or lined tubing and packer may be used to manage potential corrosion issues. A radioactive tracer survey (RAT) and a temperature log will then be conducted to establish baseline conditions and to demonstrate initial external (Part II) mechanical integrity. A pressure transient test will also be conducted to derive estimates of formation pressure and properties (See Section A.14).

No over-pressured zones are anticipated during drilling of the IW-1 and IW-2 wells. If under-pressured zones are encountered, lost-circulation materials will be utilized to control fluid loss as necessary based on well conditions. Fresh water will be trucked to the site using local oilfield suppliers or a pre-existing water well already located on the property will be used to supply water during drilling and testing of this well. Fresh water will be used as the drilling fluid, and will be held in on-site tanks with no in-ground pits. Upon completion of drilling operations, remaining fluids and solids will be disposed of at the on-site landfill owned and operated by the well owner, or off-site by a licensed waste hauler or a suitable equivalent contractor. No cuttings disposal will take place at the well sites.

The IW-1 and IW-2 wells are expected to be installed and tested in the year 2021 according to well owner demands, applicable regulations and permit requirements. Prior to conducting any injection testing, injection formation native brine chemistry and characteristics will be determined based by acquisition of a fluid sample. As discussed in more detail later in this section, static pressure testing of the injection zone will be performed, along with determination of various injection interval characteristics such as permeability-thickness using pressure transient testing methods. Characteristics of the injection interval will also be evaluated based on geophysical well logging results. Additional details regarding the well logging are presented in Table A.13-1 in Section A.13.

To obtain an original sample of injection interval fluid if a DST is not conducted during drilling, fluid will be produced from the openhole completion using either a submersible

pump or by using a workover rig and swabbing equipment. The type of testing method used will be determined based on equipment availability at the time the wells are drilled and tested. Based on fluid loss encountered during drilling and field conditions, target production volumes for obtaining representative samples will be adjusted in the field, based on conditions encountered. Field parameters including pH and conductivity will also be monitored at surface as fluid is recovered to determine when representative fluid sampling is practical. Injection Zone formation fluid will be subjected to analysis for the following parameters:

- Alkalinity, Arsenic, Barium, Bicarbonate, Cadmium, Calcium, Carbonate, Chloride, Chromium, Conductivity, Copper, Hardness, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Nitrate, as (N), pH, Potassium, Radium 226, Radium 228, Selenium, Silica as SiO₂, Sodium, Specific Gravity, Strontium, Sulfur, TDS, TSS, Zinc

Mechanical integrity and ambient reservoir monitoring will be conducted after well construction activities are complete. Annual Part I mechanical integrity testing (MIT) for the IW-1 and IW-2 wells and 5-year Part II MIT procedures are detailed below. Although test procedures or methods may be changed based on approval by EGLE staff, the following procedure will be used for the testing:

1. Conduct Wellsite Safety Meeting
 - a. Prior to commencement of field activities, conduct safety meeting with contractors and personnel to be involved with field services and MIT testing. Ensure that all safety procedures are understood and review days' work activities.
2. Conduct Reservoir (Fall-Off or Static) Pressure Test
 - a. For fall-off, record data regarding test well injection at typical operating conditions (constant rate). Rate versus time data will be recorded during the injection period. Cumulative injection volume will also be recorded. Continue injection for a minimum of approximately 8 hours. Note that significant rate variations may require more complicated analysis techniques.
 - b. Rig-up pressure gauge and run in well to a depth likely not to exceed approximately 5,460 feet or other depth approved by EGLE.
 - c. For pressure transient fall-off, obtain final stabilized injection pressure for a minimum of 1 hour. For static test, collect a minimum of two pressure/temperature readings at depth. Ensure that the gauge temperature readings have also stabilized.
 - d. After gauge recordings are stable, cease injection and monitor pressure fall-off. Continue monitoring pressure for a minimum of 8 hours or until a valid observation of fall-off curve is observed. For a static gradient survey, the well will be shut-in for a minimum of 48 hours before testing. Wellbore pressure gradients will be obtained to establish fluid gradient and bottomhole pressure data will be collected for a minimum of 4 hours for

static testing.

- e. Stop test data acquisition, rig-down and release equipment.

3. Annulus Pressure Test

- a. Stabilize well pressure and temperature for a target period of 12-hours.
- b. As practical, arrangements will be made for a representative from the EGLE to be present to witness testing.
- c. Install ball valve or similar type “bleed” valve on annulus gate valve. Pressurize annulus to a minimum of 100 psig above maximum permitted operating pressure and shut-in valve. Install certified gauge on “bleed” type valve. The annulus may need to be pressurized and bled off several times to ensure an absence of air.
- d. Monitor and record pressure for 1 hour. Pressure may not fluctuate more than 3% during the one-hour test.
- e. Lower the annulus pressure to normal operating pressure at the end of the test.

The Part II external mechanical integrity demonstration for the well will be accomplished via a minimum of one approved logging method such as temperature log, or radioactive tracer survey, or noise log, or oxygen activation log.

Although Ottawa County Landfill, Inc. may utilize any acceptable method per EGLE procedure approval, at this time it is proposed that temperature logging be utilized for 5-year Part II mechanical integrity testing. Static temperature logging is to be conducted as follows:

1. Conduct Temperature Log

- a. Shut-in well for stabilization (minimum of 36 hours, or as required by EPA/EGLE) prior to running base temperature log.
- b. Rig-up temperature log and run base log from surface to total depth. Pull tool to surface and shut-in master valve.
- c. Rig-down equipment and return the well to normal operations.

Future annual or 5-year testing will be conducted using these procedures unless alternative procedures are approved by EGLE in advance. Future periodic MIT testing will be conducted after Ottawa County Landfill, Inc. provides the agency with a minimum of a 30-day notice of testing, as practical, to allow the agency an opportunity to witness data collection activities.

Sec. 34, T08N, R14W
 Ottawa County, Michigan
 Proposed Location: Lat. 43.044394, Long. -85.94935

All depths are TVD referenced to ground level.

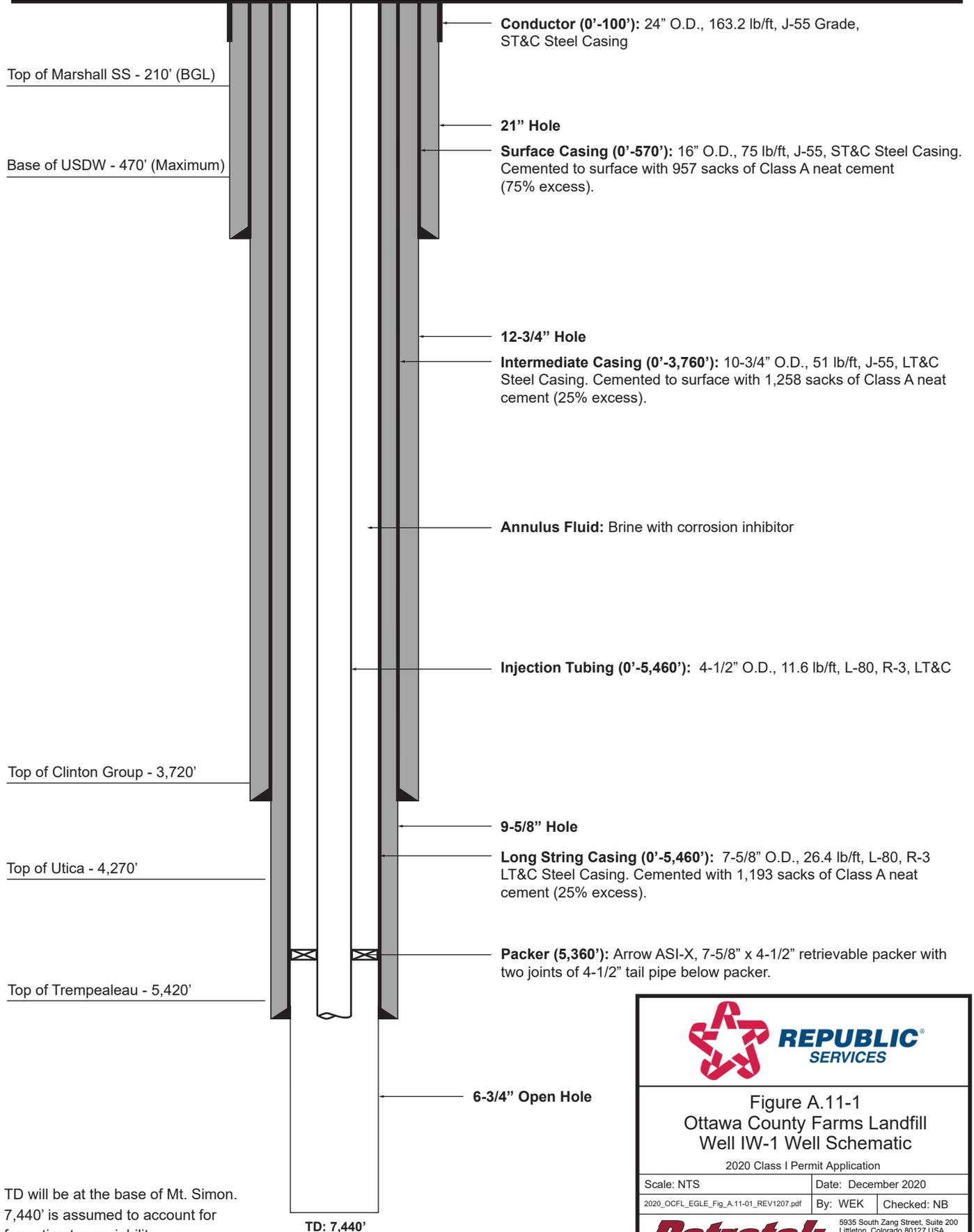




Figure A.11-1
Ottawa County Farms Landfill
Well IW-1 Well Schematic
 2020 Class I Permit Application

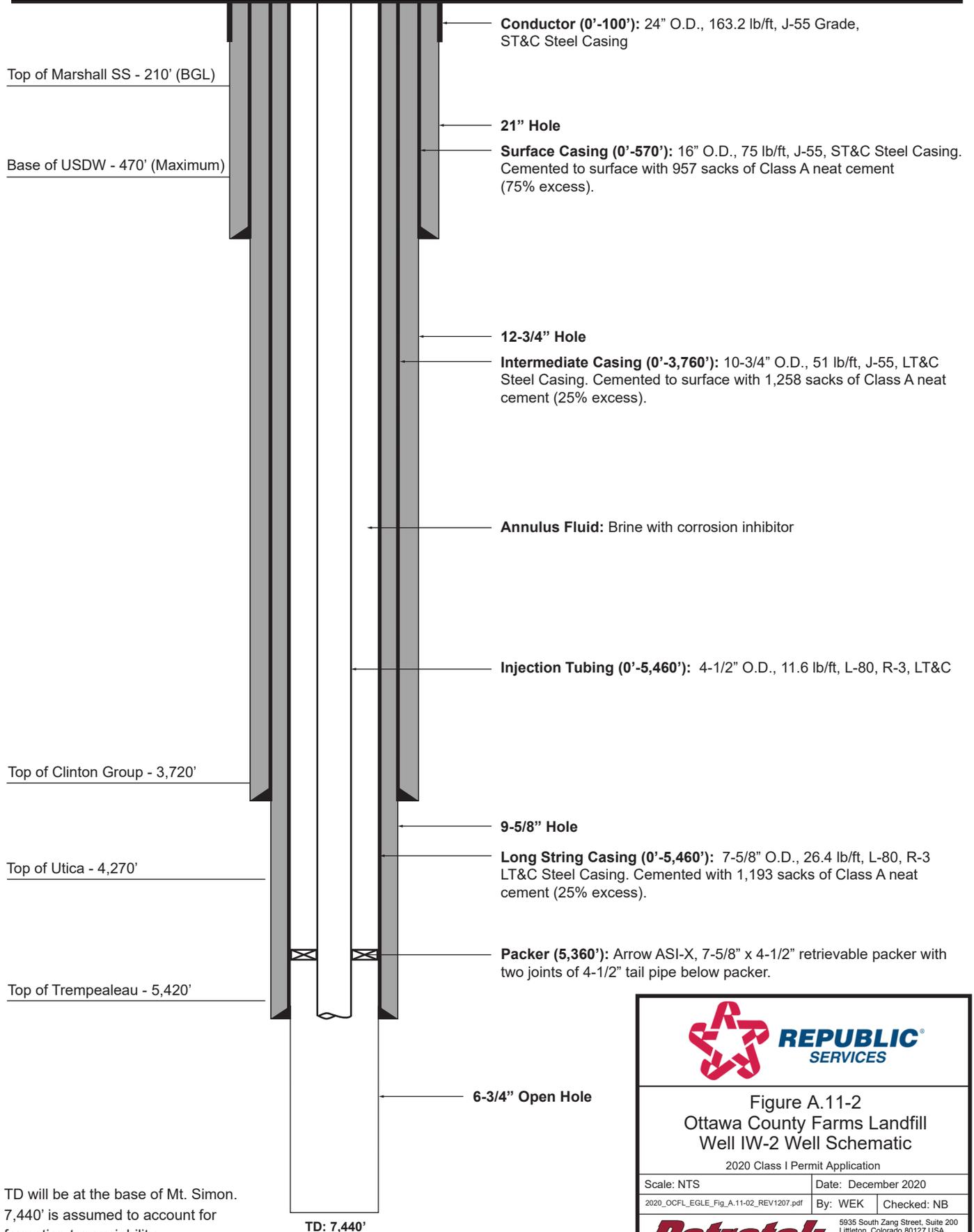
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| Scale: NTS | Date: December 2020 |
| 2020_OCFL_EGLE_Fig_A.11-01_REV1207.pdf | By: WEK Checked: NB |



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Sec. 35, T08N, R14W
 Ottawa County, Michigan
 Proposed Location: Lat. 43.044394, Long. -85.944117

All depths are TVD referenced to ground level.



TD will be at the base of Mt. Simon.
 7,440' is assumed to account for
 formation top variability.
 NOT TO SCALE



Figure A.11-2
 Ottawa County Farms Landfill
 Well IW-2 Well Schematic

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| Scale: NTS | Date: December 2020 |
| 2020_OCFL_EGLE_Fig_A.11-02_REV1207.pdf | By: WEK Checked: NB |



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A.12 Description of the cementing program including the type, properties and compressive strength of cement to be used on each casing string. Indicate if DV tools will be used.

Figures A.11-1 and A. 11-2 present the wellbore diagrams for the proposed IW-1 and IW-2 wells, respectively. The cement used for all cement jobs will be Michigan equivalent type A cement; 2% bentonite and 2% CaCl₂ may be required depending on field conditions. Assuming no bentonite or additives, the water requirements will be 5.2 gallons/sack with a slurry yield of 1.18 ft³/sack. Any casing shoe tests (surface and long string casing only) will be run at values conservatively estimated to be below fracture pressure. At a depth of 570 feet (surface casing), assuming a bottomhole gradient not to exceed 0.7 psi/ft, and a normally pressured formation (0.433 psi/ft) at the shoe, a differential pressure (Δp) of less than 152 psi (570 ft * [0.7 – 0.433]) would be applied to the casing shoe. At a depth of 3,760 feet (intermediate casing) assuming a bottom hole gradient not to exceed 0.7 psi/ft, and a normally pressured formation (0.433 psi/ft) at the shoe, a differential pressure (Δp) of less than 1,004 psi (3,760 * [0.7 – 0.433]) would be applied at the casing shoe. At a depth of 5,460 feet (long string casing), assuming a bottomhole gradient not to exceed 0.7 psi/ft, and a normally pressured formation at the shoe, a Δp of less than 1,458 psi (5,460 * [0.7 – 0.433]) would be applied to the casing shoe. As noted by Bourgouyne et al. (1991) in Section 3.4.11 of his text, the exact amount of compressive strength needed before drilling activities can continue is difficult to determine, but a value of 500 psi is commonly used in field practice. Compressive strengths that exceed projected test pressures for the proposed cement blends over the range of temperatures expected (60 to 80 degrees Fahrenheit) conservatively referenced at atmospheric pressure are given in the following table:

| Time (Hours) | Class A 60°F Compressive Strength (psi) | Class A 80°F Compressive Strength (psi) | 2% Bentonite 60°F with 2% CaCl Compressive Strength (psi) | 2% Bentonite 80°F with 2% CaCl Compressive Strength (psi) |
|--------------|---|---|---|---|
| 8 | 20 | 265 | 135 | 620 |
| 12 | 80 | 580 | 255 | 1,150 |
| 24 | 615 | 1,905 | 765 | 1,820 |
| 36* | 1,087* | 2,823* | 1,420* | -- |
| 72 | 2,050 | 4,125 | -- | -- |

*extrapolated

The cement volumes for each hole section up to and including the 7-5/8 inch casing cement job are summarized in the following table. Excess cement volumes may be increased depending on the results of caliper logging.

| Interval | Hole Size (in) | Casing Size (OD, in) | Depth (ft BGL) | Excess Cement (%) | Cement Required ¹ (with excess, sacks) | Cement Class (API) | Cement Yield (ft ³ /sk) |
|--------------|----------------|----------------------|----------------|-------------------|---|--------------------|------------------------------------|
| Conductor | 28.00 | 24.00 | 100 | 75% | 168* | A | 1.18 |
| Surface | 21.00 | 16.00 | 570 | 75% | 957 | A | 1.18 |
| Intermediate | 12.75 | 10.75 | 3,760 | 25% | 1,258 | A | 1.18 |
| Long String | 9.625 | 7.625 | 5,460 | 25% | 1,193 | A | 1.18 |

¹Includes 42' float joint for Surface, Intermediate and Long String sections

*optional if conductor casing is not driven

Unexpectedly high permeability or low reservoir pressure may require two cement stages for a particular cement job; in this case a differential valve (DV) tool may be utilized. It is anticipated that each cement job will be completed in a single stage unless conditions require a two-stage job. Any change to the procedure based on field conditions will be provided to EGLE by email and telephone notification at least 24-hours in advance of cementing.

REFERENCES

Bourgouyne, A.T., Martin E. Chenevert, Keith K. Millheim, F.S Young Jr., 1991. Applied Drilling Engineering, SPE Textbook Series, Volume 2.

A.13 Description of the proposed wireline logging program.

The proposed wireline logging program is summarized in Table A.13-1, below.

**TABLE A.13-1 LIST OF PROPOSED LOGS, OTTAWA COUNTY FARMS
 LANDFILL WELLS IW-1 AND IW-2**

| Description | Estimated Depth Run |
|--|---|
| SP, Gamma Ray and Caliper Logs (Openhole before installing surface casing) | 570 feet BGL – Surface |
| Dual LateroLog, SP, Gamma Ray, Formation Density, Compensated Neutron, and Caliper Log (Openhole before installing intermediate and long string casing) | 3,760 - 570 feet BGL 5,460 – 3,760 feet BGL |
| Cement Bond Log (Surface, Intermediate casing) | Surface casing shoe to surface Intermediate casing shoe to surface casing shoe |
| Dual LateroLog, SP, Gamma Ray, Formation Density, Compensated Neutron, Fracture Finder ID Log (Openhole) | Mt. Simon injection interval (TD to 100 feet above injection interval) |
| Cement Bond Log, Casing Inspection Log and Directional Survey (Long-string casing) | Long string shoe to surface shoe |

A.14 Description of the testing program, including pressure tests on casing strings, and any planned drill stem tests.

The following information is also presented in Section A.11 but is repeated here in Section A.14 to facilitate application review.

The IW-1 and IW-2 wells are expected to be installed and tested in the year 2021 according to well owner demands, applicable regulations and permit requirements. Prior to conducting any injection testing, injection formation native brine chemistry and characteristics will be determined based by acquisition of a fluid sample. As discussed in more detail later in this section, static pressure testing of the injection zone will be performed, along with determination of various injection interval characteristics such as permeability-thickness using pressure transient testing methods. Characteristics of the injection interval will also be evaluated based on geophysical well logging results. Additional details regarding the well logging are presented in Table A.13-1 in Section A.13.

To obtain an original sample of injection interval fluid if a DST is not conducted during drilling, fluid will be produced from the openhole completion using either a submersible pump or by using a workover rig and swabbing equipment. The type of testing method used will be determined based on equipment availability at the time the wells are drilled and tested. Based on fluid loss encountered during drilling and field conditions, target production volumes for obtaining representative samples will be adjusted in the field, based on conditions encountered. Field parameters including pH and conductivity will also be monitored at surface as fluid is recovered to determine when representative fluid sampling is practical. Injection Zone formation fluid will be subjected to analysis for the following parameters:

- Alkalinity, Arsenic, Barium, Bicarbonate, Cadmium, Calcium, Carbonate, Chloride, Chromium, Conductivity, Copper, Hardness, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Nitrate, as (N), pH, Potassium, Radium 226, Radium 228, Selenium, Silica as SiO₂, Sodium, Specific Gravity, Strontium, Sulfur, TDS, TSS, Zinc

Mechanical integrity and ambient reservoir monitoring will be conducted after well construction activities are complete. Annual Part I mechanical integrity testing (MIT) for the IW-1 and IW-2 wells and 5-year Part II MIT procedures are detailed below. Although test procedures or methods may be changed based on approval by EGLE staff, the following procedure will be used for the testing:

4. Conduct Wellsite Safety Meeting
 - a. Prior to commencement of field activities, conduct safety meeting with contractors and personnel to be involved with field services and MIT testing. Ensure that all safety procedures are understood and review days' work activities.

5. Conduct Reservoir (Fall-Off or Static) Pressure Test

- a. For fall-off, record data regarding test well injection at typical operating conditions (constant rate). Rate versus time data will be recorded during the injection period. Cumulative injection volume will also be recorded. Continue injection for a minimum of approximately 8 hours. Note that significant rate variations may require more complicated analysis techniques.
- b. Rig-up pressure gauge and run in well to a depth likely not to exceed approximately 5,460 feet or other depth approved by EGLE.
- c. For pressure transient fall-off, obtain final stabilized injection pressure for a minimum of 1 hour. For static test, collect a minimum of two pressure/temperature readings at depth. Ensure that the gauge temperature readings have also stabilized.
- d. After gauge recordings are stable, cease injection and monitor pressure fall-off. Continue monitoring pressure for a minimum of 8 hours or until a valid observation of fall-off curve is observed. For a static gradient survey, the well will be shut-in for a minimum of 48 hours before testing. Wellbore pressure gradients will be obtained to establish fluid gradient and bottomhole pressure data will be collected for a minimum of 4 hours for static testing.
- e. Stop test data acquisition, rig-down and release equipment.

6. Annulus Pressure Test

- a. Stabilize well pressure and temperature for a target period of 12-hours.
- b. As practical, arrangements will be made for a representative from the EGLE to be present to witness testing.
- c. Install ball valve or similar type "bleed" valve on annulus gate valve. Pressurize annulus to a minimum of 100 psig above maximum permitted operating pressure and shut-in valve. Install certified gauge on "bleed" type valve. The annulus may need to be pressurized and bled off several times to ensure an absence of air.
- d. Monitor and record pressure for 1 hour. Pressure may not fluctuate more than 3% during the one-hour test.
- e. Lower the annulus pressure to normal operating pressure at the end of the test.

The Part II external mechanical integrity demonstration for the well will be accomplished via a minimum of one approved logging method such as temperature log, or radioactive tracer survey, or noise log, or oxygen activation log.

Although Ottawa County Landfill, Inc. may utilize any acceptable method per EGLE procedure approval, at this time it is proposed that temperature logging be utilized for 5-year Part II mechanical integrity testing. Static temperature logging is to be conducted as follows:

2. Conduct Temperature Log

- a. Shut-in well for stabilization (minimum of 36 hours, or as required by

- EPA/EGLE) prior to running base temperature log.
- b. Rig-up temperature log and run base log from surface to total depth. Pull tool to surface and shut-in master valve.
 - c. Rig-down equipment and return the well to normal operations.

Future annual or 5-year testing will be conducted using these procedures unless alternative procedures are approved by EGLE in advance. Future periodic MIT testing will be conducted after Ottawa County Landfill, Inc. provides the agency with a minimum of a 30-day notice of testing, as practical, to allow the agency an opportunity to witness data collection activities.

A.15 Description of any planned coring program.

No coring program is currently planned during the drilling of the IW-1 and IW-2 wells. Coring may be performed at the discretion of the well owner during drilling operations, and will be reported to EGLE if core data is acquired.