Underground Injection Control – Class VI Permit Application for

High West CCS Project
Spoonbill No. 001 to 005

St. Charles and Jefferson Parishes, Louisiana

SECTION 4 – ENGINEERING DESIGN AND OPERATING STRATEGY

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LONQUIST

SECTION 4 – ENGINEERING DESIGN AND OPERATING STRATEGY

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4.1 Introduction

The following section details the engineering design and operational strategies employed during the planning of High West CCS Project, operated by High West CCS Sequestration LLC (High West). This project includes the proposed Spoonbill No. 001, 002, 003, 004 and 005 injection wells and all associated monitoring wells. All engineering design details have been evaluated to meet the requirements of Statewide Order (SWO) 29-N-6 **§3617** and Title 40, U.S. Code of Federal Regulations (40 CFR) **§146.86**.

4.2 Engineering Design

The Spoonbill Nos. 001 to 005 injection wells are designed to permanently sequester CO_2 fluid and prevent the movement of injected fluids into the Underground Sources of Drinking Water (USDW). The design of each well considers the operation factors, including injection volume, pressure, temperature, rate, chemical composition, and physical properties of the injected fluid, as well as the corrosive nature of the injected fluid and its impact on the well components. The operation strategy of the combined five wells is designed to ensure the efficient use of pore space within the injection interval and contain the injected CO_2 within the injection interval or the duration of the project.

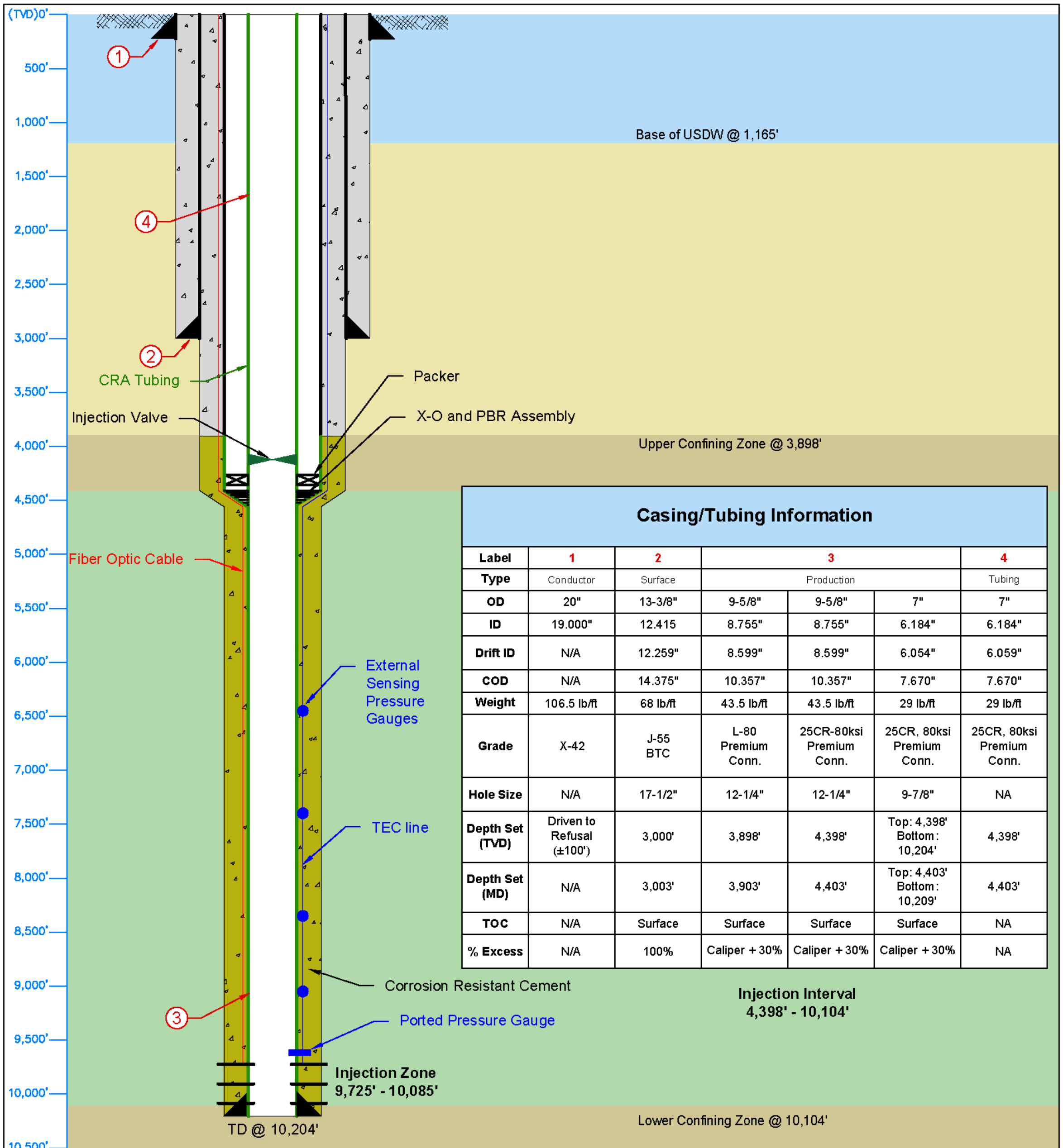
The design of these wells considered several key components, including volume, pressure, temperature and rate of injection, chemical composition, physical properties of the injectate fluid, corrosion concerns, metallurgical evaluations, and operational details necessary to maintain proper reservoir management.

The proposed injection wells were all designed to withstand a corrosive environment. Though CO_2 alone is not corrosive, it can create carbonic acid with a pH as low as 3 when combined with water and other chemical compounds. Special considerations were given to the selected metallurgy of the casing, tubing, wellhead equipment, and downhole tools that may encounter a corrosive environment.

The five proposed wells will be drilled from a barge with platforms then installed for injection operations. The wells will therefore be drilled slightly directionally. Each well will be drilled to a similar total depth (TD) but will target different injection zones. The wells will all be “monobore” completions, with a single string of 7-in. tubing and casing from surface to TD. The long string casing will be a tapered 9-5/8 in. to 7-in. design with a crossover at the base of the upper confining zone (UCZ) of each well. A 7-in. tubing string will tie into the crossover at the top of the 7-in. casing with a polished bore receptacle (PBR). An injection packer will be run with the tubing and will be set above the PBR. An injection valve will be set in the tubing above the packer via wireline. This completion design allows for the setting of plugs and any necessary recompletion work to be performed via wireline, without pulling the tubing and packer. Currently, one completion stage is planned for each well, shown in Table 4-1. The schematics for the proposed design and completion of each well are provided in Figures 4-1 through 4-5.

Table 4-1 – High West CCS Project Operational Strategy

Well Name	Injection Zone	Top Perf (ft) (TVDSS)	Bottom Perf (ft) (TVDSS)	Gross Thickness (ft)	Net Pay (ft)	Duration (yrs)
Spoonbill No. 001	1	9,725	10,085	360	303	20
Spoonbill No. 002	2	8,703	9,474	771	534	20
Spoonbill No. 003	3	8,160	8,672	512	409	20
Spoonbill No. 004	4	7,036	7,914	878	466	20
Spoonbill No. 005	5	6,122	6,938	815	660	20

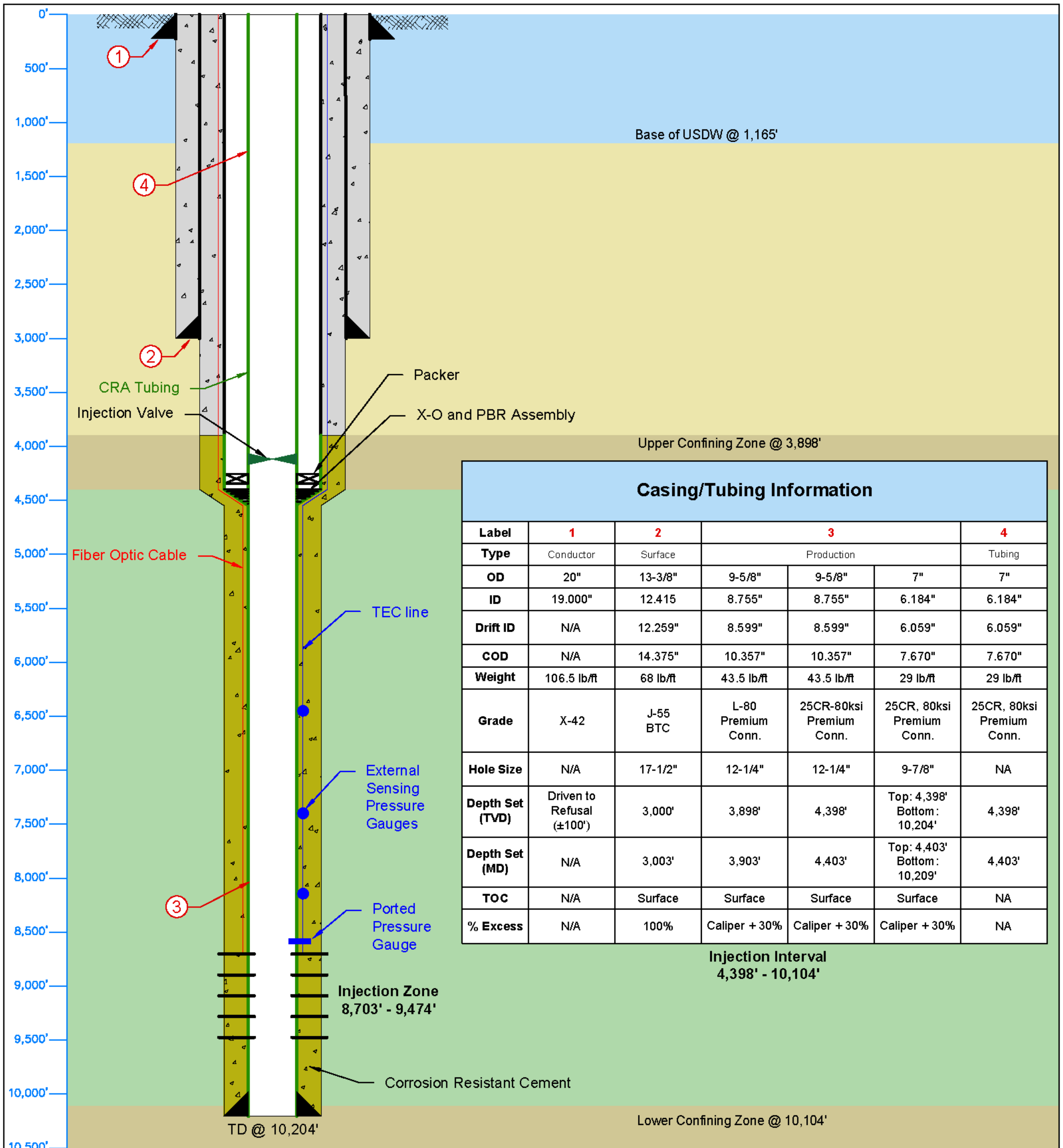


Casing/Tubing Information

Label	1	2	3	3	3	4
Type	Conductor	Surface	Production			Tubing
OD	20"	13-3/8"	9-5/8"	9-5/8"	7"	7"
ID	19.000"	12.415	8.755"	8.755"	6.184"	6.184"
Drift ID	N/A	12.259"	8.599"	8.599"	6.054"	6.059"
COD	N/A	14.375"	10.357"	10.357"	7.670"	7.670"
Weight	106.5 lb/ft	68 lb/ft	43.5 lb/ft	43.5 lb/ft	29 lb/ft	29 lb/ft
Grade	X-42	J-55 BTC	L-80 Premium Conn.	25CR-80ksi Premium Conn.	25CR, 80ksi Premium Conn.	25CR, 80ksi Premium Conn.
Hole Size	N/A	17-1/2"	12-1/4"	12-1/4"	9-7/8"	NA
Depth Set (TVD)	Driven to Refusal (±100')	3,000'	3,898'	4,398'	Top: 4,398' Bottom: 10,204'	4,398'
Depth Set (MD)	N/A	3,003'	3,903'	4,403'	Top: 4,403' Bottom: 10,209'	4,403'
TOC	N/A	Surface	Surface	Surface	Surface	NA
% Excess	N/A	100%	Caliper + 30%	Caliper + 30%	Caliper + 30%	NA

LONQUIST		Spoonbill No. 001	
	Country: USA	**State/Province:** Louisiana	**County/Parish:** St. Charles
	API No: TBD	**Field:**	**Well Type/Status:** Class VI
Louisiana License EF-7423	**RRC District No:**	**Project No:** LS232	**Date:** 02/19/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** Lauren Mayo	**Reviewed:** Andy Ellis	**Approved:** William H. George, P.E.
	Rev No: 1	**Notes:**	

Figure 4-1 – Spoonbill No. 001 Completion Schematic

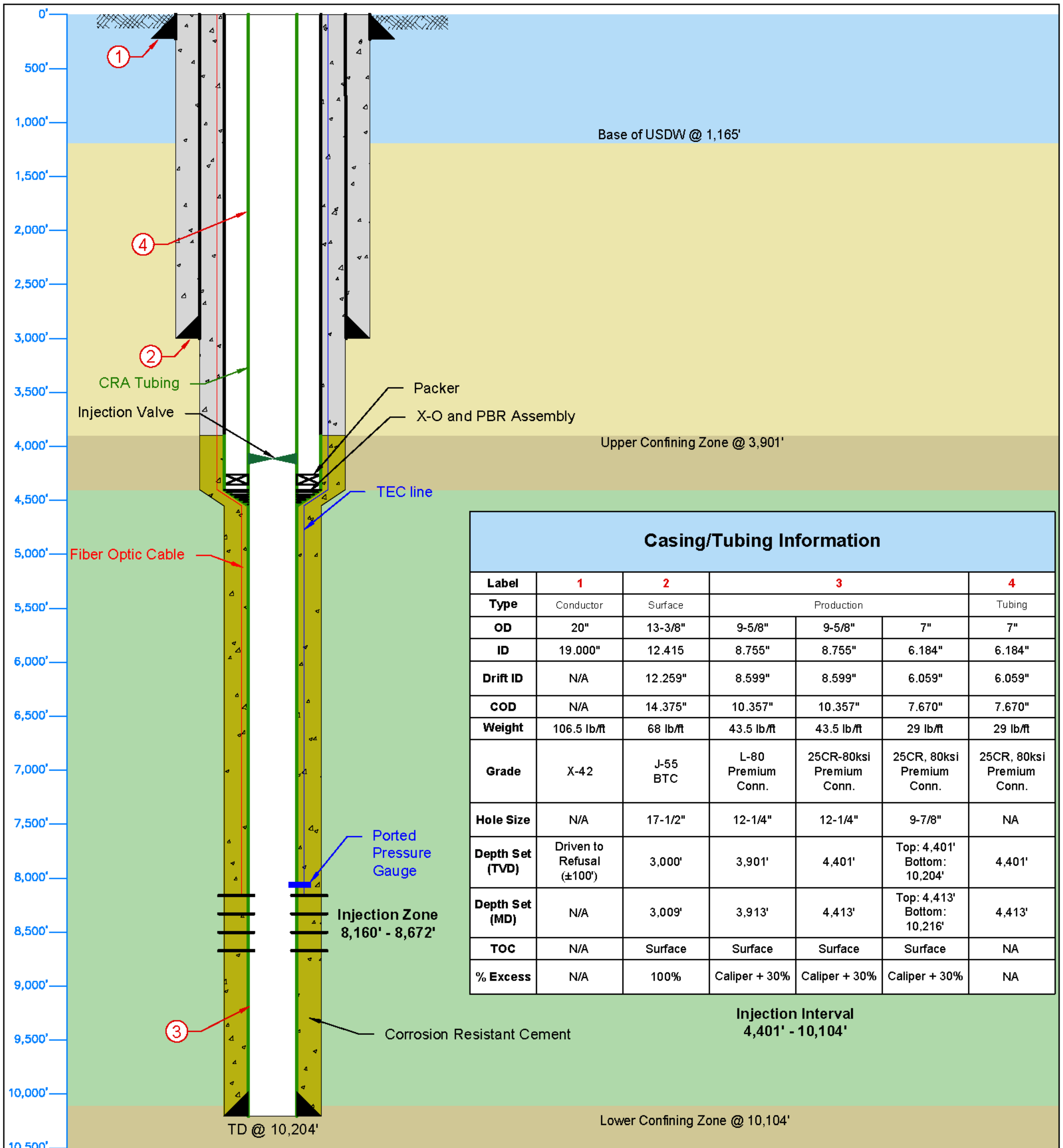


Casing/Tubing Information

Label	1	2	3			4
Type	Conductor	Surface	Production			Tubing
OD	20"	13-3/8"	9-5/8"	9-5/8"	7"	7"
ID	19.000"	12.415	8.755"	8.755"	6.184"	6.184"
Drift ID	N/A	12.259"	8.599"	8.599"	6.059"	6.059"
COD	N/A	14.375"	10.357"	10.357"	7.670"	7.670"
Weight	106.5 lb/ft	68 lb/ft	43.5 lb/ft	43.5 lb/ft	29 lb/ft	29 lb/ft
Grade	X-42	J-55 BTC	L-80 Premium Conn.	25CR-80ksi Premium Conn.	25CR, 80ksi Premium Conn.	25CR, 80ksi Premium Conn.
Hole Size	N/A	17-1/2"	12-1/4"	12-1/4"	9-7/8"	NA
Depth Set (TVD)	Driven to Refusal (±100')	3,000'	3,898'	4,398'	Top: 4,398' Bottom: 10,204'	4,398'
Depth Set (MD)	N/A	3,003'	3,903'	4,403'	Top: 4,403' Bottom: 10,209'	4,403'
TOC	N/A	Surface	Surface	Surface	Surface	NA
% Excess	N/A	100%	Caliper + 30%	Caliper + 30%	Caliper + 30%	NA

LONQUIST		Spoonbill No. 002	
	Country: USA	**State/Province:** Louisiana	**County/Parish:** St. Charles
	API No: TBD	**Field:**	**Well Type/Status:** Class VI
Louisiana License EF-7423	**RRC District No:**	**Project No:** LS232	**Date:** 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** Lauren Mayo	**Reviewed:** Andy Ellis	**Approved:** William H. George, P.E.
	Rev No: 1	**Notes:**	

Figure 4-2 – Spoonbill No. 002 Completion Schematic

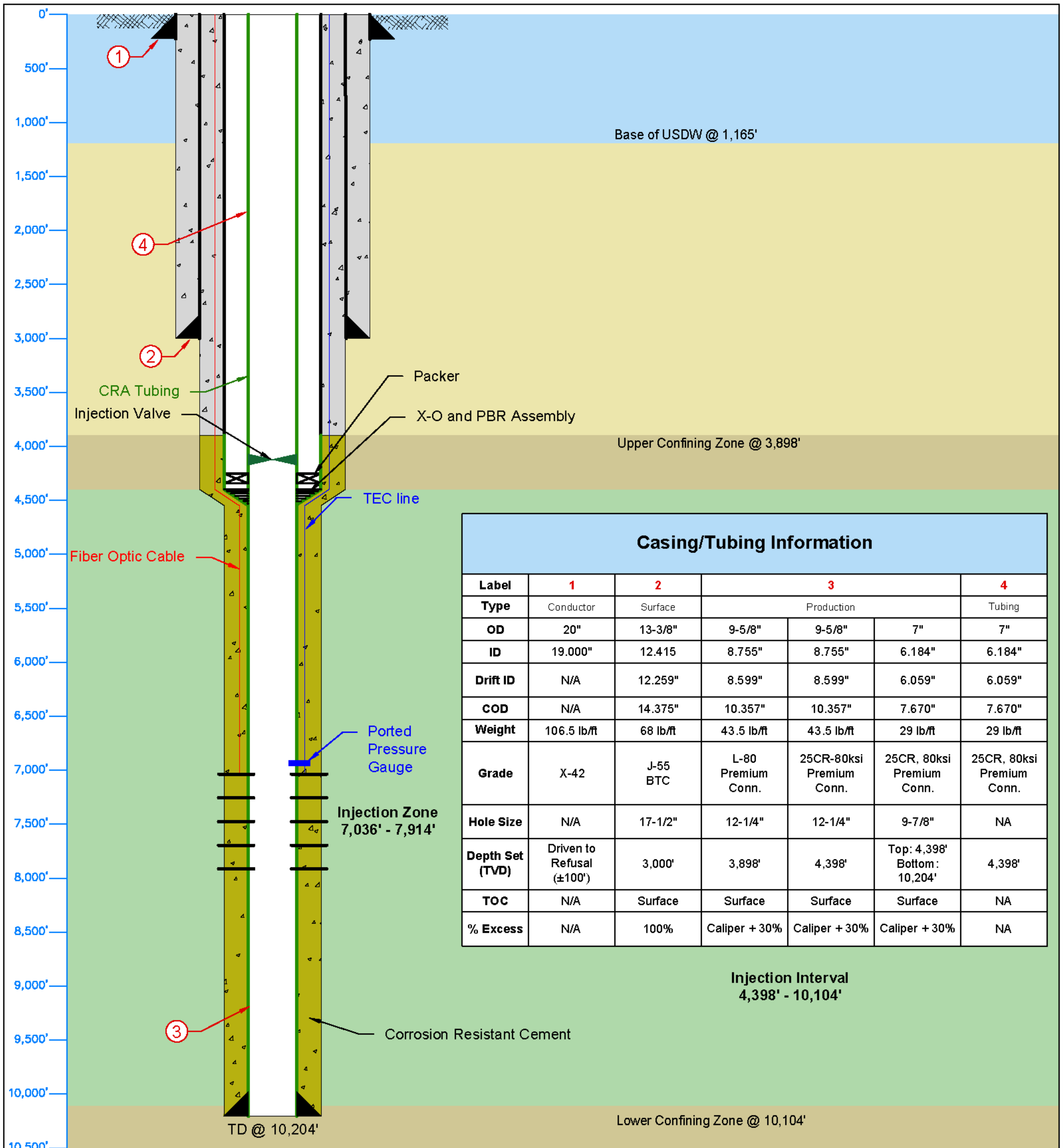


Casing/Tubing Information

Label	1	2	3			4
Type	Conductor	Surface	Production			Tubing
OD	20"	13-3/8"	9-5/8"	9-5/8"	7"	7"
ID	19.000"	12.415	8.755"	8.755"	6.184"	6.184"
Drift ID	N/A	12.259"	8.599"	8.599"	6.059"	6.059"
COD	N/A	14.375"	10.357"	10.357"	7.670"	7.670"
Weight	106.5 lb/ft	68 lb/ft	43.5 lb/ft	43.5 lb/ft	29 lb/ft	29 lb/ft
Grade	X-42	J-55 BTC	L-80 Premium Conn.	25CR-80ksi Premium Conn.	25CR, 80ksi Premium Conn.	25CR, 80ksi Premium Conn.
Hole Size	N/A	17-1/2"	12-1/4"	12-1/4"	9-7/8"	NA
Depth Set (TVD)	Driven to Refusal (±100')	3,000'	3,901'	4,401'	Top: 4,401' Bottom: 10,204'	4,401'
Depth Set (MD)	N/A	3,009'	3,913'	4,413'	Top: 4,413' Bottom: 10,216'	4,413'
TOC	N/A	Surface	Surface	Surface	Surface	NA
% Excess	N/A	100%	Caliper + 30%	Caliper + 30%	Caliper + 30%	NA

LONQUIST		Spoonbill No. 003	
	Country: USA	State/Province: Louisiana	County/Parish: St. Charles
	API No: TBD	Field:	Well Type/Status: Class VI
Louisiana License EF-7423	RRC District No:	Project No: LS232	Date: 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	Drawn: Lauren Mayo	Reviewed: Andy Ellis	Approved: William H. George, P.E.
	Rev No: 1	Notes:	

Figure 4-3 – Spoonbill No. 003 Completion Schematic

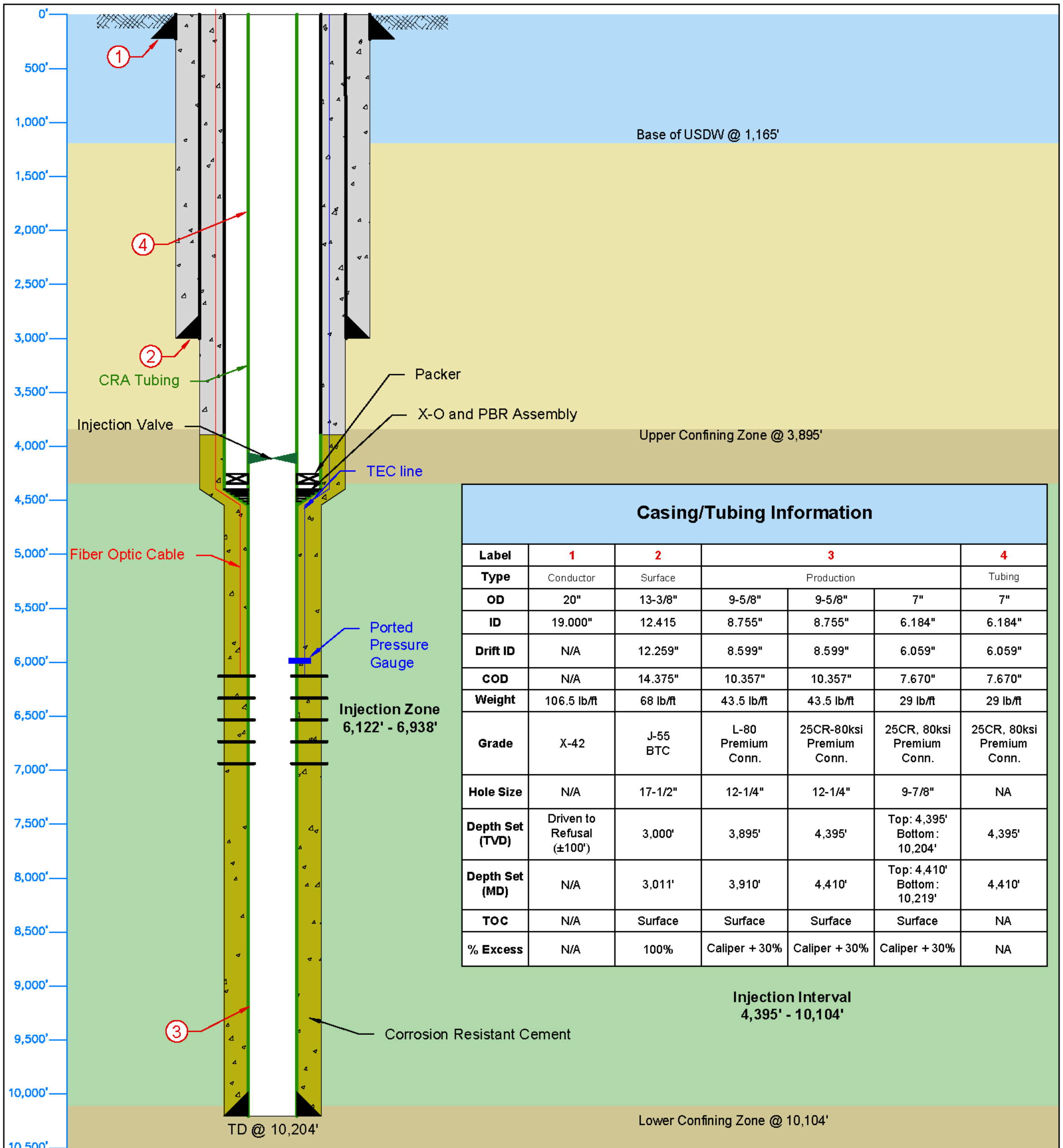


Casing/Tubing Information

Label	1	2	3			4
Type	Conductor	Surface	Production			Tubing
OD	20"	13-3/8"	9-5/8"	9-5/8"	7"	7"
ID	19.000"	12.415	8.755"	8.755"	6.184"	6.184"
Drift ID	N/A	12.259"	8.599"	8.599"	6.059"	6.059"
COD	N/A	14.375"	10.357"	10.357"	7.670"	7.670"
Weight	106.5 lb/ft	68 lb/ft	43.5 lb/ft	43.5 lb/ft	29 lb/ft	29 lb/ft
Grade	X-42	J-55 BTC	L-80 Premium Conn.	25CR-80ksi Premium Conn.	25CR, 80ksi Premium Conn.	25CR, 80ksi Premium Conn.
Hole Size	N/A	17-1/2"	12-1/4"	12-1/4"	9-7/8"	NA
Depth Set (TVD)	Driven to Refusal (±100')	3,000'	3,898'	4,398'	Top: 4,398' Bottom: 10,204'	4,398'
TOC	N/A	Surface	Surface	Surface	Surface	NA
% Excess	N/A	100%	Caliper + 30%	Caliper + 30%	Caliper + 30%	NA

LONQUIST		Spoonbill No. 004	
	Country: USA	State/Province: Louisiana	County/Parish: St. Charles
	API No: TBD	Field:	Well Type/Status: Class VI
Louisiana License EF-7423	RRC District No:	Project No: LS232	Date: 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	Drawn: Lauren Mayo	Reviewed: Andy Ellis	Approved: William H. George, P.E.
	Rev No: 1	Notes:	

Figure 4-4 – Spoonbill No. 004 Completion Schematic



Casing/Tubing Information

Label	1	2	3			4
Type	Conductor	Surface	Production			Tubing
OD	20"	13-3/8"	9-5/8"	9-5/8"	7"	7"
ID	19.000"	12.415	8.755"	8.755"	6.184"	6.184"
Drift ID	N/A	12.259"	8.599"	8.599"	6.059"	6.059"
COD	N/A	14.375"	10.357"	10.357"	7.670"	7.670"
Weight	106.5 lb/ft	68 lb/ft	43.5 lb/ft	43.5 lb/ft	29 lb/ft	29 lb/ft
Grade	X-42	J-55 BTC	L-80 Premium Conn.	25CR-80ksi Premium Conn.	25CR, 80ksi Premium Conn.	25CR, 80ksi Premium Conn.
Hole Size	N/A	17-1/2"	12-1/4"	12-1/4"	9-7/8"	NA
Depth Set (TVD)	Driven to Refusal (±100')	3,000'	3,895'	4,395'	Top: 4,395' Bottom: 10,204'	4,395'
Depth Set (MD)	N/A	3,011'	3,910'	4,410'	Top: 4,410' Bottom: 10,219'	4,410'
TOC	N/A	Surface	Surface	Surface	Surface	NA
% Excess	N/A	100%	Caliper + 30%	Caliper + 30%	Caliper + 30%	NA

LONQUIST		Spoonbill No. 005	
	Country: USA	**State/Province:** Louisiana	**County/Parish:** St. Charles
	API No: TBD	**Field:**	**Well Type/Status:** Class VI
Louisiana License EF-7423	**RRC District No:**	**Project No:** LS232	**Date:** 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** Lauren Mayo	**Reviewed:** Andy Ellis	**Approved:** William H. George, P.E.
	Rev No: 1	**Notes:**	

Figure 4-5 – Spoonbill No. 005 Completion Schematic

The drilling and completion design for the Spoonbill injection wells is as follows:

- Conductor
    - 20 in. to +/- 100 ft (driven to refusal)
- Surface Casing
    - 17-1/2 in. hole size
    - 13-3/8 in. outer diameter (OD), 68 lb/ft, J-55 BTC casing set to 3,000 ft (TVD)
    - Cemented to surface
- Production Casing
    - 12-1/4 in. x 9-7/8 in. hole size
    - 9-5/8 in. x 7 in. casing set to TD of well
        - 9-5/8 in. casing above the UCZ will be L-80 premium connection
            - 9-5/8 in. L-80 from surface to the top of the UCZ
            - 9-5/8 in. x 9-5/8 in. galvanic crossover at the top of the UCZ
        - 9-5/8 in. casing across the UCZ will be 25CR-80ksi Premium connection
            - 9-5/8 in. 25CR-80ksi from the top of the UCZ to the base of the UCZ
            - 9-5/8 in. x 7 in. PBR and crossover at the base of the UCZ
        - 7 in. casing to TD will be 25CR-80ksi Premium connection
    - Cemented to surface
        - Blended Portland cement from surface to the top of the UCZ
        - Corrosion resistant cement from the top of the UCZ to TD
- Injection Tubing
    - 7 in. 25CR-80ksi premium connection casing set from surface to the PBR at the base of the UCZ
    - 7 in. x 9-5/8 in. injection packer 100 ft above the base of the UCZ
        - 25CR or equivalent
    - Tubing annulus will be filled with non-corrosive fluid
    - Downhole injection valve, set above the injection packer
- Wellhead
    - 13-3/8 in. slip-on-weld (SOW) x 13 5/8 in. 5M – casing head
    - 13-5/8 in. NOM x 9-5/8 in. – casing hanger
    - 13-5/8 in. 5M x 11 in. 5M – casing spool
    - 11 in. NOM x 7 in. – tubing hanger (HH trim)
- Production Tree
    - 11in. 5M x 7-1/16 in. 5M – adapter flange (HH trim)
    - 7-1/16 in. 5M, gate valve, manual (HH trim)
    - 7-1/16 in. 5M, gate valve, hydraulic (FF trim)
    - 7-1/16 in. 5M flow tee with 7-1/16 in. 5M wing valves (FF trim)
    - 7-1/16 in. 5M, gate valve, manual for crown with cap (FF trim)

4.2.1 Detailed Discussion of Injection Well Design

High West plans to inject a combined maximum of 10 million metric tons per year (MMT/yr) of captured CO_2 into the Spoonbill injection wells. The maximum injection rates per well are detailed in Table 4-2.

Table 4-2 – High West CCS Project Maximum Injection Rates

Well Name	Injection Rate (MMT/yr)	Injection Rate (MMscf/D)*
Spoonbill No. 001	2.0	105
Spoonbill No. 002	1.5	78
Spoonbill No. 003	2.0	105
Spoonbill No. 004	2.0	105
Spoonbill No. 005	2.5	130

* MMscf/D – Million standard cubic feet per day

4.2.1.1 Pressure Design Parameters

Detailed modeling analyses were conducted based on casing and tubing size, injectate properties, injectate temperatures and pressures, and proposed injection rates to determine appropriate grade and weight for the injection tubing. Table 4-3 shows the estimated pipeline conditions of CO_2 used in the flow calculations and well design.

Table 4-3 – Estimated CO_2 Pipeline Conditions

Temperature (°F)	Pressure (psia)	Density (lbm/ft^3)	Enthalpy (Btu/lbm)	Entropy (Btu/lbm-°R)
90	2,000	51.077	115.15	0.28522

psia – pounds per square inch absolute
lbm – pound mass
ft^3 – cubic foot

A tubing design sensitivity analysis, accounting for calculated pipe-friction losses, exit velocities, and economics, was performed. Detailed reservoir-engineering model runs estimated the bottomhole pressures (BHPs) during injection operations over time for each well (Figures 4-6 to 4-10). The outputs detailed in these plots were used to identify the maximum BHP for each well during the life of the project. These outputs were used to determine the maximum wellhead pressure at surface to utilize in the design of the casing, tubing, and wellhead.

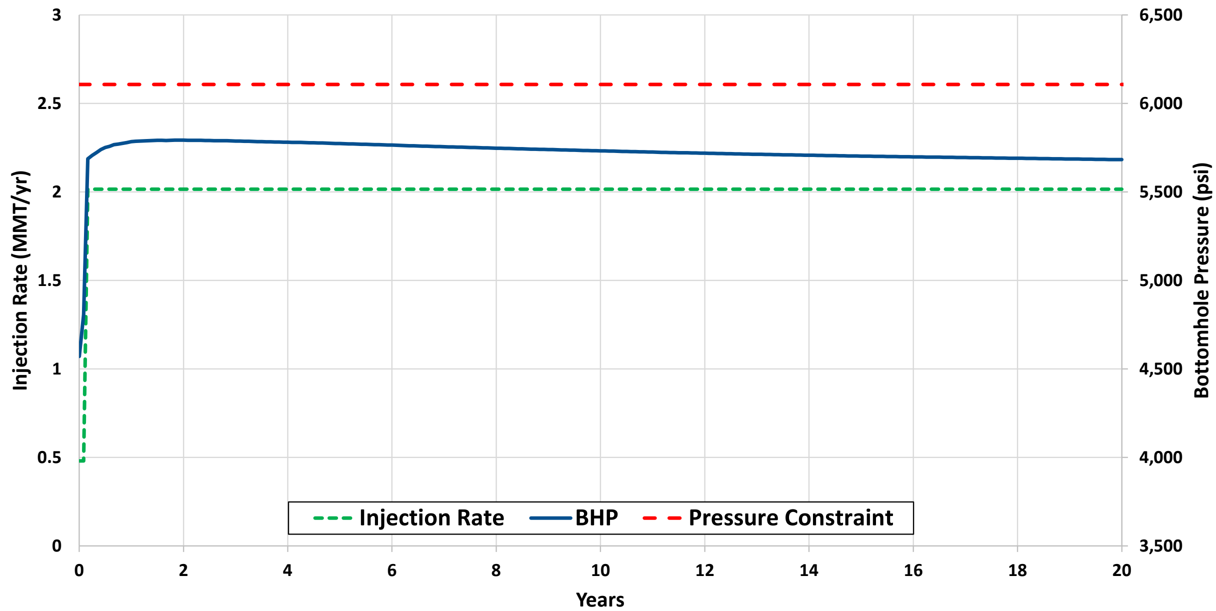


Figure 4-6 – Spoonbill No. 001 Bottomhole Injection Pressure Plot vs. Gas Mass Rate

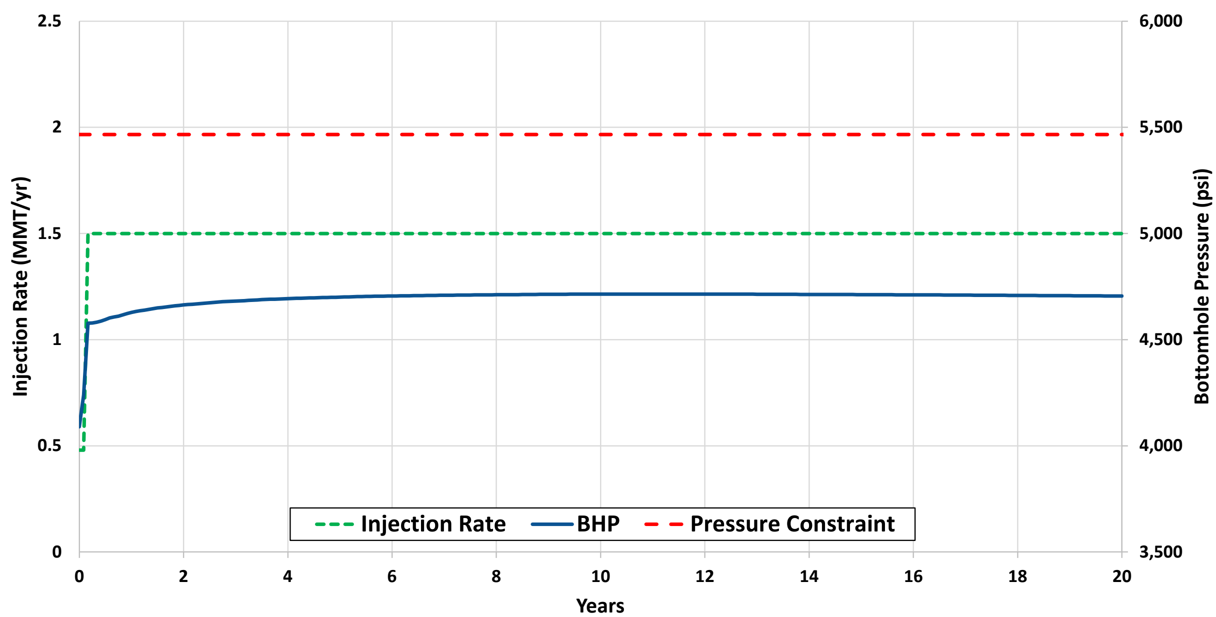


Figure 4-7 – Spoonbill No. 002 Bottomhole Injection Pressure Plot vs. Gas Mass Rate

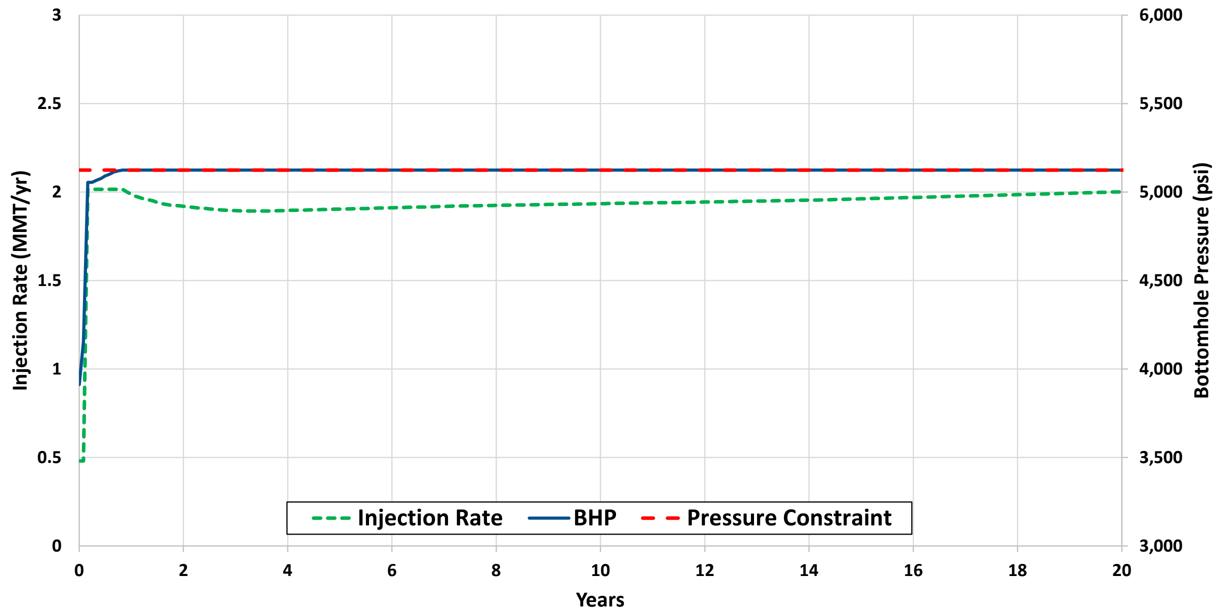


Figure 4-8 – Spoonbill No. 003 Bottomhole Injection Pressure Plot vs. Gas Mass Rate

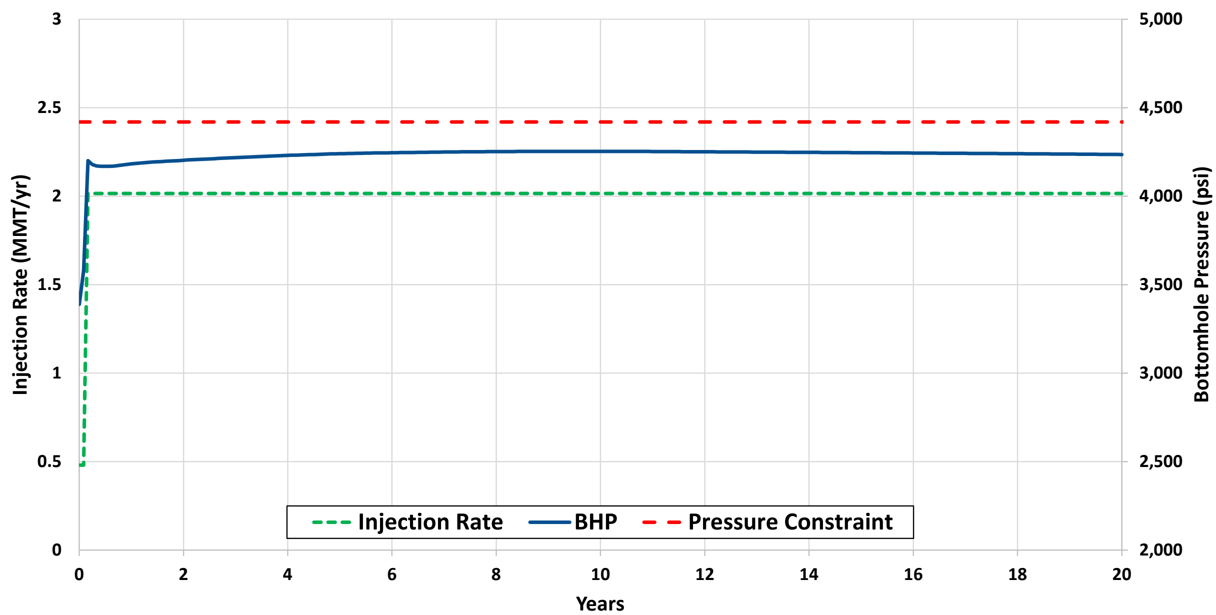


Figure 4-9 – Spoonbill No. 004 Bottomhole Injection Pressure Plot vs. Gas Mass Rate

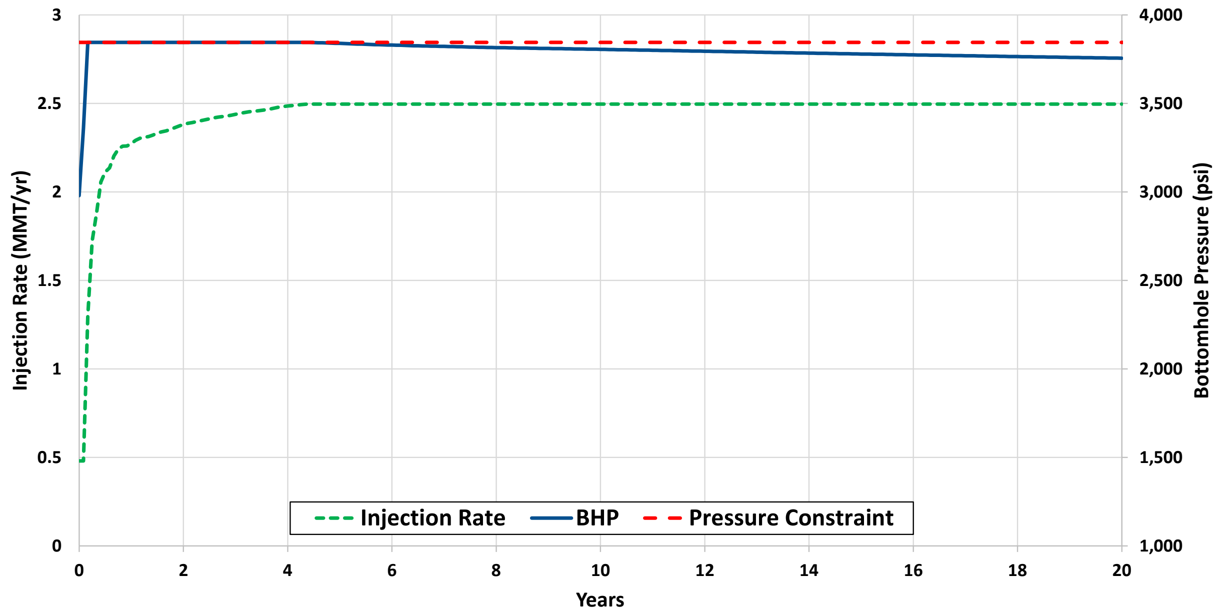


Figure 4-10 – Spoonbill No. 005 Bottomhole Injection Pressure Plot vs. Gas Mass Rate

Based on the anticipated injection rates and BHP outputs from the model, a tubing size of 7 in. was selected for all the injection wells. The injection composition was assumed to be 100% CO_2 for the well design calculations. The maximum wellhead pressure was calculated using a multi-segmented pressure traverse, starting with the known maximum BHP and calculating the surface injection pressure. The inputs used for these calculations are provided in Table 4-4, and the calculated injection parameters in Table 4-5.

Table 4-4 – Input Parameters for Well Calculations

Parameter	Spoonbill No.				
	001	**002**	**003**	**004**	**005**
Max Injection Rate (MMscf/D)	105	78	105	105	130
Average Injection Rate (MMscf/D)	2.01	1.49	1.94	2.01	2.45
Tubing Inner Diameter (ID, in.)	6.184	6.184	6.184	6.184	6.184
Reference depth (ft)	9,725	8,703	8,160	7,036	6,122
Max BHP (psi)	5,793	4,715	5,124	4,253	3,845
Avg BHP (psi)	5,729	4,696	5,116	4,233	3,803
BHT at Reference Depth(°F)	104.5	111.3	103	104.8	102.7

Table 4-5 – Calculated Injection Parameters

Parameter	Spoonbill No.				
	001	**002**	**003**	**004**	**005**
Maximum Wellhead Pressure (psi)	2,310	1,652	2,248	1,847	1,882
Average Wellhead Pressure (psi)	2,257	1,600	2,222	1,829	1,837
Maximum Wellhead Temperature (°F)	94	85	93	88	88
Average Wellhead Temperature (°F)	93	84	93	88	88

A combination of friction pressure and hydrostatic head affects the pressure differential (Δp) between the top and base of each pressure traverse segment. Friction pressure drops were calculated using conventional pipe-flow relations. The hydrostatic head component of the Δp within each segment is calculated based on the injected fluid density, average temperature, and pressure therein. The multi-segmented approach of calculating the pressure traverse allows for consideration of variations in the injected density and viscosity of the fluid with temperature and pressure.

The critical point of CO_2 is 87.8°F and 1,071 psi, above which CO_2 exists in a supercritical state. Given the pressures and temperatures calculated for the Spoonbill injection wells, the injection fluid will remain in the supercritical phase in the injection interval. Figure 4-11 shows a phase diagram for CO_2, depicting the supercritical phase.

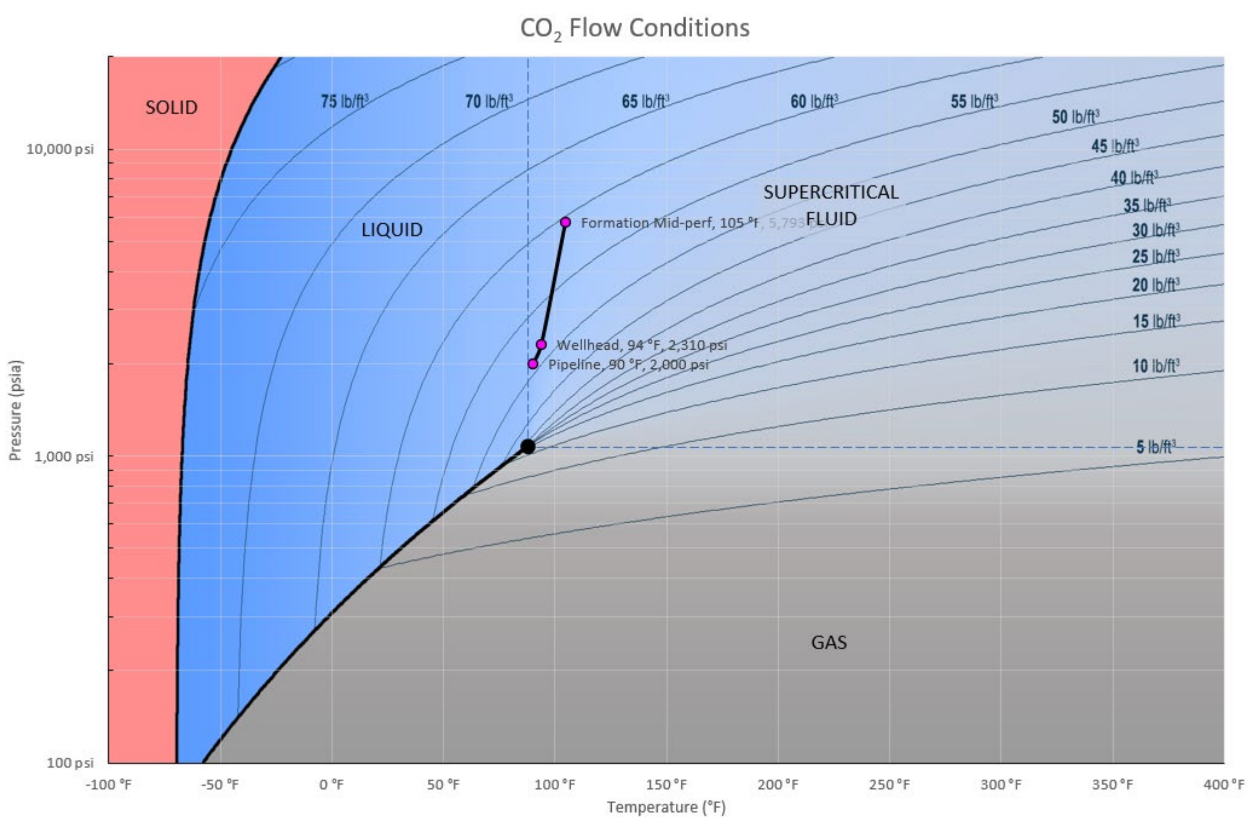


Figure 4-11 – Representative CO_2 Flow Conditions Phase Diagram (Spoonbill No. 001)

4.2.1.2 Casing and Cement Design Calculations

In support of the selected tubing size, the following casing and hole sizes were chosen to provide sufficient annular space to obtain a good cement sheath that will promote adequate cement bonding, and to provide sufficient protection for the casing.

- 20-in. conductor casing
- 17-1/2 in. openhole with 13-3/8 in. surface casing
- 12-1/4 in. x 9-7/8 in. openhole with 9-5/8 in. x 7 in. long string casing

Conductor Casing

Conductor casing will be utilized to maintain the integrity of the hole during the initial drilling of the wells. A 20-in. conductor casing was selected. The casing will be driven using a hydraulic ram either to refusal or to approximately 100 ft. After the conductor casing is in place, the inside of the casing will be flushed, and drilling will commence.

The selection of the conductor casing is based on the desired bit size for drilling the surface casing borehole. With the conductor casing having an ID of 19.5 in., a 17-1/2 in. bit can be used to drill the next section of the well to a depth of 3,000 ft. The casing design calculation results for the conductor string are provided in Table 4-6.

Table 4-6 – Injection Well Conductor Casing Engineering Design Calculation Results

Description	Casing Wt. (ppf)	Depth (ft)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)*	ID (in.)	Drift ID (in.)
20 in., 106.5 lb/ft, X-42, Welded	106.5	100	1,286,000	770	1,840	0.3694	19.000	NA
Using Mud Weight of 10 ppg - Design Criteria			10,650	52	52			
Safety Factor			120.75	14.81	35.38			

* bbl/ft – barrels per foot

Surface Casing

The surface hole will be drilled using a 17-1/2 in. bit with casing set at approximately 3,000 ft (TVD). The surface casing shoe setting point will be confirmed with openhole logs and will be set in a confining bed. A string of 13-3/8 in. casing will be run and cemented to surface with the casing centered in the open hole using centralizers, providing a consistent cement thickness between the casing and the open hole. The consistent cement thickness will ensure a quality cement bond and create a barrier between the USDW formation and the well during the remaining drilling and completion operations. Cement will be circulated to surface, and a top job will be performed, should the level fall after cement has been circulated to surface. After cementing, a cement bond log (CBL) will be run to evaluate and verify bonding throughout the surface hole.

Summaries of the engineering calculation results for the surface casing for the five injection wells are provided in Tables 4-7 through 4-21.

Spoonbill No. 001 Surface Casing Engineering Calculation Results

Table 4-7 – Spoonbill No. 001 Injection Well Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
13-3/8 in., 68.0 lb/ft, J55, BTC	68	3,000	1,069,000	1,950	3,450	0.1497	12.415	12.259
Using Mud Weight of 10 ppg – Design Criteria			204,204	1,560	1,560			
Safety Factor			5.23	1.25	2.21			

Table 4-8 – Spoonbill No. 001 Injection Well Surface Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Drive Pipe	19.0	100	100
Openhole	17.5	3,003	3,000

Table 4-9 – Spoonbill No. 001 Injection Well Surface Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Drive Pipe/Casing Annulus Lead Cement	100	0.9933	0	99
Openhole/Casing Annulus Lead Cement	1,400	0.6946	100	1,945
Openhole/Casing Annulus Tail Cement	1,503	0.6946	100	2,088
Shoe Track	45	0.8407	0	38

Spoonbill No. 002 Surface Casing Engineering Calculation Results

Table 4-10 – Spoonbill No. 002 Injection Well Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
13-3/8 in., 68.0 lb/ft, J55, BTC	68	3,000	1,069,000	1,950	3,450	0.1497	12.415	12.259
Using Mud Weight of 10 ppg – Design Criteria			204,204	1,560	1,560			
Safety Factor			5.23	1.25	2.21			

Table 4-11 – Spoonbill No. 002 Injection Well Surface-Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Drive Pipe	19.0	100	100
Openhole	17.5	3,003	3,000

Table 4-12 – Spoonbill No. 002 Injection Well Surface-Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Drive Pipe/Casing Annulus Lead Cement	100	1.0982	0	99
Openhole/Casing Annulus Lead Cement	1,400	0.6946	100	1,945
Openhole/Casing Annulus Tail Cement	1,503	0.6946	100	2,088
Shoe Track	45	0.8407	0	38

__Spoonbill No. 003 Surface Casing Engineering Calculation Results__

Table 4-13 – Spoonbill No. 003 Injection Well Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
13-3/8in., 68.0 lb/ft, J55, BTC	68	3,009	1,069,000	1,950	3,450	0.1497	12.415	12.259
Using Mud Weight of 10 ppg – Design Criteria			204,612	1,560	1,560			
Safety Factor			5.22	1.25	2.20			

Table 4-14 – Spoonbill No. 003 Injection Well Surface Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Drive Pipe	19.0	100	100
Openhole	17.5	3,009	3,000

Table 4-15 – Spoonbill No. 003 Injection Well Surface Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Drive Pipe/Casing Annulus Lead Cement	100	0.9933	0	110
Openhole/Casing Annulus Lead Cement	1,400	0.6946	100	1,945
Openhole/Casing Annulus Tail Cement	1,509	0.6946	100	2,096
Shoe Track	45	0.8407	0	38

Spoonbill No. 004 Surface Casing Engineering Calculation Results

Table 4-16 – Spoonbill No. 004 Injection Well Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
13-3/8 in., 68.0 lb/ft, J55, BTC	68	3,000	1,069,000	1,950	3,450	0.1497	12.415	12.259
Using Mud Weight of 10 ppg – Design Criteria			204,000	1,560	1,560			
Safety Factor			5.24	1.25	2.21			

Table 4-17 – Spoonbill No. 004 Injection Well Surface Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Drive Pipe	19.0	100	100
Openhole	17.5	3,000	3,000

Table 4-18 – Spoonbill No. 004 Injection Well Surface Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Drive Pipe/Casing Annulus Lead Cement	100	0.9933	0	99
Openhole/Casing Annulus Lead Cement	1,400	0.6946	100	1,945
Openhole/Casing Annulus Tail Cement	1,500	0.6946	100	2,084
Shoe Track	45	0.8407	0	38

Spoonbill No. 005 Surface Casing Engineering Calculation Results

Table 4-19 – Spoonbill No. 005 Injection Well Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
13-3/8 in., 68.0 lb/ft, J55, BTC	68	3,000	1,069,000	1,950	3,450	0.1497	12.415	12.259
Using Mud Weight of 10 ppg – Design Criteria			204,748	1,560	1,560			
Safety Factor			5.22	1.25	2.21			

Table 4-20 – Spoonbill No. 005 Injection Well Surface Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Drive Pipe	19.0	100	100
Openhole	17.5	3,011	3,000

Table 4-21 – Spoonbill No. 005 Injection Well Surface Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Drive Pipe/Casing Annulus Lead Cement	100	0.9933	0	99
Openhole/Casing Annulus Lead Cement	1,400	0.6946	100	1,945
Openhole/Casing Annulus Tail Cement	1,511	0.6946	100	2,099
Shoe Track	45	0.8407	0	38

Long String Casing

Long string casing will be installed from surface to TD and cemented to surface. The design criteria for the long string casing include: the use of 25CR material or equivalent and corrosion-resistant cement across the UCZ, centralizers, float equipment, a PBR, galvanic crossovers, fiber optic and TEC cable, and pressure gauges.

A metallurgical analysis, considering the chemical composition of the CO_2 injectate and downhole conditions, was conducted to select metallurgy for casing and downhole tools. The metallurgical analysis is included in *Appendix E – Metallurgy*. Based on the analysis, 25CR material was selected to be run across the UCZ and in the injection zone.

Corrosion-resistant cement will be used to prevent cement from degradation caused by exposure to an acidic environment, thereby providing integrity and extending the lifespan of the well. As shown in Figure 4-1 through 4-5, corrosion-resistant cement will be set from the top of the UCZ to TD. The cement column will be brought back to surface. The long string casing engineering calculation results for each of the five wells are shown in Table 4-22 through 4-36.

Note: For all calculations, burst and collapse are calculated using TVD while tensile uses MD.

<u>Spoonbill No. 001 Long String Casing Engineering Calculation Results</u>

Table 4-22 – Spoonbill No. 001 Injection Well Long String Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in)	Drift ID (in)
9-5/8 in., 43.5 lb/ft, L-80, Premium Conn.	43.5	3,898	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			359,905	2,230	2,230			
Safety Factor			2.79	1.71	2.84			
9-5/8 in., 43.5 lb/ft, 25CR-80, Premium Conn.	43.5	500	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			190,124	2,516	2,516			
Safety Factor			5.29	1.51	2.52			
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	5,806	676,000	7,030	8,160	0.0371	6.184	6.059
Using Mud Weight of 11 ppg – Design Criteria			168,374	5,837	5,837			
Safety Factor			4.01	1.20	1.40			

Table 4-23 – Spoonbill No. 001 Injection Well Long String-Casing Annular Geometries

Section	ID (in)	MD (ft)	TVD (ft)
Surface Casing	12.415	3,003	3,000
Openhole	12.25	4,403	4,398
Openhole	9.875	10,209	10,204

Table 4-24 – Spoonbill No. 001 Injection Well Long String Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	% Excess (%)	Cement Volume (ft^3)
Production Casing/Surface Casing Annulus	1,200	0.3354	0	402
Production Casing/Surface Casing Annulus	1,803	0.3354	0	605
Production Casing/12-1/4 in. Openhole	900	0.3132	30	366
Production Casing/12-1/4 in. Openhole	500	0.3132	30	204
Production Casing/9-7/8 in. Openhole	5,806	0.2646	30	1,997
Shoe Track	90	0.2086	0	19

Spoonbill No. 002 Long String Casing Engineering Calculation Results

Table 4-25 – Spoonbill No. 002 Injection Well Long String Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
9-5/8 in., 43.5 lb/ft, L-80, Premium Conn.	43.5	3,898	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			359,905	2,230	2,230			
Safety Factor			2.79	1.71	2.84			
9-5/8 in., 43.5 lb/ft, 25CR-80, Premium Conn.	43.5	500	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			190,124	2,516	2,516			
Safety Factor			5.29	1.51	2.52			
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	5,806	676,000	7,030	8,160	0.0371	6.184	6.059
Using Mud Weight of 11 ppg – Design Criteria			168,374	5,837	5,837			
Safety Factor			4.01	1.20	1.40			

Table 4-26 – Spoonbill No. 002 Injection Well Long String Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Surface Casing	12.415	3,003	3,000
Openhole	12.25	4,403	4,398
Openhole	9.875	10,209	10,204

Table 4-27 – Spoonbill No. 002 Injection Well Long String Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	% Excess (%)	Cement Volume (ft^3)
Production Casing/Surface Casing Annulus	1,200	0.3354	0	402
Production Casing/Surface Casing Annulus	1,803	0.3354	0	605
Production Casing/12-1/4 in. Openhole	900	0.3132	30	366
Production Casing/12-1/4 in. Openhole	500	0.3132	30	204
Production Casing/9-7/8 in. Openhole	5,806	0.2646	30	1,997
Shoe Track	90	0.2086	0	19

<u>Spoonbill No. 003 Long String Casing Engineering Calculation Results</u>

Table 4-28 – Spoonbill No. 003 Injection Well Long String Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
9-5/8 in., 43.5 lb/ft, L-80, Premium Conn.	43.5	3,901	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			360,253	2,231	2,231			
Safety Factor			2.79	1.71	2.84			
9-5/8 in., 43.5 lb/ft, 25CR-80, Premium Conn.	43.5	500	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			190,037	2,517	2,517			
Safety Factor			5.29	1.51	2.51			
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	5,803	676,000	7,030	8,160	0.0371	6.184	6.059
Using Mud Weight of 11 ppg – Design Criteria			168,287	5,837	5,837			
Safety Factor			4.02	1.20	1.40			

Table 4-29 – Spoonbill No. 003 Injection Well Long String Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Surface Casing	12.415	3,009	3,000
Openhole	12.25	4,413	4,401
Openhole	9.875	10,216	10,204

Table 4-30 – Spoonbill No. 003 Injection Well Long String Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Production Casing/Surface Casing Annulus	1,200	0.3354	0	402
Production Casing/Surface Casing Annulus	1,809	0.3354	0	607
Production Casing/12-1/4 in. Openhole	904	0.3132	30	368
Production Casing/12-1/4 in. Openhole	500	0.3132	30	204
Production Casing/9-7/8 in. Openhole	5,803	0.2646	30	1,996
Shoe Track	90	0.2086	0	19

Spoonbill No. 004 Long String Casing Engineering Calculation Results

Table 4-31 – Spoonbill No. 004 Injection Well Long String Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
9-5/8 in., 43.5 lb/ft, L-80, Premium Conn.	43.5	3,898	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			359,687	2,230	2,230			
Safety Factor			2.79	1.71	2.84			
9-5/8 in., 43.5 lb/ft, 25CR-80, Premium Conn.	43.5	500	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			190,124	2,516	2,516			
Safety Factor			5.29	1.51	2.52			
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	5,806	676,000	7,030	8,160	0.0371	6.184	6.059
Using Mud Weight of 11 ppg – Design Criteria			168,374	5,837	5,837			
Safety Factor			4.01	1.20	1.40			

Table 4-32 – Spoonbill No. 004 Injection Well Long String Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Surface Casing	12.415	3,000	3,000
Openhole	12.25	4,398	4,398
Openhole	9.875	10,204	10,204

Table 4-33 – Spoonbill No. 004 Injection Well Long String Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Production Casing/Surface Casing Annulus	1,200	0.3354	0	402
Production Casing/Surface Casing Annulus	1,800	0.3354	0	604
Production Casing/12-1/4 in. Openhole	898	0.3132	30	366
Production Casing/12-1/4 in. Openhole	500	0.3132	30	204
Production Casing/9-7/8 in. Openhole	5,806	0.2646	30	1,997
Shoe Track	90	0.2086	0	19

Spoonbill No. 005 Long String Casing Engineering Calculation Results

Table 4-34 – Spoonbill No. 005 Injection Well Long String Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
9-5/8 in., 43.5 lb/ft, L-80, Premium Conn.	43.5	3,895	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			360,296	2,228	2,228			
Safety Factor			2.79	1.71	2.84			
9-5/8 in., 43.5 lb/ft, 25CR-80, Premium Conn.	43.5	500	1,005,000	3,810	6,330	0.0745	8.755	8.599
Using Mud Weight of 11 ppg – Design Criteria			190,211	2,514	2,514			
Safety Factor			5.28	1.52	2.52			
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	5,809	676,000	7,030	8,160	0.0371	6.184	6.059
Using Mud Weight of 11 ppg – Design Criteria			168,461	5,837	5,837			
Safety Factor			4.01	1.20	1.40			

Table 4-35 – Spoonbill No. 005 Injection Well Long String Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Surface Casing	12.415	3,011	3,000
Openhole	12.25	4,410	4,395
Openhole	9.875	10,219	10,204

Table 4-36 – Spoonbill No. 005 Injection Well Long String Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Production Casing/Surface Casing Annulus	1,200	0.3354	0	402
Production Casing/Surface Casing Annulus	1,811	0.3354	0	607
Production Casing/12-1/4 in. Openhole	899	0.3132	30	366
Production Casing/12-1/4 in. Openhole	500	0.3132	30	204
Production Casing/9-7/8 in. Openhole	5,809	0.2646	30	1,998
Shoe Track	90	0.2086	0	19

<u>Centralizers</u>

The bow-spring centralizer design for the 13-3/8 in. surface casing will ensure the protection of the USDW according to regulations. The specific placement of the centralizers will ensure that a continuous, uniform column of cement is present throughout the approximately 3,000 ft of 13-3/8 in. x 17-½ in. annular space. The recommended locations will be as follows:

- One above the shoe joint
- One above the float collar
- Five subsequent joints of casing
- Every fourth joint to surface

Total centralizers – 25

The cross-coupling centralizer design for the 9-5/8 in. x 7 in. long string casing ensures that a continuous, uniform column of cement is present throughout the approximately 10,200 ft of 12-¼ in. x 9-5/8 in and 9-7/8 in. by 7 in. annular space. The cross-coupling centralizer spacing will be designed to provide adequate stand-off, to be updated and finalized with the as-drilled directional surveys to provide a minimum of 70% standoff.

<u>Injection Tubing</u>

The injection tubing size and material were selected based on the injection volume, rate, and injectate composition. 25CR material was selected for the tubing based on the third-party metallurgical analysis provided in *Appendix E – Metallurgy*. The tubing string will be installed using premium connections.

Tables 4-37 through 4-41 summarize the tubing string engineering calculation results for each of the five wells. The burst design assumes an evacuated annulus filled with a column of 10 pound per gallon (ppg) mud, and the calculated maximum wellhead pressure from Table 4-5 applied. The collapse assumes an evacuated tubing and a 7 ppg noncorrosive fluid on the backside with 100 psi over the calculated maximum wellhead pressure from Table 4-5 applied.

Table 4-37 – Spoonbill No. 001 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	4,398	676,000	7,030	8,160	0.0371	6.184	6.059
			127,687	4,011	4,826			
Safety Factor			5.29	1.75	1.69			
		Evacuated tubing, 7 ppg diesel on backside with 2,410 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 2,310psi applied						

Table 4-38 – Spoonbill No. 002 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	4,398	676,000	7,030	8,160	0.0371	6.184	6.059
			127,687	4,011	4,826			
Safety Factor			5.29	1.75	1.69			
		Evacuated tubing, 7 ppg diesel on backside with 2,410 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 2,310 psi applied						

Table 4-39 – Spoonbill No. 003 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	4,413	676,000	7,030	8,160	0.0371	6.184	6.059
			127,977	4,012	4,827			
Safety Factor			5.28	1.75	1.69			
		Evacuated tubing, 7 ppg diesel on backside with 2,410 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 2,310 psi applied						

Table 4-40 – Spoonbill No. 004 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	4,398	676,000	7,030	8,160	0.0371	6.184	6.059
			127,542	4,011	4,826			
Safety Factor			5.30	1.75	1.69			
		Evacuated tubing, 7 ppg diesel on backside with 2,410 psi applied						
		Evacuated annulus, full column of 11ppg mud with 2,310 psi applied						

Table 4-41 – Spoonbill No. 005 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
7 in., 29.0 lb/ft, 25CR-80, Premium Conn.	29	4,395	676,000	7,030	8,160	0.0371	6.184	6.059
			127,890	4,010	4,824			
Safety Factor			5.29	1.75	1.69			
		Evacuated tubing, 7 ppg diesel on backside with 2,410 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 2,310 psi applied						

4.2.1.3 Downhole Equipment

Packer Assembly and PBR Discussion

A polished bore receptacle will be installed in the long string casing at the 9-5/8 in. x 7-in. crossover, at the base of the UCZ. The packer and PBR will be run on a work string, the PBR seal assembly will engage the PBR, and the packer will be hydraulically set in the UCZ. The packer seal assembly will be run on the 7-in. tubing. The tubing and long string annulus will be filled with a noncorrosive fluid (diesel) before setting the packer.

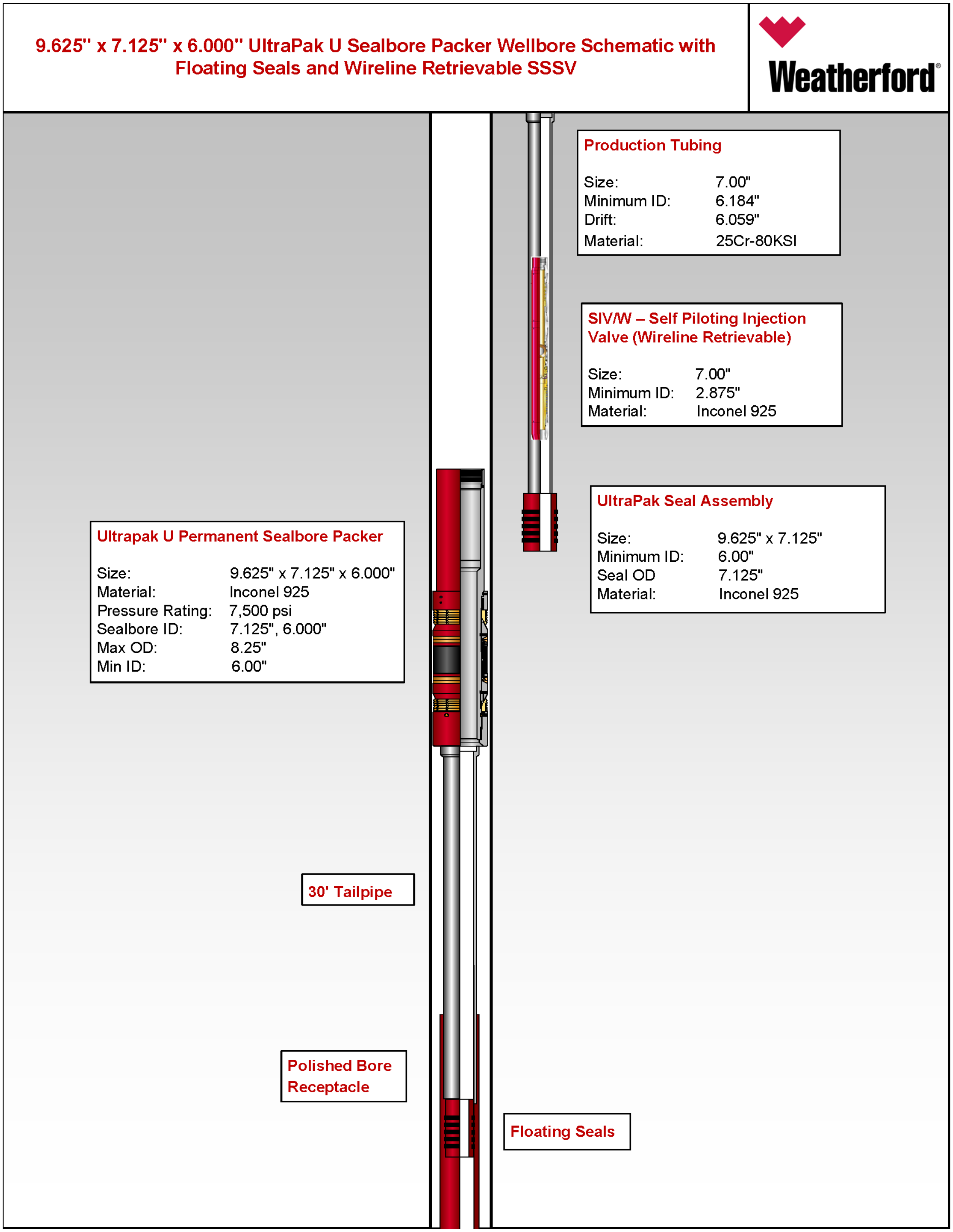


Figure 4-12 – Packer Assembly and PBR Schematic

Injection Valve

A downhole injection valve will be installed in the 7-in. tubing. The downhole injection valve is a one-way valve that will automatically close when the well is not injecting, preventing flowback above the valve.

Fiber Optic Cable, Tubing Encapsulated Conductor, and Pressure Gauge Array

Pressure and temperature gauges will be installed across the active injection zone to provide continuous data in real time for reservoir monitoring purposes. A fiber optic and TEC cable will be installed on the exterior of the long string casing to power the gauges and provide communication to the surface. The fiber optic and TEC cables will be run to a depth above the top of the injection interval in each of the Spoonbill injection wells, A ported pressure and temperature gauge will be run on the bottom of each TEC cable and set above the top of the injection interval in that well. External sensing pressure and temperature gauges will be installed in Spoonbill No. 001 and No. 002 to monitor formation pressure in the injection zones of Spoonbill No. 003, No. 004, and No. 005.

4.2.1.4 Wellhead Discussion

The wellhead is designed to accommodate anticipated working pressures and eliminate corrosion complications. The equipment will be manufactured from a combination of stainless-steel components across the hanger and casing spool. Inconel or equivalent lining will be placed across trims, stems, gates, valves, etc. The final pressure rating will be confirmed before manufacturing begins. The wellhead will be configured as displayed in Figure 4-17. The wellhead design and manufacturer shown may change based on well and commercial factors before drilling these wells.

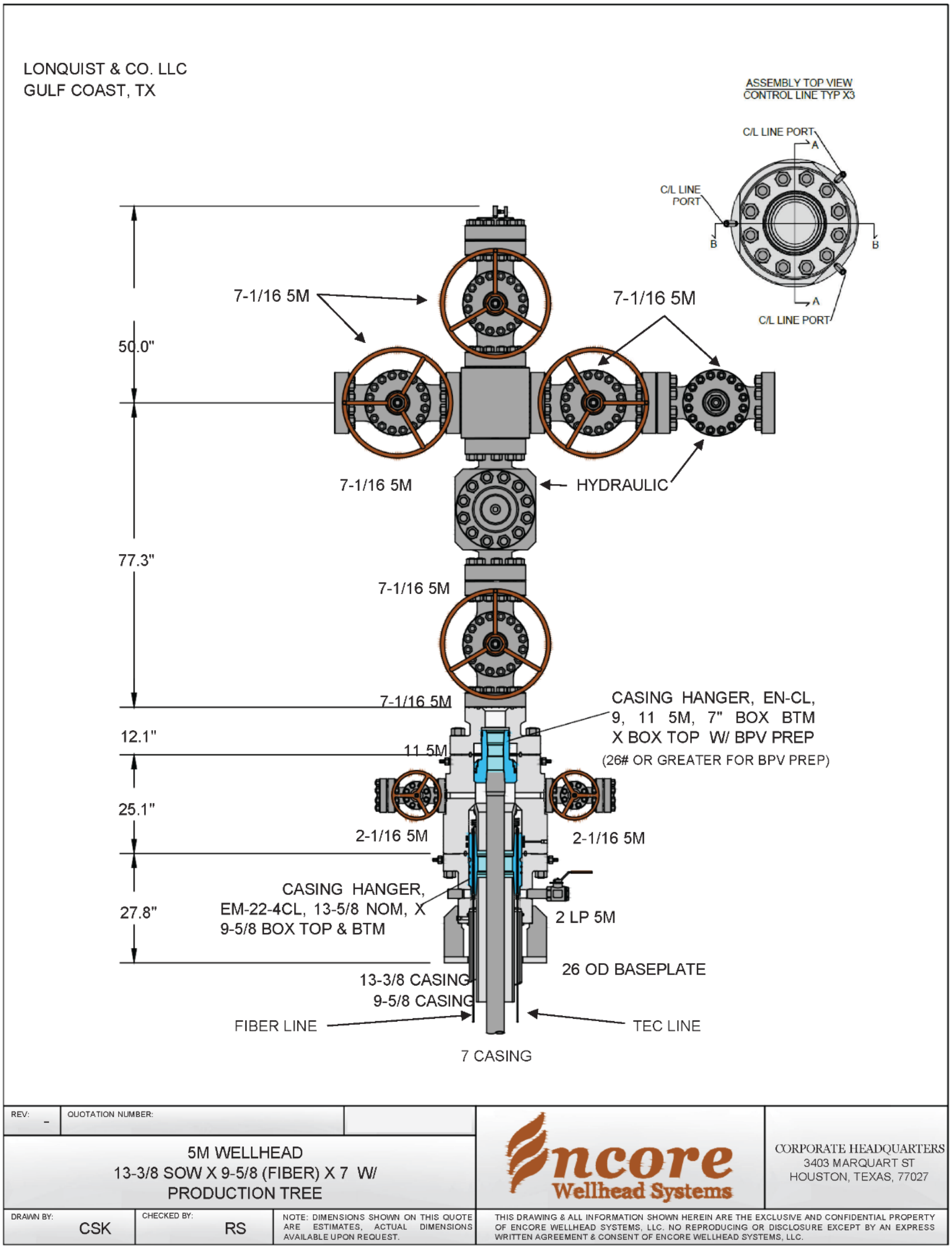


Figure 4-13 – Proposed Wellhead Schematic

4.3 Testing and Logging During Drilling and Completion Operations

4.3.1 Coring Plan

Sidewall cores will be obtained as needed from the upper confining, lower confining, and injection zones to supplement the whole cores that will be obtained during the drilling of the stratigraphic test well.

4.3.2 Logging Plan

An extensive suite of electric logs will be run in the open hole and in each string of casing. The openhole logging plan is detailed in Table 4-42 and the cased-hole logging plan is detailed in Table 4-43.

Table 4-42 – Openhole Logging Plan

					Spoonbill No.				
Hole Section	**Logging Suite**	**Target Data Acquisition**	**Open Hole Diameter (in.)**	**Depths of Survey (ft)**	**001**	**002**	**003**	**004**	**005**
Surface Hole	Gyro Survey	Directional survey	17.5	Surface - 3,000	x	x	x	x	x
	Gamma Ray Temperature HDIL/SP (Resistivity) Density Log Neutron Log Sonic Multi-Arm Caliper								
Long string section	Gyro Survey	Directional Survey	12-1/4 – 9-7/8	3,000 - ~10,200	x	x	x	x	x
	Spectral Gamma Ray Temperature HDIL/SP (Resistivity) Density Log Neutron Log								
	Deep Shear-Wave Sonic/Acoustic with Orientation	Deep Shear-Wave Imaging							
	Multi-Arm Caliper	Aid in Cement Calcs							
	Rotary Sidewall Cores	Augment Whole Core Data	12-1/4 – 9-7/8	Discrete intervals TBD based on OH logging runs	x				
	Formation Imaging Tool	Structural Dip Analysis		~3,900 - ~10,200	x	x	x	x	x
	Magnetic Resonance	Determine Reservoir Storage Potential							

					Spoonbill No.				
Hole Section	**Logging Suite**	**Target Data Acquisition**	**Open Hole Diameter (in.)**	**Depths of Survey (ft)**	**001**	**002**	**003**	**004**	**005**
	Formation Lithology	In Situ Minerology							
Injection Interval	Formation Fluid Sampling (optional)	Reservoir Fluid Samples	8-3/4	Discrete intervals TBD based on OH logging runs	x				
Injection Zone	Formation Stress/Reservoir Testing (optional)	Hydrogeologic Property Verification	12-1/4 – 9-7/8		x				

Table 4-43 – Cased-Hole Logging Plan

Hole Section	Logging Suite	Target Data Acquisition	Casing Dimension (in.)	Depths of Survey (ft)
Surface Casing	Radially Investigative Cement Bond Log	Cement Bond Investigation	13-3/8	3,000 - Surface
	Gamma Ray			
	CCL			
Long String Casing	Radially Investigative Cement Properties Log	Cement Properties Investigation	9-5/8 x 7 (Tapered String)	~10,200 - ~3,900
	Gamma Ray			
	CCL			
	Radially Investigative Cement Bond Log	Cement Bond Investigation		~3,900 - Surface
	Imaging Caliper	Roundness and Ovality		~10,200 - Surface
	Electromagnetic Corrosion Evaluation	Corrosion Identification		
	Electromagnetic Corrosion Evaluation	Fiber Optic Cable Location		
	Pulse Neutron	Gas Movement Behind Pipe		
Tubing and Packer	Multi-Barrier Casing Wall Thickness	Wall Thickness - Through Tubing	7	~4,400 - Surface

4.3.3 Formation Fluid Testing

Fluid samples will be acquired during the drilling and completion of the stratigraphic test well or initial injection well. If needed, supplemental samples may be taken during drilling and completion operations or immediately prior to injection operations.

4.3.5 Step-Rate Injection and Falloff Test

The step-rate injection test is designed to test the formation and verify its ability to receive and properly sequester CO_2 at the proposed injection rate. The test will either identify the formation fracture pressure or confirm that the proposed injection rates will not fracture the formation. As each well in the High West CCS project targets a different injection interval, the test will be performed at each well prior to injection. The test will be performed with a minimum step duration of 30 minutes. The actual step duration time will depend on the time required for pressure stabilization during the initial step. A maximum rate of at least 150% of the proposed maximum injection rate planned for each well will be reached during each test, with a goal to record at least three steps above and below the permitted injection rate or the formation fracture pressure. The proposed steps for each well are listed in Table 4-44 through 4-48.

Table 4-44 – Spoonbill No. 001 Proposed Step-Rate Injection Test

Step	Duration (min)	Rate (bpd)	Rate (bpm)	Volume (bbl)	Cumulative (bbl)
1	30	1,440	1	30	30
2	30	7,200	5	150	180
3	30	12,960	9	270	450
4	30	24,480	17	510	960
5	30	36,000	25	750	1,710
6	30	47,520	33	990	2,700
7	30	59,040	41	1,230	3,930
8	30	70,560	49	1,470	5,400
Total					5,400

Table 4-45 – Spoonbill No. 002 Proposed Step-Rate Injection Test

Step	Duration (min)	Rate (bpd)	Rate (bpm)	Volume (bbl)	Cumulative (bbl)
1	30	1,440	1	30	30
2	30	7,200	5	150	180
3	30	12,960	9	270	450
4	30	21,600	15	450	900
5	30	30,240	21	630	1,530
6	30	38,880	27	810	2,340
7	30	47,520	33	990	3,330
8	30	56,160	39	1170	4,500
Total					4,500

Table 4-46 – Spoonbill No. 003 Proposed Step-Rate Injection Test

Step	Duration (min)	Rate (bpd)	Rate (bpm)	Volume (bbl)	Cumulative (bbl)
1	30	1,440	1	30	30
2	30	7,200	5	150	180
3	30	12,960	9	270	450
4	30	24,480	17	510	960
5	30	36,000	25	750	1,710
6	30	47,520	33	990	2,700
7	30	59,040	41	1230	3,930
8	30	70,560	49	1470	5,400
Total					5,400

Table 4-47 – Spoonbill No. 004 Proposed Step-Rate Injection Test

Step	Duration (min)	Rate (bpd)	Rate (bpm)	Volume (bbl)	Cumulative (bbl)
1	30	1,440	1	30	30
2	30	7,200	5	150	180
3	30	12,960	9	270	450
4	30	24,480	17	510	960
5	30	36,000	25	750	1,710
6	30	47,520	33	990	2,700
7	30	59,040	41	1230	3,930
8	30	70,560	49	1470	5,400
Total					5,400

Table 4-48 – Spoonbill No. 005 Proposed Step-Rate Injection Test

Step	Duration (min)	Rate (bpd)	Rate (bpm)	Volume (bbl)	Cumulative (bbl)
1	30	1,440	1	30	30
2	30	7,200	5	150	180
3	30	12,960	9	270	450
4	30	27,360	19	570	1,020
5	30	41,760	29	870	1,890
6	30	56,160	39	1170	3,060
7	30	70,560	49	1470	4,530
8	30	84,960	59	1770	6,300
Total					6,300

4.3.6 Completion/Stimulation Plans

The High West CCS Project injection wells may be stimulated to improve injection operations. Stimulation may involve, but is not limited to, flowing fluids into or out of the well, increasing or connecting pore spaces in the injection formation, or other activities that are intended to allow the injectate to move more readily into the injection zone. Advanced notice of proposed stimulation activities will be provided to the Commissioner, as detailed below, prior to conducting the stimulation. High West will describe all fluids to be utilized for stimulation activities and will demonstrate that the stimulation will not interfere with containment. High West will submit proposed procedures for all stimulation activities to the Commissioner in writing at least 30 days in advance, per 40 CFR **§146.91(d)(2)**. High West will carry out the stimulation procedures, including any conditions, as approved or set forth by the Commissioner.

Standard industry stimulation that may be utilized includes the following:

- Acid matrix stimulation (hydrochloric and/or hydrofluoric)
- Non-acid stimulation
- Coiled-tubing nitrogen washout to remove sand near the wellbore
- Flow or swab well back to tank

Additives that may be utilized during stimulation operations may include the following:

- Surfactants
- Corrosion inhibitors
- Clay stabilizers
- Mutual solvents
- Chelating agents
- Inhibitor aids

4.4 Injection Well Operating Strategy

High West intends to inject a combined total of 10.0 MMT/yr of CO_2 into the five proposed injection wells. All five wells will be drilled from a barge with platforms then installed for injection operations to reduce the surface footprint of the project. As a result, Spoonbill No. 001, 002, 003 and 005 will all be drilled slightly directionally, kicking off below the USDW and returning vertical before the top of the UCZ. All of the wells will be drilled to the top of the lower confining zone (LCZ) but will each only inject into one of the selected injection intervals. The operating parameters for each well are provided in Table 4-49.

Table 4-49 – High West CCS Project Operating Parameters

Parameter	Spoonbill No. 001	002	003	004	005
Perforated Injection Interval (ft) (TVDSS)	9,725 – 10,085	8,703 – 9,474	8,160 – 8,672	7,036 – 7,914	6,122 – 6,938
Maximum Injection Volume (MMT/yr)	2.02	1.5	2.02	2.02	2.5
Average Injection Volume (MMT/yr)	2.01	1.49	1.94	2.01	2.45
Maximum Injection Rate (MMscf/d)	105	78.1	105	105	130.11
Average Injection Rate (MMscf/d)	104.5	77.77	100.82	104.5	127.59
Maximum BHP (psi)	5,793	4,715	5,124	4,253	3,845
Maximum Surface Injection Pressure (psi)	2,310	1,652	2,248	1,847	1,882
Expected Surface Injection Pressure (psi)	2,257	1,600	2,222	1,829	1,837
Maximum Annular Pressure	2,410	1,752	2,348	1,947	1,982

High West plans to inject 1.5 and 2.5 MMT/yr of CO_2 into the five injection wells, as was shown previously in Table 4-2. Under downhole well and reservoir conditions, the CO_2 will be in the supercritical phase throughout the project life. Surface injection pressures will be limited to ensure the BHP stays below 90% of the fracture pressure of the injection zone. The estimated fracture and maximum allowable BHP for each well are shown in Table 4-50. Bottomhole pressures will be measured directly using the gauges installed on the TEC cable as described in Section 4.2.1.

Table 4-50 – Injection Pressures by Well

Well Name	Top Depth (ft)	Fracture Pressure (psi)	Maximum Allowable BHP (psi)
Spoonbill No. 001	9,725	6,788	6,108
Spoonbill No. 002	8,703	6,073	5,466
Spoonbill No. 003	8,160	5,693	5,124
Spoonbill No. 004	7,036	4,910	4,419
Spoonbill No. 005	6,122	4,272	3,845

Each well will target a different injection interval to maximize the available pore space. Each injection interval was selected to collectively maximize the acreage position for CO_2 sequestration. A summary of the planned injection strategy is listed in Table 4-51.

Table 4-51 – High West CCS Project Injection Strategy

Well Name	Injection Duration (years)	Top Depth (ft) (TVDSS)	Bottom Depth (ft) (TVDSS)	Net Pay (ft)
Spoonbill No. 001	20	9,725	10,085	303
Spoonbill No. 002	20	8,703	9,474	534
Spoonbill No. 003	20	8,160	8,672	409
Spoonbill No. 004	20	7,036	7,914	466
Spoonbill No. 005	20	6,122	6,938	660

4.5 Injection Well Construction and Operation Summary

The High West CCS Project injection wells are designed to consider the planned injection rates, volumes, and injectate composition. A comprehensive metallurgical analysis was utilized to ensure that all material that may encounter the injectate stream will be constructed with materials compatible with that stream. Additionally, engineering design calculations, accounting for collapse, burst, and tensile strength, were executed to ensure the integrity of the well design. Overall, these wells are designed to ensure the safe, long-term storage of CO_2.

The High West CCS Project injection wells are designed to maximize the available pore space and safely sequester CO_2. Formation pressures and temperatures will be measured within the wells and used to update the CO_2 plume model and refine future injection strategies. This process will accurately evaluate and provide assurance of where the CO_2 is moving and at what rate, allowing for alteration to the injection and operation strategy if required. After injection ceases, the wells will be plugged or converted to in-zone monitoring wells for the project.

4.6 Monitoring Wells

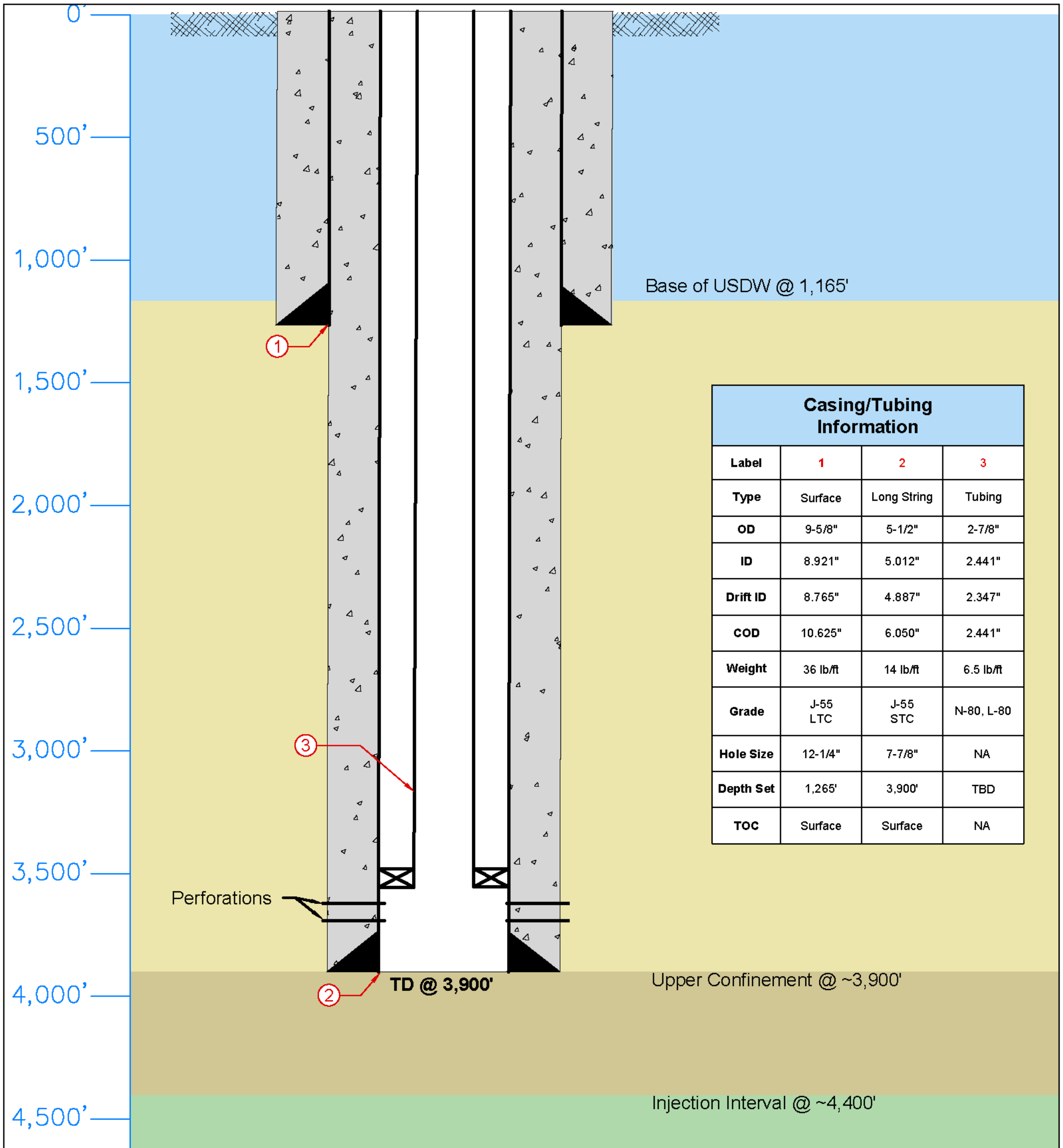
High West proposes to drill and complete one above zone monitoring (AZM) well. This well is intended to monitor the first permeable zone above the upper confining zone for indications of formation brine or CO_2 leaking out of the upper confining zone. Fluid sampling, gas detection tubes, temperature, and pressure anomalies are early warning signs that injectate from the High West CCS Project may be moving out of the injection internal. High West also proposes to drill and complete one USDW monitoring well and recomplete the High West stratigraphic test well as a USDW monitoring well.

4.6.1 General Outline of AZM Well Design

The AZM Well No. 001 was designed with the following specifications, as shown in Figure 4-18:

- Surface Casing
    - 9-5/8 in. 36 lb/ft casing set at ~1,265 ft (100 ft below the base of the USDW)
    - Cemented back to surface
- Long string Casing

    - 5 ½ in. 14 lb/ft casing set at ~3,900 ft
    - Cemented back to surface
- Tubing
    - 2 7/8 in. tubing 6.5 lb/ft tubing
- Wellhead
    - 9-5/8 in. SOW x 11 in. 5M casing head
    - 11 in. NOM x 5-1/2 in casing hanger
    - 11 in. 5M x 7-1/16 in. 5M tubing head with one blind flanged outlet and one outlet with a 2-1/16 in. manual gate valve
    - 7-1/16 in. NOM x 2-7/8 in. – tubing hanger
    - 7-1/16 in. 5M x 2-1/16 in. 5M – adapter flange
- Production Tree
    - Two 2-1/16 in. 5M manual gate valves with cap, needle valve, and gauge



Casing/Tubing Information

Label	1	2	3
Type	Surface	Long String	Tubing
OD	9-5/8"	5-1/2"	2-7/8"
ID	8.921"	5.012"	2.441"
Drift ID	8.765"	4.887"	2.347"
COD	10.625"	6.050"	2.441"
Weight	36 lb/ft	14 lb/ft	6.5 lb/ft
Grade	J-55 LTC	J-55 STC	N-80, L-80
Hole Size	12-1/4"	7-7/8"	NA
Depth Set	1,265'	3,900'	TBD
TOC	Surface	Surface	NA

LONQUIST		AZM Well No. 001	
	Country: USA	**State/Province:** Louisiana	**County/Parish:** St. Charles
	API No: TBD	**Field:**	**Well Type/Status:** Class VI
Louisiana License EF-7423	**RRC District No:**	**Project No:** LS232	**Date:** 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** Lauren Mayo	**Reviewed:** Andy Ellis	**Approved:** William H. George, P.E.
	Rev No: 1	**Notes:**	

Figure 4-14 – AZM Well No. 001 Schematic

AZM Well No. 001 Surface Casing Engineering Calculation Results

Table 4-52 – AZM Well No. 001 Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
9-5/8 in., 36.0 lb/ft, J55, LTC	36	1,265	453,000	2,020	3,520	0.0773	8.921	8.765
Using Mud Weight of 10 ppg – Design Criteria			45,540	658	658			
Safety Factor			9.95	3.07	5.35			

Table 4-53 – AZM Well No. 001 Surface-Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Openhole	12.25	1,265	1,265

Table 4-54 – AZM Well No. 001 Surface-Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Openhole/Casing Annulus Cement	1,265	0.3132	100	792
Shoe Track	45	0.4341	0	20

AZM Well No. 001 Long-String Casing Engineering Calculation Results

Table 4-55 – AZM Well No. 004 Injection Well Long String Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
5-1/2 in., 14 lb/ft, J-55, STC	14	3,900	222,000	3,120	4,280	0.0244	5.012	4.887
Using Mud Weight of 11 ppg – Design Criteria			54,600	2,231	2,231			
Safety Factor			4.07	1.40	1.92			

Table 4-56 – AZM Well No. 004 Injection Well Long String Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Surface Casing	8.921	1,265	1,265
Openhole	7-7/8	3,900	3,900

Table 4-57 – AZM Well No. 004 Injection Well Long String Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Production Casing/Surface Casing Annulus	1,265	0.2691	0	340
Production Casing/Openhole	2,635	0.1733	30	593
Shoe Track	90	0.1370	0	12

AZM Well No. 001 Tubing Engineering Calculation Results

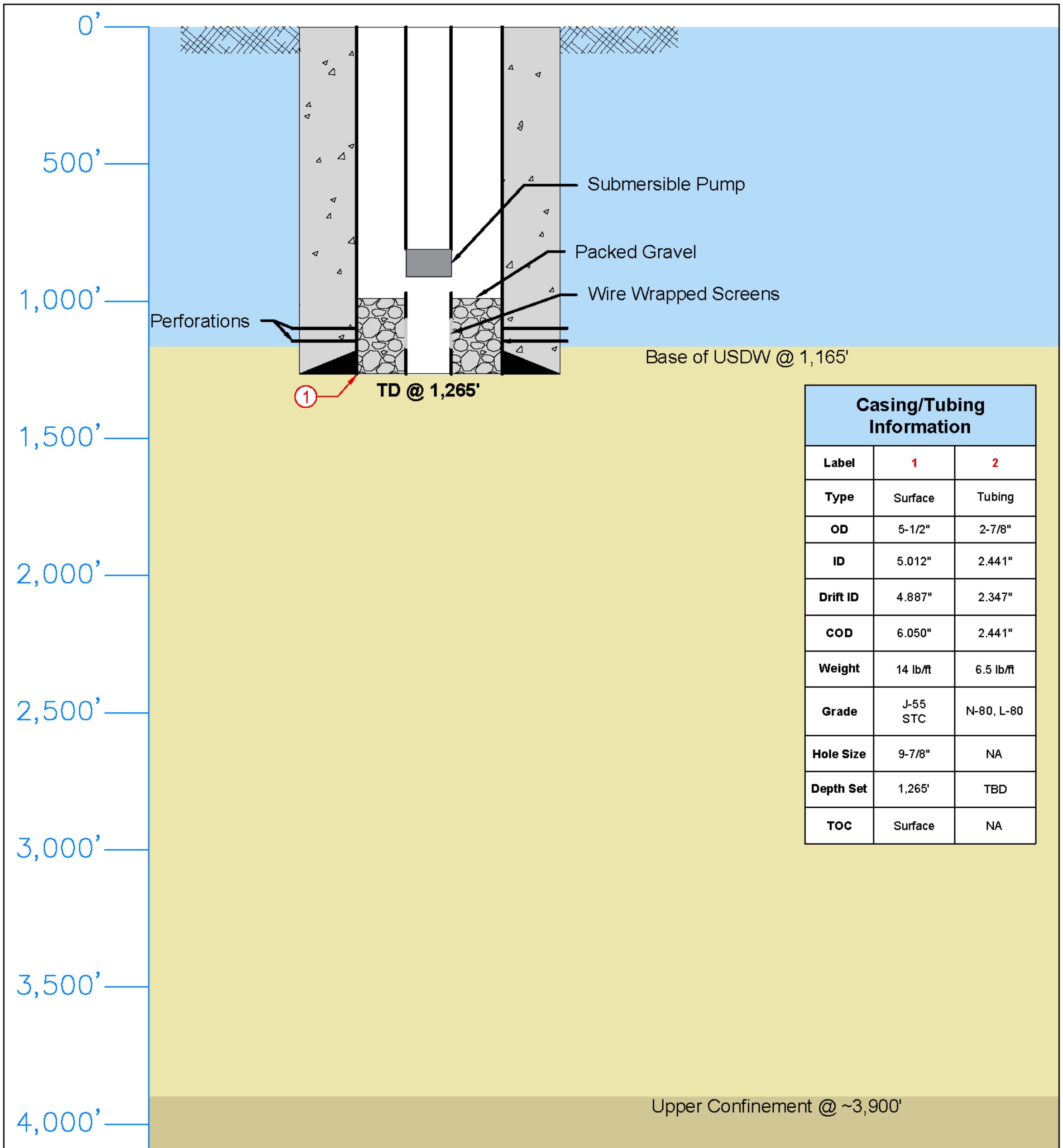
Table 4-58 – AZM Well No. 001 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
2-7/8 in., 6.5 lb/ft, N80/L80	6.5	3,800	145,000	11,100	12,100	0.0058	2.441	2.347
			24,700	3,793	4,484			
Safety Factor			5.87	2.93	2.70			
		Evacuated tubing, 9 ppg brine on backside with 500 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 1,000 psi applied						

4.6.2 General Outline of USDW Monitoring Well Design (USDW Monitoring Well No. 001)

The USDW Monitoring Well No. 001 was designed with the following specifications, as shown in Figure 4-19:

- Surface Casing
  - 5-1/2 in. 14 lb/ft casing set at ~1,265 ft (100 ft below the base of the USDW)
  - Cemented back to surface
- Tubing
  - 2-7/8 in. 6.5 lb/ft tubing
- Wellhead
  - 5-1/2 in. SOW x 7-1/16 in. 5M casing head
  - 7-1/16 in. NOM x 2-3/8 in. – tubing hanger
  - 7-1/16 in. 5M x 2-1/16 in. 5M – adapter flange
- Production Tree
  - Two 2-1/16 in. 5M manual gate valves with cap, needle valve, and gauge



Casing/Tubing Information

Label	1	2
Type	Surface	Tubing
OD	5-1/2"	2-7/8"
ID	5.012"	2.441"
Drift ID	4.887"	2.347"
COD	6.050"	2.441"
Weight	14 lb/ft	6.5 lb/ft
Grade	J-55 STC	N-80, L-80
Hole Size	9-7/8"	NA
Depth Set	1,265'	TBD
TOC	Surface	NA

LONQUIST		USDW Monitor Well No. 001	
	Country: USA	**State/Province:** Louisiana	**County/Parish:** St. Charles
	API No: TBD	**Field:**	**Well Type/Status:** Class VI
Louisiana License EF-7423	**RRC District No:**	**Project No:** LS232	**Date:** 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** Lauren Mayo	**Reviewed:** Andy Ellis	**Approved:** William H. George, P.E.
	Rev No: 1	**Notes:**	

Figure 4-15 – USDW Monitor Well No. 001 Schematic

USDW Monitor Well No. 001 Surface Casing Engineering Calculation Results

Table 4-59 – USDW Monitor Well No. 001 Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
5-1/2 in., 14.0 lb/ft, J55, STC	14	1,265	222,000	3,120	4,280	0.244	5.012	4.887
Using Mud Weight of 10 ppg – Design Criteria			17,710	658	658			
Safety Factor			12.54	4.74	6.51			

Table 4-60 – USDW Monitor Well No. 001 Surface-Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Openhole	9.875	1,265	1,265

Table 4-61 – USDW Monitor Well No. 001 Surface-Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Openhole/Casing Annulus Cement	1,265	0.3669	100	928
Shoe Track	45	0.1370	0	6

USDW Monitor Well No. 001 Tubing Engineering Calculation Results

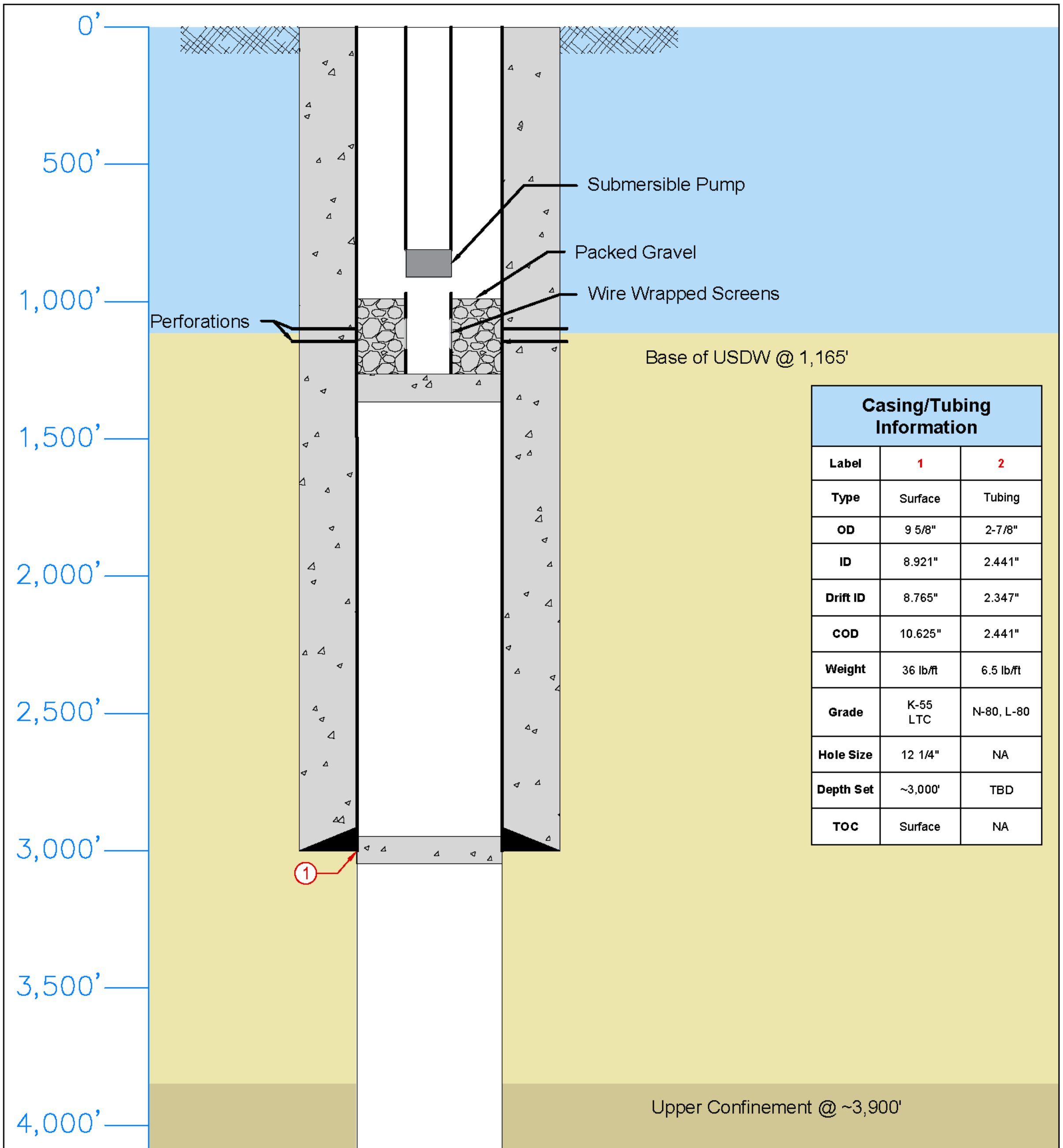
Table 4-62 – USDW Monitor Well No. 001 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
2-7/8 in., 6.5 lb/ft, N80/L80	6.5	1,000	145,000	11,100	12,100	0.0058	2.441	2.347
			6,500	2,774	2,882			
Safety Factor			22.31	4.00	4.20			
		Evacuated tubing, 9 ppg brine on backside with 500 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 1,000 psi applied						

4.6.3 General Outline of USDW Monitoring Well Design (USDW Monitoring Well No. 002)

The USDW Monitoring Well No. 002 recompletion was designed with the following specifications, as shown in Figure 4-20:

- Surface Casing (existing)
  - 9-5/8 in. 36 lb/ft casing set at ~3,000 ft
  - Cemented back to surface
- Tubing
  - 2-7/8 in. 6.5 lb/ft tubing
- Wellhead
  - 9-5/8 in. SOW x 11 in. 5M casing head
  - 11 in. NOM x 2-3/8 in. – tubing hanger
  - 11 in. 5M x 2-1/16 in. 5M – adapter flange
- Production Tree
  - Two 2-1/16 in. 5M manual gate valves with cap, needle valve, and gauge



Casing/Tubing Information		
Label	1	2
Type	Surface	Tubing
OD	9 5/8"	2-7/8"
ID	8.921"	2.441"
Drift ID	8.765"	2.347"
COD	10.625"	2.441"
Weight	36 lb/ft	6.5 lb/ft
Grade	K-55 LTC	N-80, L-80
Hole Size	12 1/4"	NA
Depth Set	~3,000'	TBD
TOC	Surface	NA

LONQUIST		USDW Monitor Well No. 002	
	Country: USA	**State/Province:** Louisiana	**County/Parish:** St. Charles
	API No: TBD	**Field:**	**Well Type/Status:** Class VI
Louisiana License EF-7423	**RRC District No:**	**Project No:** LS232	**Date:** 03/27/2025
12912 Hill Country Blvd. Ste F-200 Austin, Texas 78738 Tel: 512.732.9812 Fax: 512.732.9816	**Drawn:** Lauren Mayo	**Reviewed:** Andy Ellis	**Approved:** William H. George, P.E.
	Rev No: 1	**Notes:**	

Figure 4-16 – USDW Monitor Well No. 002 Schematic

USDW Monitor Well No. 002 Surface Casing Engineering Calculation Results

Table 4-63 – USDW Monitor Well No. 002 Surface Casing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
9-5/8 in., 36.0 lb/ft, K-55, LTC	36	3,000	489,000	2,020	3,520	0.0773	8.921	8.765
Using Mud Weight of 10 ppg – Design Criteria			108,000	1,560	1,560			
Safety Factor			4.53	1.29	2.26			

Table 4-64 – USDW Monitor Well No. 002 Surface-Casing Annular Geometries

Section	ID (in.)	MD (ft)	TVD (ft)
Openhole	12.25	3,000	3,000

Table 4-65 – USDW Monitor Well No. 002 Surface-Casing Cement Calculation Results

Section	Footage (ft)	Capacity (ft^3/ft)	Excess (%)	Cement Volume (ft^3)
Openhole/Casing Annulus Cement	3,000	0.3132	100	1,879
Shoe Track	45	0.4341	0	20

USDW Monitor Well No. 002 Tubing Engineering Calculation Results

Table 4-66 – USDW Monitor Well No. 002 Injection Tubing Engineering Calculation Results

Description	Casing Wt. (lb/ft)	Depth (ft) (TVD)	Tensile (psi)	Collapse (psi)	Burst (psi)	Capacity (bbl/ft)	ID (in.)	Drift ID (in.)
2-7/8 in., 6.5 lb/ft, N80/L80	6.5	1,000	145,000	11,100	12,100	0.0058	2.441	2.347
			6,500	2,774	2,882			
Safety Factor			22.31	4.00	4.20			
		Evacuated tubing, 9 ppg brine on backside with 500 psi applied						
		Evacuated annulus, full column of 11 ppg mud with 1,000 psi applied						

4.7 Engineering Design and Operations Summary

The Spoonbill Nos. 001 to 005 and all associated monitoring wells are designed to meet the requirements of SWO **§3617** [40 CFR **§146.86**]. This design, along with a robust monitoring, verification, and reporting (MRV) plan, will allow for the safe injection and sequestration of CO_2.

Appendix D - Construction:

- Appendix D-1 Spoonbill No. 001 Proposed Well Schematic
- Appendix D-2 Spoonbill No. 001 Well Drilling and Completion Prognosis
- Appendix D-3 Spoonbill No. 002 Proposed Well Schematic
- Appendix D-4 Spoonbill No. 002 Well Drilling and Completion Prognosis
- Appendix D-5 Spoonbill No. 003 Proposed Well Schematic
- Appendix D-6 Spoonbill No. 003 Well Drilling and Completion Prognosis
- Appendix D-7 Spoonbill No. 004 Proposed Well Schematic
- Appendix D-8 Spoonbill No. 004 Well Drilling and Completion Prognosis
- Appendix D-9 Spoonbill No. 005 Proposed Well Schematic
- Appendix D-10 Spoonbill No. 005 Well Drilling and Completion Prognosis
- Appendix D-11 Mud Program
- Appendix D-12 AZM Well No. 001 Proposed Well Schematic
- Appendix D-13 USDW Monitor Well No. 001 Proposed Well Schematic
- Appendix D-14 USDW Monitor Well No. 002 Proposed Well Schematic
- Appendix E-1 Metallurgy Report