

Kemper County Storage Complex

Injection Well 19-2 and MPC 32-1

Mississippi Power Company

Injection Well Plugging Plan

40 CFR 146.92; 40 CFR 146.93(e)

Facility Information

Facility Name: Kemper County Storage Complex

Well Names: MPC 19-2 MPC 32-1

Facility Contact: Mississippi Power Company

Environmental Affairs

P.O. Box 4079

Gulfport, MS 39502-4079

Well Locations: Kemper County, Mississippi

MPC 19-2

Latitude: 32.6130560, Longitude: -88.8061110

MPC 32-1

Latitude: 32.5908015, Longitude: -88.7792582

Table of Contents

| | |
|---|---|
| List of Acronyms/Abbreviations | 3 |
| A. Injection Well Plugging Plan | 4 |
| B. Injection Well Configuration | 4 |
| B.1 Injection Well Tests | 7 |
| B.1.a Tests or Measures for Determining Bottomhole Reservoir Pressure | 7 |
| B.1.b Testing Method to Ensure External Mechanical Integrity..... | 7 |
| B.2 Plugging Plan Procedure | 8 |

List of Figures

| | |
|---|----|
| Figure 1. Proposed MPC 19-2 Injection Well Schematic | 5 |
| Figure 2. Proposed MPC 32-1 Injection Well Schematic | 6 |
| Figure 3. Diagram of MPC 19-2 After Plugging and Abandonment..... | 10 |
| Figure 4. Diagram of MPC 32-1 After Plugging and Abandonment..... | 11 |

List of Tables

| | |
|---|---|
| Table 1: Intervals to Be Plugged and Materials/Methods Used | 9 |
|---|---|

List of Acronyms/Abbreviations

| | |
|--------------------|--|
| AoR | Area of Review |
| CCUS | Carbon capture, utilization, and storage |
| CO ₂ | Carbon dioxide |
| CMG | Computer Modelling Group |
| DOE | Department of Energy |
| ECO ₂ S | Establishing An Early Carbon Dioxide Storage |
| EPA | Environmental Protection Agency |
| ERRP | Emergency and Remedial Response |
| ft | feet |
| mg/L | milligrams per liter |
| MMt | Millions of Metric tons |
| MPC | Mississippi Power Company |
| PCC | Porters Creek Clay |
| PISC | Post-Injection Site Care |
| psi | Pounds per square inch |
| psia | Pounds per square inch absolute |
| psig | Pounds per square inch gauge |
| RCA | Routine Core Analysis |
| SS | Sub- Sea |
| TMS | Tuscaloosa Marine Shale |
| Tonnes | Metric tons |
| TVD | True Vertical Depth |
| UIC | Underground Injection Control |
| USDW | Underground Source of Drinking Water |

A. Injection Well Plugging Plan

The well plugging plan describes the process that Mississippi Power Company (MPC) will follow to plug the MPC 19-2 and MPC 32-1 injection wells in accordance with EPA's requirements 40 CFR 146.92 and 40 CFR 146.93(e), to ensure that the abandoned wells maintain integrity and will not pose a threat to Underground Sources of Drinking Water (USDWs). Plugging activities will begin immediately following the cessation of CO₂ injection. MPC will notify the UIC Program Director in writing at least 60 days before plugging the injection wells, as required in 40 CFR 146.92(c) Class VI Rule. Additionally, MPC will submit a well plugging report to the UIC Program Director within 60 days of plugging the injection wells [40 CFR 146.92(d)].

B. Injection Well Configuration

The proposed injection wells are designed to accommodate constant-rate flow of the total mass of CO₂ that will be stored over the 30-year injection period. Accordingly, the injection tubing consists of a corrosion-resistant four and a half inch CR13 L-80 tubular set on a corrosion-resistant packer inside a nine and five-eighths inch chrome long string casing that is perforated in the injection zone (Paluxy Formation). The planned perforations will be set between 5,040 feet and 5,575 feet with 6 shots-per-foot and 60-degree phasing. **Figure 1** and **Figure 2** illustrates the proposed wellbore schematics for the planned MPC 19-2 and MPC 32-1 injection wells, which depicts the size of the tubulars and completion design that will guide the type, quantity, and design of the cement operations. For more information on the injection well construction, including detailed tubular information and safety factors, please refer to the *Geological Site Characterization*.

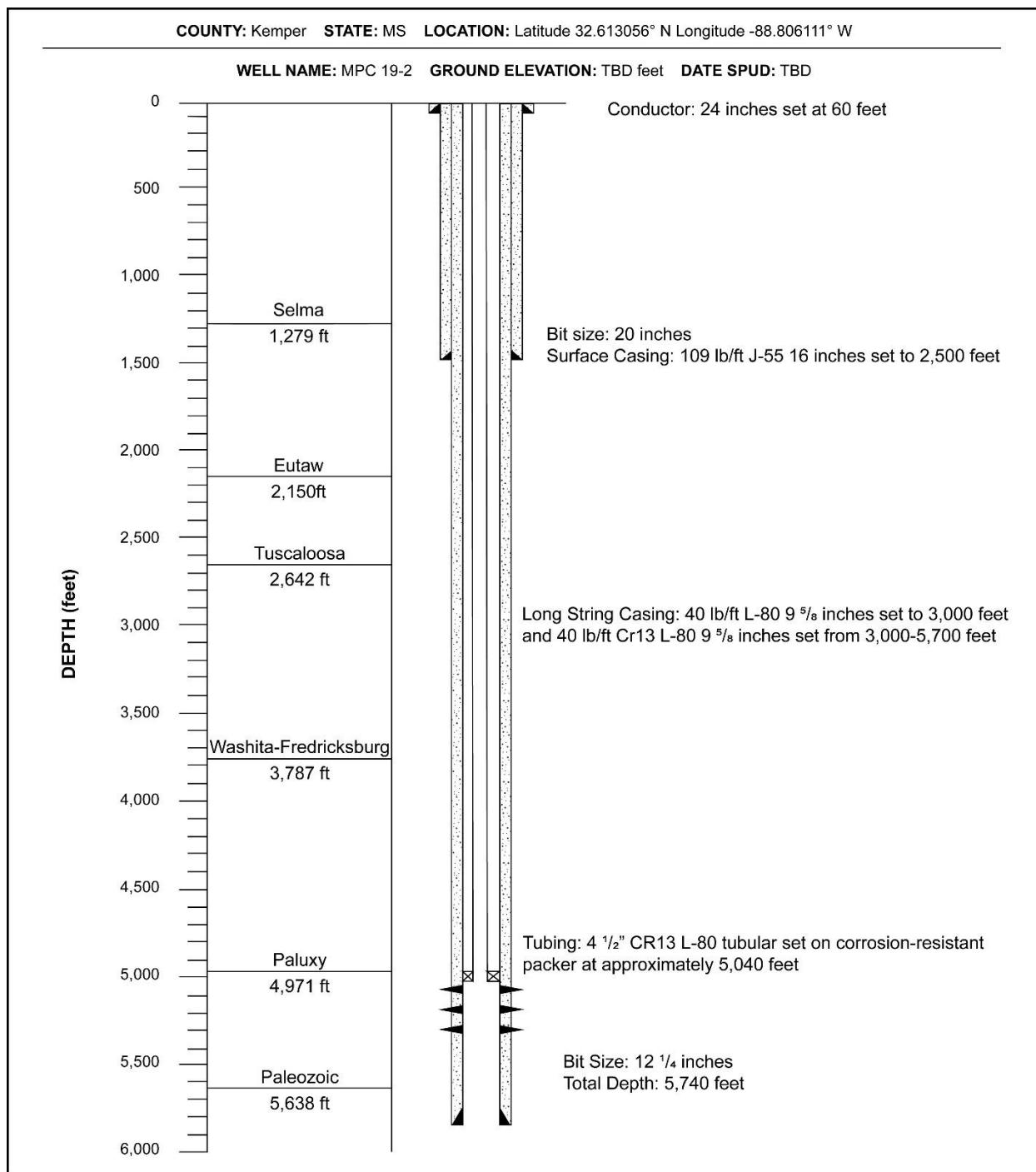


Figure 1. Proposed MPC 19-2 Injection Well Schematic

Proposed Injection Well MPC 19-2 and MPC 32-1
 Injection Well Plugging Plan, Kemper County Storage Complex, Kemper County, MS

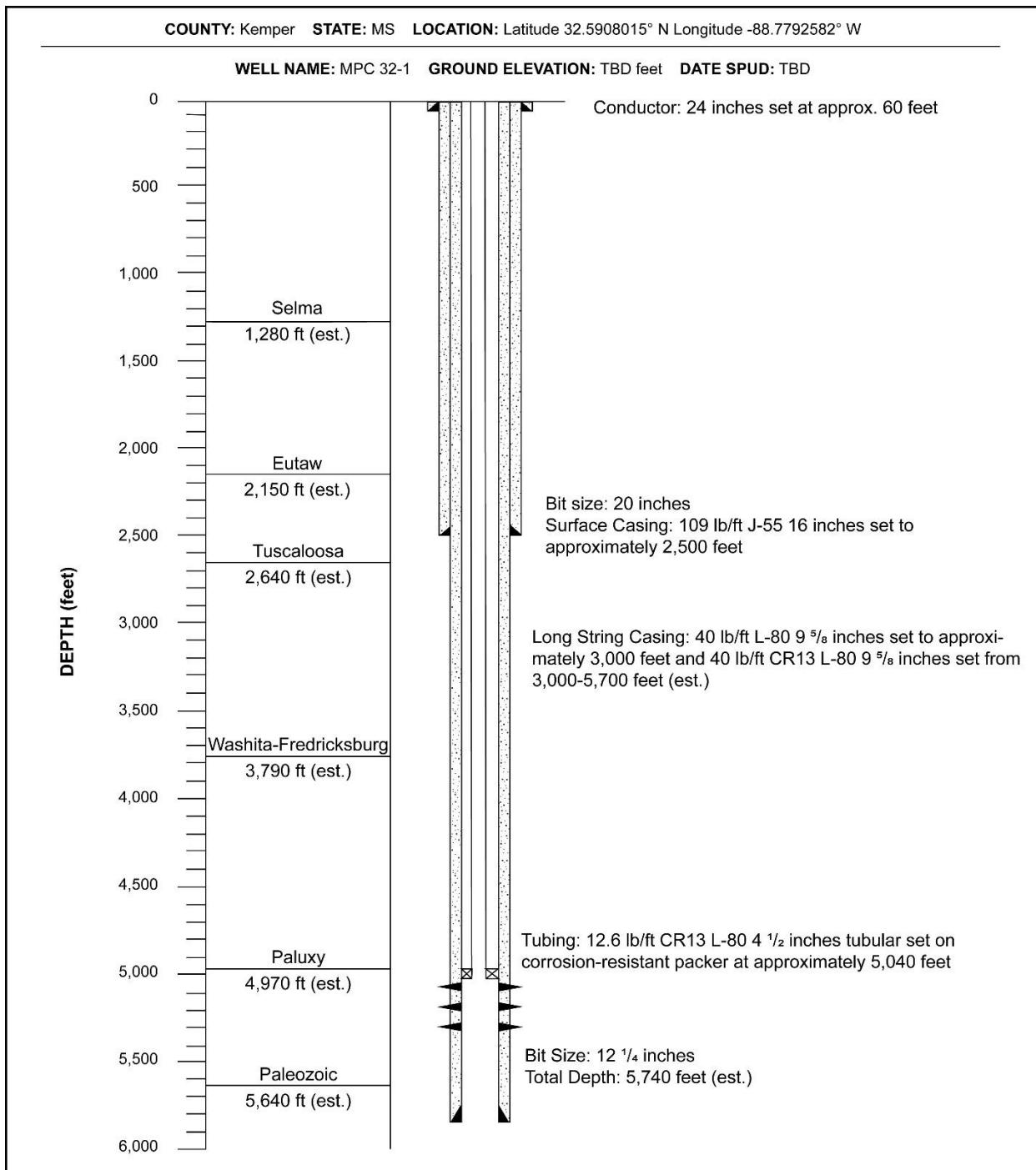


Figure 2. Proposed MPC 32-1 Injection Well Schematic

B.1 Injection Well Tests

B.1.a Tests or Measures for Determining Bottomhole Reservoir Pressure

Bottomhole pressure measurements will be recorded throughout the project. Pressure gauges will be placed in the injection tubing or within the long string casing adjacent to the injection zone. These pressure-measurement devices will allow for continuous, real-time, surface readout of the pressure data. Bottomhole reservoir pressure measurements will be obtained after the cessation of CO₂ injection to guide abandonment procedures. For more details on the monitoring strategy, please refer to the *Testing and Monitoring Plan*.

After the bottomhole pressure is determined, a buffered fluid (brine) will be used to flush and fill the well to maintain pressure control. The bottomhole pressure will be used to determine the proper brine weight necessary to stabilize the wells. This data will also be used to determine the blend of cement to be used to plug the wells (i.e., weight range of cement to prevent leak-off into formation or flowing of well, or to prevent premature setting and curing of the cement).

B.1.b Testing Method to Ensure External Mechanical Integrity

The mechanical integrity of the wells must be demonstrated after CO₂ injection and prior to the plugging of the wells to ensure no communication has been established between the injection zone and the USDWs or ground surface (per Section 146.92 of the EPA Class VI Regulations). Such integrity testing requires a temperature log, noise log, or an activated-oxygen log to be run in the wells.

The project proposes to run a temperature log over the entire depths of the injection wells. Data from the logging run will be evaluated for anomalies in the temperature curve, which would be indicative of fluid migration outside of the injection zone. This data will also be compared to data from the logs performed prior to injection of CO₂ into the wells. Deviations between the temperature logs performed before and after the injection of CO₂ may indicate issues related to the integrity of the well casing or cement.

B.2 Plugging Plan Procedure

The EPA recommends that owners or operators emplace plugs: (1) above any production or injection zones; (2) above, below, and/or through each USDW; (3) at the bottom of intermediate and surface casings; (4) across any casing stubs (pulled casing sections); and (5) at the surface¹. Mississippi Oil and Gas Board requirements state that in well plugging operations, cement plugs must be placed across the freshwater zone (approximately 1,200 ft to 1,300 ft), and across any casing shoes in the construction of the well². The following procedure details the operations required to place a solid column of cement from the total depth of the well to the top of the casing string. This exceeds the recommendations/requirements of both the EPA's and the Mississippi Oil and Gas Board.

At the cessation of injection, the injection tubing and packer will be removed. Once this is complete, the balanced-plug placement method will be used to plug the well. If, after flushing, the tubing and packer cannot be released, an electric line with tubing cutter will be used to cut off the tubing above the packer and the packer will be left in the well and the cement retainer method will be used for plugging the injection formation below the abandoned packer.

To further ensure no communication from the injection zone with the overlying USDWs or ground surface, the injection well casing will be plugged with cement. **Table 1** presents the intervals that will be plugged and the materials and methods that will be used to plug the intervals. The portion of the well corresponding to the injection zone will be plugged using CO₂-resistant cement with a retainer method. The cement retainer will be set 100 ft above the contact between the Paluxy Formation and the overlying regional seal (**Figure 1** and **Figure 2**) and will be constructed of corrosion-resistant materials. Approximately 210 sacks of CO₂-resistant cement will be used to plug the injection zone. This volume of cement includes a 10 percent excess volume to be squeezed through the perforations into the Paluxy Formation.

¹ EPA, 2016. *Underground Injection Control Program Class VI Plugging, Post-Injection Site Care, and Site Closure Guidance*. EPA 816-R16-006.

² 26 Miss. Code R. § 2-1.28.B.2.a

Table 1: Intervals to Be Plugged and Materials/Methods Used

| Description | Top | Bottom | Type | Quantity |
|-------------|-------|--------|-----------|-----------|
| Lift 1 | 5,200 | 5,700 | EverCRETE | 210 sacks |
| Lift 2 | 4,700 | 5,200 | EverCRETE | 190 sacks |
| Lift 3 | 4,200 | 4,700 | EverCRETE | 190 sacks |
| Lift 4 | 3,700 | 4,200 | EverCRETE | 190 sacks |
| Lift 5 | 3,200 | 3,700 | EverCRETE | 190 sacks |
| Lift 6 | 2,700 | 3,200 | Class A | 190 sacks |
| Lift 7 | 2,200 | 2,700 | Class A | 190 sacks |
| Lift 8 | 1,700 | 2,200 | Class A | 190 sacks |
| Lift 9 | 1,200 | 1,700 | Class A | 190 sacks |
| Lift 10 | 700 | 1,200 | Class A | 190 sacks |
| Lift 11 | 5 | 700 | Class A | 260 sacks |

The pressure used to squeeze the cement will be determined from the bottomhole pressure data. However, the injection pressure of the cement will not exceed 90% of the fracture pressure of the Paluxy Formation. If it appears that the injection pressure will exceed 90% of the fracture pressure and the total amount of cement has not been pumped into the injection zone, cement pumping will cease, and the tubing will be removed from the cement retainer to allow the pressure to return to static conditions. After allowing the pressure to reduce, the tubing will be re-strung through the cement retainer and cement pumping will be attempted again. A rapid increase in pressure on the tubing would indicate that the perforations have been sealed with cement, and no additional cement will be added to the zone or plug.

Cementing operations will continue until the entire wellbore is cemented. Cement will be pumped in 500 ft lifts (190 sacks) using a balance method. This will ensure efficient cement placement and prevent tubing from sticking in the cement column. **Figure 3** and **Figure 4** show the details of the injection wells after plugging and abandonment.

Proposed Injection Well MPC 19-2 and MPC 32-1
 Injection Well Plugging Plan, Kemper County Storage Complex, Kemper County, MS

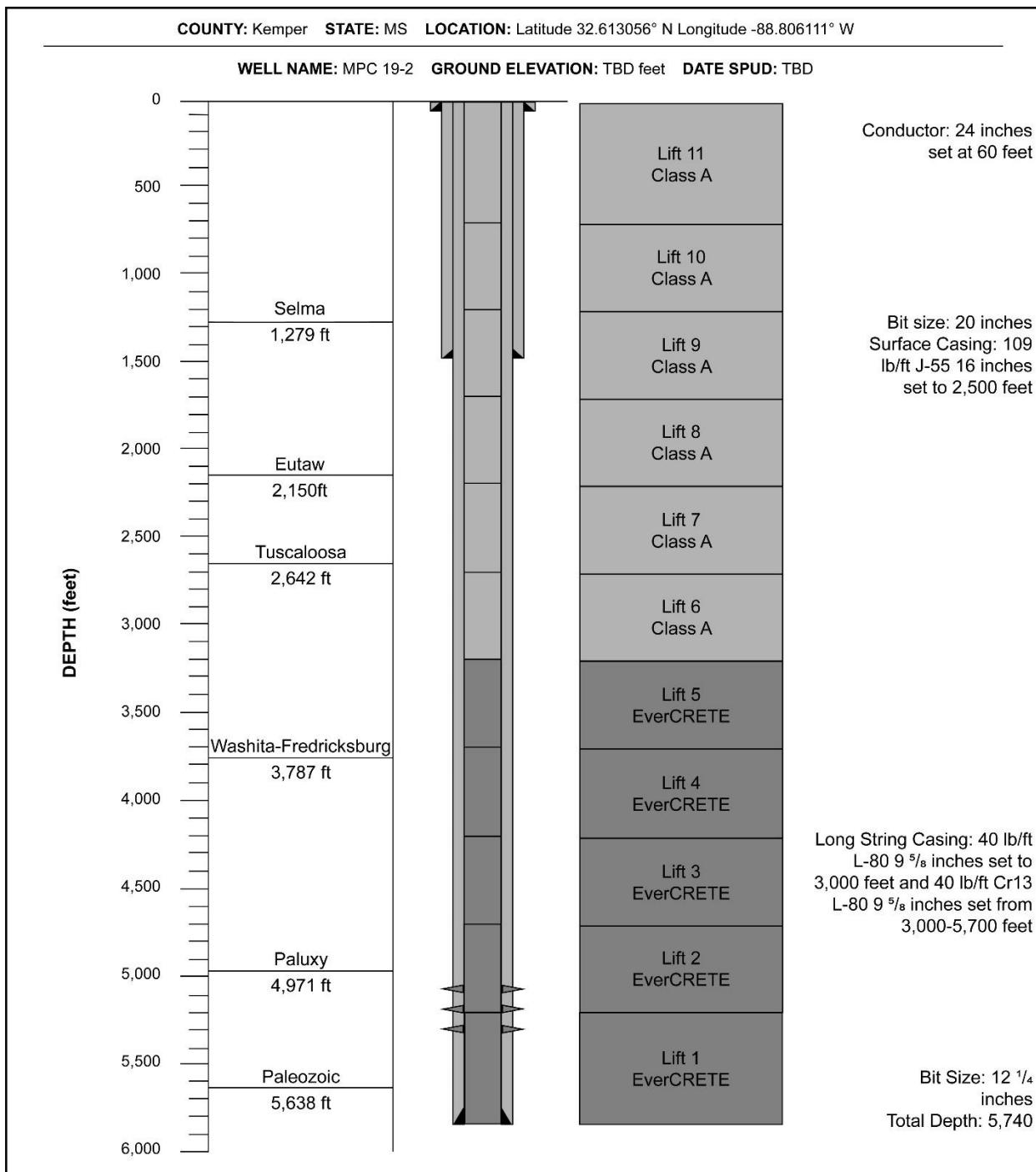


Figure 3. Diagram of MPC 19-2 After Plugging and Abandonment

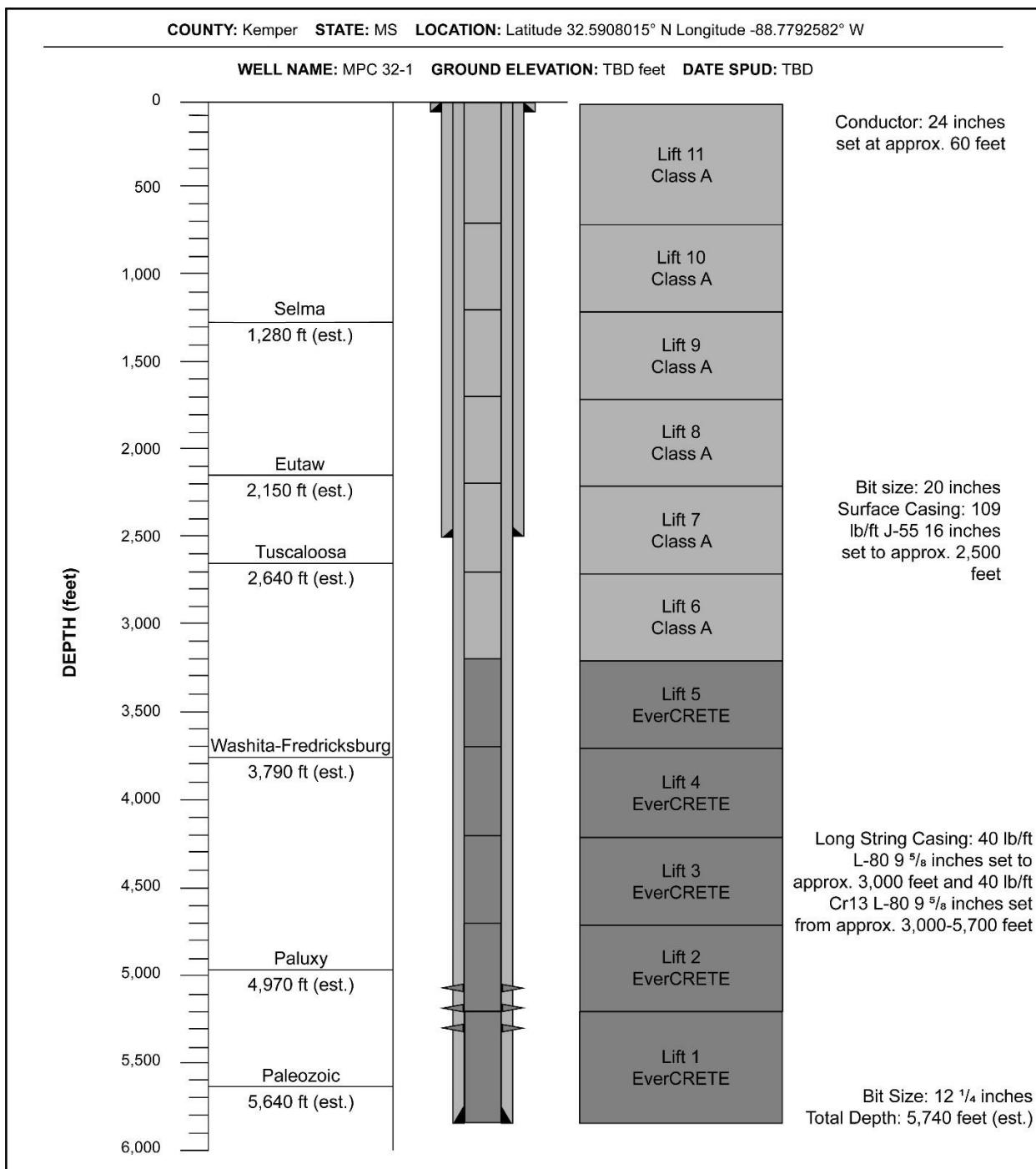


Figure 4. Diagram of MPC 32-1 After Plugging and Abandonment

After the final cement lift (Lift 11) has been completed, the casing sections will be cut off approximately 5 ft below ground surface, and a steel cap will be welded to the top of the deep casing string. The cap will have the well identification number, the UIC Class VI permit number, and the date of plug and abandonment inscribed on it. Soil will be backfilled around the well to bring the area around the well back to pre-installation grade. This area will then be planted with natural vegetation.

The methods and materials described to abandon the injection wells are based upon the current understanding of the geology at the site and current well designs. If modifications are found to be required, the plans will be updated to reflect the latest geologic understanding and resultant well design. Updates to designs, materials, and methods will be described in the Notice of Intent to Plug submitted at least 60 days prior to the plugging of the wells.