Gunnison Copper Project
Well Stimulation Plan and Procedures

Underground Injection Control (UIC) Permit R9UIC-AZ3-FY16-1

Submitted by:

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Contents

1. INTRODUCTION 1
2. Plan Details (Selected Wells, Intervals and Locations) 1
   2.1. Trial 1 Freshwater Stimulation +- Acid Stimulation 4
   2.2. Trial 2 Acid Stimulation 5
3. Individual Test Methodology for a Stimulation Event 6
4. Injected Materials 8
5. Trial Constraints, Protection of USDW and Permit Compliance 8
   5.1. Termination Conditions 8
   5.2. Operating Constraints and Protection of USDW 8
   5.3. Solution Management 9
   5.4. Hydraulic Control 10
   5.5. Well Mechanical Integrity 10
6. Modelling 10
   6.1. Closed-System Modelling 10
   6.2. Real-World Modelling with Leak-Off 14
   6.3. Modelling Conclusions 17
7. Data Collection and Reporting 17
8. Schedule 18

TRIAL WELL STIMULATION PLAN &
PROCEDURES

1. INTRODUCTION

Excelsior Mining Arizona, Inc. ("Excelsior") submits this proposed plan and procedures for well stimulation activities in accordance Permit No. R9UIC-AZ3-FY16-1 and as modified on April 21, 2023.

Well stimulation is designed to enhance the injectivity potential of the injection zone and is used to clean the well bore, enlarge channels, and increase pore space in the interval to be injected thus making it possible for fluids to move more readily into the formation. Well stimulation is intended to allow the injectate to move more readily between injection and recovery wells (approximately 75 feet apart) and to move more readily into the injection formation.

The plan is to complete two trials of well stimulation (hydraulic fracturing) as summarized below and described in more detail in this document.

Trial 1 will use fresh water only as the fracking fluid ("Fresh Water Stimulation") for the first round of activities to be applied to one well of a 5-spot pattern. The first well planned is well 7759 (or alternate). Multiple down-hole intervals of approximately 10 to 20 feet will be tested in this well and subsequent wells (each a "Stimulation Event"), and the same interval may be tested several times to determine the benefit, if any, of stimulating the same interval more than once. After the first round of stimulation activities has been completed on the first well (7759), stimulation activities will move to the activities and wells in Trial 2. After Trial 2 activities are complete, the equipment will be moved back to test the remainder of the Trial 1 wells. In this case, stimulation activities may use a freshwater or acid solution depending on the initial results from Trials 1 and 2.

Trial 2 will use standard mining raffinate charged with weak sulfuric acid ("Acid Stimulation") and be applied to a single well within a 5-spot pattern. Multiple down-hole intervals in the well may be tested, and the same interval(s) may be tested several times to determine the benefit, if any, of stimulating the same interval more than once. Fresh water stimulation may occur at the same interval before or after acid stimulation to help determine which stimulation fluid generates the greater benefits.

In summary, three Primary Wells are expected to be tested in Trial 1 (the first with water only, the other two with water and/or acid solution, after Trial 2), and one well in Trial 2 (subject to having sufficient Target Intervals available in this well).

A Stimulation Event will terminate when the Termination Conditions described in Section 5.1 are met. The overall trial will terminate when all the Target Intervals (see Table 1) have been tested in Trial 1 and Trial 2 Primary Wells (or Alternate Wells if the Primary Well is unsuitable). This is expected to take approximately 6 weeks and is expected to commence in February or March 2024 (subject to EPA approvals).

2. Plan Details (Selected Wells, Intervals and Locations)

Table 1 below indicates the approximate depths down-hole (the "Target Depths") of the wells (the "Selected Wells") that Excelsior intends to undertake well stimulation. Tested intervals will occur below casing in the open hole portions of these wells. There will be situations where the straddle packer depths may need to be adjusted to obtain a good seal in the open boring of the well at the Target Depth. In this case the depths indicated in the table may vary by 10's of feet, but under no circumstances will the final Target Interval be closer than 50 feet from the bottom of the FRP casing or closer than 50 feet from the bottom of the well.

TRIAL WELL STIMULATION PLAN & PROCEDURES

The table shows which wells will receive Freshwater Stimulation (Trial 1) and which will receive Acid Stimulation (Trial 2), with the caveat that after the first well (7759) has been tested in Trial 1, and after Trial 2 is complete, the remaining wells in Trial 1 may receive a combination of Acid Stimulation and/or Freshwater Stimulation. The table also lists several Alternate Wells. In the event Target Depths in the Primary Well can't be stimulated, the Alternate Well may be used.

Table 1. Selected Wells for stimulation trials. Table includes Target Depths (depth of Target Interval), depth of the casing (bottom of the FRP casing) and depth of the well (bottom of the well).

Trial 1 Wells (Freshwater then acid solution)						**Trial 2 Wells (Acid solution)**		
	Primary Well			**Alternate Well**			**Primary Well**	**Alternate Well**
Well ID	**5474**	**5475**	**7759**	**5406**	**5407**	**Well ID**	**5408**	**5340A**
Depth of casing	**678**	**696**	**648**	**619**	**678**	**Depth of casing**	**717**	**716**
Target Depths*								
feet	730	895	755	900	728	**Target Depths***	865	903
feet	813	1015	1038	960	776	feet	935	990
feet	928	1105	1110	1100	840	feet	1032	1024
feet	965	1145	1139		938	feet	1080	1068
feet	1018		1181		998	feet	1143	1115
feet	1054		1233		1040			
feet	1118				1097			
feet	1160				1158			
feet					1189			
Depth of well	**1280**	**1280**	**1330**	**1300**	**1280**	**Depth of well**	**1274**	**1350**

* Target Depths represent the center of a Target Interval. Straddles packers would be placed either side of the Target Depth with the overall Target Interval representing approximately 10 to 20 feet. Each well has multiple Target Depths.

The location of the Selected Wells along with the remaining production wells in the wellfield, the surrounding monitoring and hydraulic control wells, and the AOR/Aquifer Exemption are shown in Figure 1. A cross-section showing the wellfield wells in relation to the bottom of the Aquifer Exemption are shown in Figure 2.

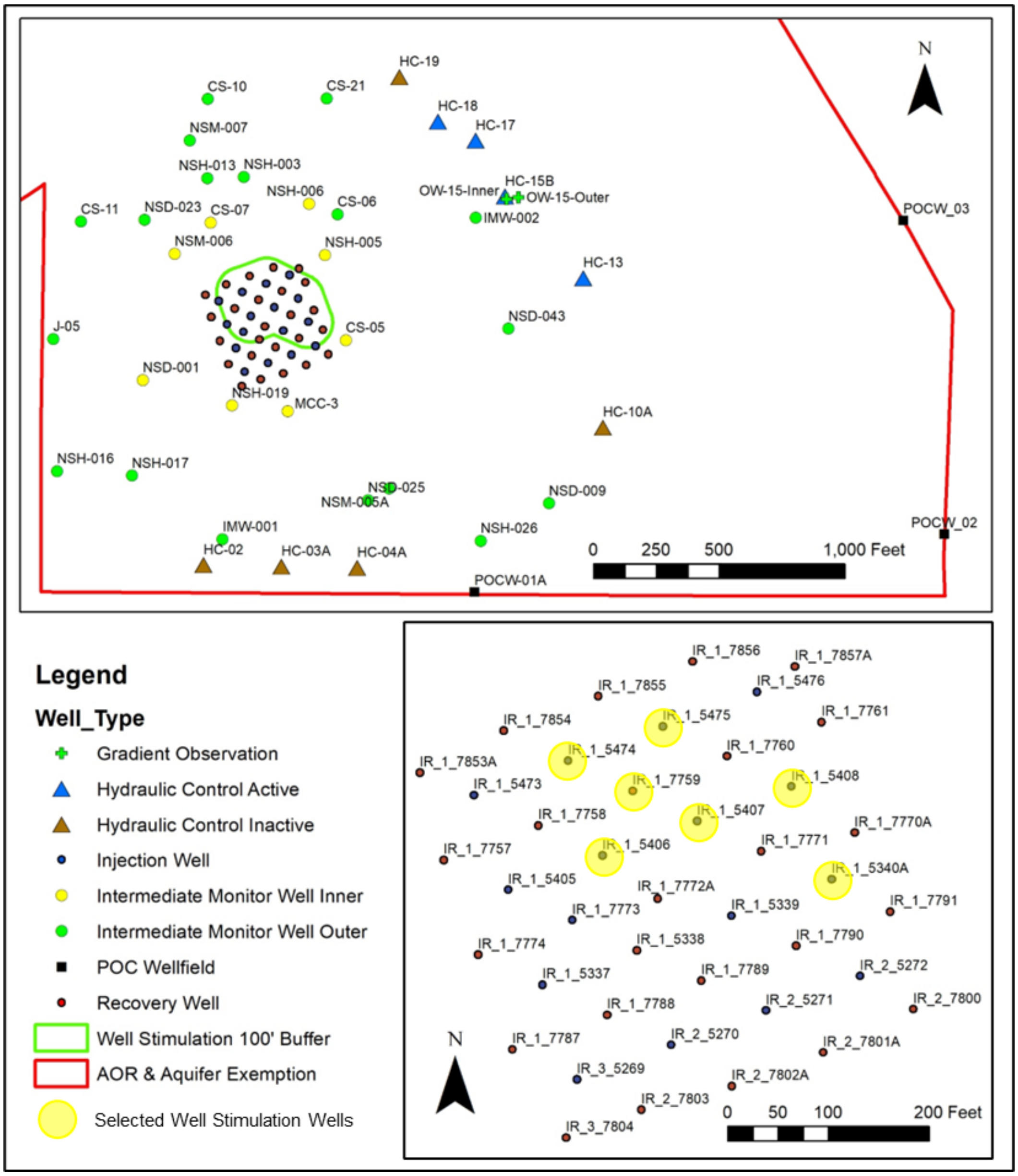

Figure 1. The top diagram shows the location of the production wellfield (Injection and Recovery Wells) in relation to the surrounding monitoring and hydraulic control wells. Included is a polygon that represents a 100-foot buffer zone around any Selected Well. The lower diagram is a close-up of the production wellfield with the Selected Wells highlighted in yellow.

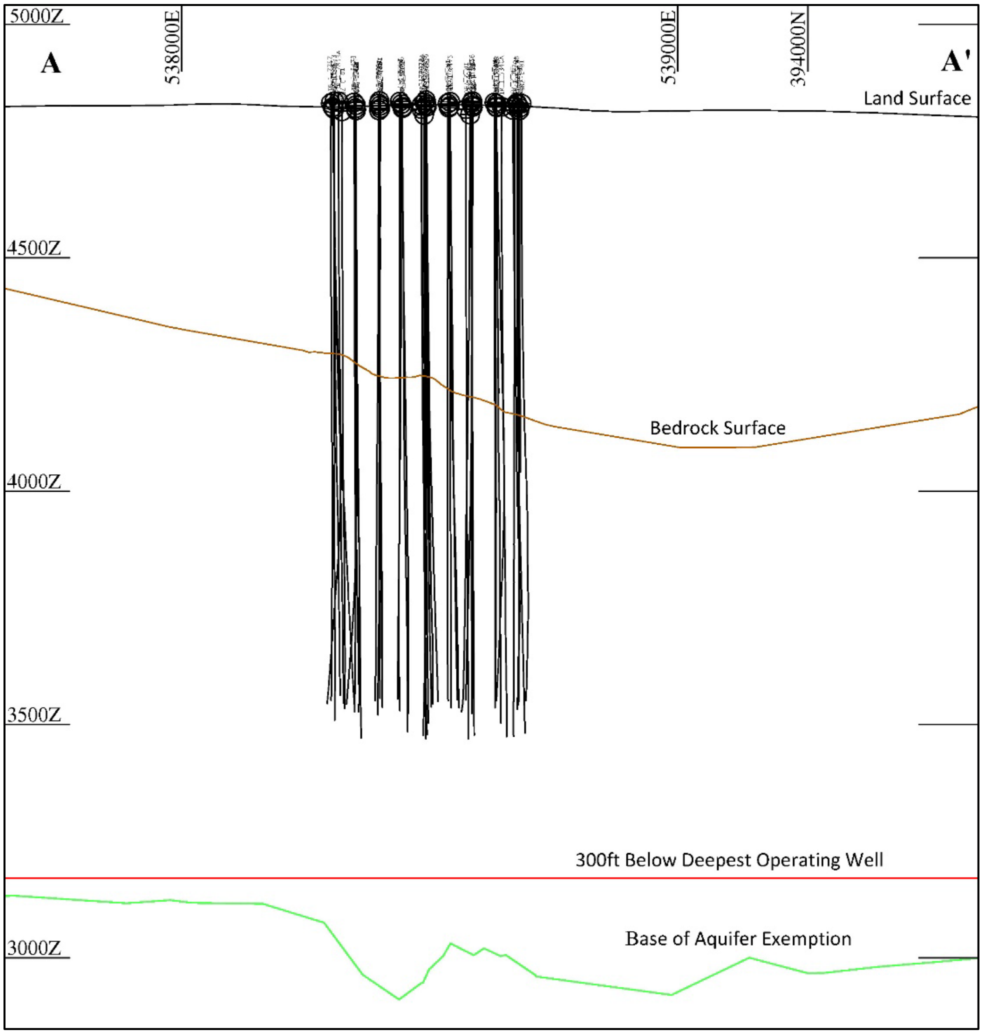

Figure 2. View looking north through a west-east cross-section of the current wellfield showing the base of the Aquifer Exemption, which is greater than 300 feet below the deepest operating well. Selected Wells are not the deepest operating wells.

2.1. Trial 1 Freshwater Stimulation +- Acid Stimulation

This section describes the plan for Trial 1 using freshwater only on the first well to be tested and then freshwater and/or acid solution on the remaining wells (after Trial 2). The individual test methodology for each Stimulation Event is described in more detail in Section 3.

Hydraulic fracturing will be first tested with freshwater in well 7759 located in the center of the 5-spot pattern (see Figure 1). The well heads of the surrounding four wells will be in recovery mode, meaning they will be unpressured but connected to the recovery solution lines (see Section 5.2.e).

The first Target Interval to be tested will be at a depth of approximately 1233 feet within well 7759. This is the deepest interval of any well to be tested and is at least 90 feet above the bottom of the well and over 400 feet from the bottom of the Aquifer Exemption. If straddle packers cannot be seated properly at this interval, then the straddle packers will be moved up the well until a proper seal on the straddle packers can be achieved.

Once the straddle packers have been effectively set, the interval will be pressured-up to initiate hydraulic fracturing as per the individual test methodology described in Section 3.

Experienced operators will determine the effectiveness of the Stimulation Event and will terminate the Stimulation Event if any of the Termination Conditions are met (see Section 5.1) or if they deem the test to be complete or ineffective. A single Stimulation Event is expected to take between one and six hours of Active Stimulation (defined in Section 5.1.f). During a Stimulation Event there will be periods of non-Active Stimulation such that the overall time of a Stimulation Event may exceed 6 hours.

Over-pressure and flow rate during the Stimulation Event will be adjusted by the operator to optimize inflation of existing fractures close to the well bore, and eventually extending the inflation of pre-existing fractures (if possible) to the adjacent well bores that are approximately 75 feet away.

Once the information for the first Stimulation Event has been collected and recorded, the straddle packers will be disengaged and raised within the borehole to the next highest Target Interval. The same process as described above will then be repeated until all the Target Intervals in well 7759 have been tested. Note that the Target Intervals in Table 1 represent a maximum number of target intervals for the well and that some intervals may not allow effective straddle packer setting and will therefore not be tested.

Some or all of the Target Intervals in well 7759 may be re-stimulated with freshwater before the straddle packers are moved to the next Target Interval. This could result in a second, third or fourth Stimulation Event at the same Target Interval. This is designed to determine if there is a benefit to multiple re-stimulations of the same interval. In all cases pressure and flow will be recorded to comply with permit conditions.

After testing has been completed on well 7759, the rig and equipment will be moved to well 5408 for Acid Stimulation trials (see Trial 2 description below).

After Trial 2 has been completed, the rig and equipment will be moved back to the remaining Trial 1 wells (5474 and 5475).

The remaining wells in the 5-spot pattern (5474 and 5475) will undergo Stimulation Events using Freshwater and/or Acid Stimulation. Target Intervals may undergo multiple Stimulation Events using Freshwater or Acid Stimulation. This is designed to assess the differences between these two stimulation fluids and the effect of multiple stimulations at the same Target Interval using either of these solutions.

2.2. Trial 2 Acid Stimulation

This section describes the plan for Trial 2 using weak acid solution. The individual test methodology for each Stimulation Event is described in more detail in Section 3.

Trial 2 will be similar in methodology to Trial 1 however instead of freshwater as the stimulation fluid, sulfuric acid in the range of 5 gram per liter to 100 gram per liter, mixed with standard mining solution (raffinate), will be used as the stimulation fluid, although freshwater stimulation may also occur in some or all of the Target Intervals.

Trial 2 will be performed on up to five Target Intervals in well 5408 (Table 1), starting from the bottom interval and moving up the well. The sequence of tasks for each Target Interval will be as follows:

1. Set straddle packers at the Target Interval.
2. Perform Stimulation Event using freshwater solution.
3. Perform Stimulation Event using acid solution.
4. Perform Stimulation Event using freshwater solution.
5. Perform Stimulation Event using acid solution.
6. Steps 2 to 5 may be repeated several more times to see if there is any trend in the data collected.
7. Once a trend has been determined the trial at this Target Interval will be complete.
8. Remove packers and go to next Target Interval.

At all times during Steps 2 to 6 the flow and pressures of all injected and recovered solutions will be monitored and recorded to maintain permit compliance.

The four non-test wells surrounding well 5408 will be in recovery mode (see section 5.2.e).

The sequence of tasks described above will be repeated at the other Target Intervals for well 5408. However, if the data being collected during the trial indicates there is little value in the intermittent freshwater stimulation events, or the multiple acid stimulation events, one or all of these repeat steps in the sequence may be omitted (meaning just one or more acid stimulation events may occur at the Target Interval).

If during the trial it is determined the packers can't be set effectively at some of the Target Intervals in well 5408, then well 5340A will be used as an alternative well with the four surrounding recovery wells equally equipped and monitored (see Section 5.2.e).

After Trial 2 the rig and equipment will be moved to the remaining Trial 1 wells to complete Trial 1 (see Section 2.1).

3. Individual Test Methodology for a Stimulation Event

Each Stimulation Event will be conducted in approximately the same manner. An interval of approximately 10 to 20 feet in the Selected Well (the "Target Interval") will be isolated by expandable straddle packers, one packer placed at the top of the interval and the other at the bottom of the interval. If needed, a "kerf" (small horizontal cut around the circumference of the rock-wall within the bore hole) or perforation "perf" (a number of small horizontal holes cut around the circumference of the rock-wall within the bore hole) will be created to promote nucleation of desirable fractures.

Stimulation Events will use conventional equipment and techniques and injection pressures and flows will be monitored during the test to ensure test conditions and constraints are met.

A more detailed description of the test methodology follows.

a) For Selected Wells, the pump and all down-hole equipment will be removed from the well at an appropriate time and the well head will remain open for the Stimulation Event.
b) Prior to setting straddle packers, the Target Depth will be evaluated with a down-hole video camera to determine the best location around the Target Interval to set the straddle packers. Straddle packers will be set approximately 10 to 20 feet apart, but this distance may vary to ensure good seating of the straddle packers.
c) If considered necessary, a kerf or perf may be made using industry standard techniques around the

middle of the Target Interval. After kerfing or perfing, the Target Interval will be examined using a down-hole video camera to ensure the kerfing or perfing was adequate. If for some reason the kerfing or perfing is not adequate, additional kerfing or perfing may be performed around the Target Interval.

d) Straddle packers will then be set at the Target Interval (one expandable packed at the top of the interval and one at the bottom).
e) A pressure transducer will be placed above the top packer to measure the pressure in the solution column above the Target Interval (the "Top Transducer"). A second pressure transducer will be placed below the bottom packer to measure the pressure of the solution column below the Target Interval (the "Bottom Transducer"). These transducers will be monitored during the Stimulation Event and data recorded.
f) Once the straddle packers are effectively set, a high-pressure tube will be inserted through the top packer into the Target Interval. Stimulation fluid will be pumped into the Target Interval through the tube at sufficient volumes and pressures to initiate and propagate a hydraulic fracture or propagate the inflation of existing fractures. Stimulation fluids will be delivered via industry standard surface pumps and applicable valving, suitable to this type of operation. The volumes and pressures necessary for well stimulation are discussed in Sections 5.2.h, 5.2.i, and in section 6.2.
g) During stimulation, injection pressures will be monitored, measured, and recorded by the operator.
h) Volumes of injected fluid will be monitored, measured, and recorded by the operator.
i) The monitoring of injection pressures and volumes in the Target Interval are used by operators to gauge the effectiveness and progression of the Stimulation Event. This allows operators to determine when a stimulation event should continue or be terminated.
j) An ineffective seal by either straddle packer will be evidenced by an inability to sufficiently pressure up the Target Interval. In the case of an ineffective seal, the straddle packer(s) will be re-set or moved up or down the well until an effective seal is maintained. A Stimulation Event will not proceed until an effective seal is established.
k) A Stimulation Event will be terminated when sufficient pressure to maintain Active Stimulation can no longer be maintained or if any of the Termination Conditions in Section 5.1 are met.
l) The injected fluid is described in more detail in Section 4.
m) Immediately adjacent recovery or injection wells will not be operating during a Stimulation Event. These wells will be equipped with pressure transducers to assist with monitoring the progression of the Stimulation Event.
n) Recovery wells elsewhere in the wellfield may be operated before, during or after Stimulation Events to capture stimulation fluids and maintain permit conditions. Hydraulic containment will be maintained.
o) When a Stimulation Event is terminated, flow may return up the injection tube to the surface. The volume of this solution will be recorded. Chemically it is equivalent to mining/process solutions and will be collected and returned to the process stream via the adjacent PLS collection pond.
p) On some occasions the same Target Interval will be re-stimulated, in which case the straddle packers will remain in place and the procedure from item g) onwards will re-commence. If re-stimulation is not going to occur, then after a Stimulation Event, once the pressure in the Target Interval has declined sufficiently, the packers will be disengaged and removed, to be re-used at the next Target Interval.
q) Any solution that migrates to adjacent wells or remains in the formation will become part of the process stream.
r) Once a Stimulation Event is completed the procedure will start again at the next Target Interval until the entire program is complete.

4. Injected Materials

No stimulation additives or additional chemicals are proposed to be used. Freshwater Stimulation will use just freshwater (no additives). Acid stimulation will use standard mining raffinate with between 5 gram per liter and 100 gram per liter sulfuric acid added.

Diesel or derivatives will not be used in the Gunnison well stimulation activities.

Given only freshwater or acidified raffinate will be used, there are no requirements for additional Level 1 or Level 2 groundwater monitoring.

5. Trial Constraints, Protection of USDW and Permit Compliance

5.1. Termination Conditions

A Stimulation Event will be terminated if any one of the following conditions are met.

a) If the pressure or flow required to maintain Active Stimulation cannot be maintained.
b) If the Top Transducer consistently measures an increase in pressure greater than 200 psi above the static column pressure (note the well head is open). This prevents solution from flowing out the top of the open well head.
c) If the Bottom Transducer measures a pressure greater than the upper limit of operating pressures as described in Permit Section II.E.4.a.
d) If any operator or personnel considers it is unsafe to continue a test.
e) If any operator or personnel considers a test will put USDWs or groundwater at risk.
f) If the cumulative time of Active Stimulation exceeds six hours. Active Stimulation is defined as the active lateral or vertical propagation of new fractures or the active lateral or vertical propagation of the inflation of pre-existing fractures away from the Target Interval. Note that total time of a Stimulation Event may exceed six hours due to pauses between periods of Active Stimulation.

The stimulation trial will be completed (end) when all the Target Intervals in the Primary Wells (or the Alternate Wells if all the Target Intervals in the Primary Well are not used), have been tested. The stimulation trial may end sooner if Excelsior determines sufficient data has been collected without the need to test all the Target Intervals so described.

5.2. Operating Constraints and Protection of USDW

a) Excelsior will comply with the requirements of UIC Permit R9UIC-AZ3-FY16-1 (as amended).
b) Solutions injected and recovered in connection with this well stimulation program will form part of the overall solution balance in compliance with Permit Section II.E.1. and II.E.5., and Hydraulic Control will always be maintained.
c) Stimulation Events will only be conducted during day shifts.
d) During the trial, no perimeter injection or recovery well will be tested (this includes the following wells IR_1_7853A, IR_1_7854, IR_1_7855, IR_1_7856, IR_1_7857A, IR_1_5476, IR_1_7761, IR_1_7770A, IR_1_7791, IR_1_7800, IR_1_7801A, IR_1_7802A, IR_1_7803, IR_1_7804, IR_1_7787, IR_1_7774, IR_1_7757).

e) Whenever a Stimulation Event is being conducted or a well is undergoing stimulation activity, the four surrounding and immediately adjacent wells located approximately 75 feet away (the four wells surrounding the central well of a 5-spot pattern) will be in recovery mode, meaning they will be unpressured and connected to the recovery solutions lines so any solution that might travel up these wells will be measured, recorded, collected and returned to the nearby pregnant liquor solution ("PLS") pond. These wells will also be instrumented with pressure transducers to help evaluate the stimulation event.
f) Should a new feature propagate sufficiently, or an existing feature inflate sufficiently such that it intersects an adjacent well (~75 feet away) or an adjacent pre-exiting permeable structure, then the injected fluid will enter the intersected well/structure, thereby bleeding off the solution and reducing pore pressure. This will most likely result in the termination of the Stimulation Event or greatly reduce further propagation due to the inability to maintain Active Stimulation pressures.
g) Injection over-pressure (pressure more than that required to induce existing fracture inflation or new fracture creation) is required to stimulate multiple features in multiple orientations and maintain the stimulation event. Higher over-pressures favor the inflation of pre-existing features/fractures as opposed to the creation of new fractures. This is the desired outcome and is supported by modelling (see Section 6), which used over-pressures in the range of 200 to 500 psi. Over-pressures during a Stimulation Event are likely to be in the range of 200 to 500 psi but may vary depending on the conditions encountered at that Target Interval.
h) The highest individual fracture gradient observed from prior testing was approximately 2.22 psi/ft for the Middle Abrigo. The deepest Target Interval in well 7759 is in the Middle Abrigo at approximately 1233 feet. This indicates the pressure required for well stimulation at this Target Interval might need to be as high as approximately 2,700 psi. At the surface this is equivalent to approximately 2400 psi. Applying an over-pressure of 500 psi indicates surface pressures to maintain well stimulation may be as high as 2900 to 3000 psi. However, it is possible that Target Intervals may contain more competent rock than has previously been tested, requiring higher pressures to induce stimulation or higher over-pressures may be needed to generate the desired outcomes (multiple stimulated features close to the well bore). In any event, surface pressures will not exceed 3500 psi over a sustained period of time. Shallower Target Intervals or in weaker rock types will require less pressure at the Target Interval and therefore less pressure at the surface.
i) Injection flow rates into a Target Interval will be dependent on how the specific Target Interval responds to the Stimulation Event. At a given over-pressure (e.g., 500 psi), non-permeable (tight rocks) are likely to have a low flow rate to initiate the event, but higher flow rates will be required to sustain the Stimulated Event as they expand away from the well and intersect more permeable rocks or adjacent wells (thus bleeding off pressure and flow). As a result, flow rates are expected to range from 20 gpm up to approximately 350 gpm per Stimulation Event. If a lot of leak-off occurs during a Stimulation Event (see modelling section 6.2) total injected volumes during Active Stimulation could be in the order of 100,000 gallons per Target Interval.
j) Active Stimulation (see Section 5.1.f) will not occur for more than 6 cumulative hours per Stimulation Event. This is designed to limit the stimulation distance from the Target Interval.
k) Under no circumstances will the final Target Interval be closer than 50 feet from the bottom of the FRP casing or closer than 50 feet from the bottom of the well.

5.3. Solution Management

When a Stimulation Event is completed and the pressure is reduced, a portion of the injected solution may return to the surface via the injection tube. The volume of this solution will be measured and recorded. This solution will be collected and returned to the usual operating solutions via the nearby PLS pond. Any well stimulation solution that migrates to adjacent wells will become part of the operating process stream. Any stimulation solution that remains in the ground after a stimulation test will become part of the operating process stream. At all times the volume of solutions going into the ground or coming out of the ground will be monitored and recorded and form part of the overall solution management to maintain Permit conditions.

5.4. Hydraulic Control

The volume of all injected and recovered solutions, including stimulation fluids, during the well stimulation program will form part of the total injected and recovered volumes and hydraulic control solution balance. Specifically, at all times, permit conditions specified in Part II.E.1.a, Part II.E.5 and Part II.F.5 will be maintained, including stimulation fluids, along with all other permit conditions. Therefore, hydraulic containment will be maintained at all times.

5.5. Well Mechanical Integrity

All Stimulation Events will occur in the un-cased, open borehole portion of the Selected Wells at least fifty (50) feet below the bottom of the well casing. There is no expectation or anticipation of potential for loss of mechanical integrity in any wells. Once the trials are complete and before a Selected Well is brought back into injection operations, the cased portion of the well will be video logged to ensure there has been no accidental damage to the casing. If damage to casing in any well is suspected, then mechanical integrity testing will occur in compliance with Permit Section II.E.3.a.i.A.

6. Modelling

Extensive well stimulation (hydraulic fracture) modelling has been completed for representative wells and 5-spot patterns using existing local and regional geotechnical/geomechanical data sets, geological and structural models, and hydrogeological models and data sets. Two sets of modelling were completed, the first using a closed system model that does not allow for leak-off of solutions into adjacent non-stimulated features of wells. This is useful for determining how the rocks physically respond to hydrofracturing (orientation, distribution, and changes related to pressure) but does not give real-world indications of potential flow rates and volumes. The second set of modelling allows for leak-off, giving a more real-world indication of volumes of injected fluid required to maintain well stimulation. The two sets of modelling are described below.

6.1. Closed-System Modelling

Closed system well stimulation modelling (where no stimulation solution leaks-off to adjacent structures or wells) was completed on four 5-spot patterns as shown in Figure 3.

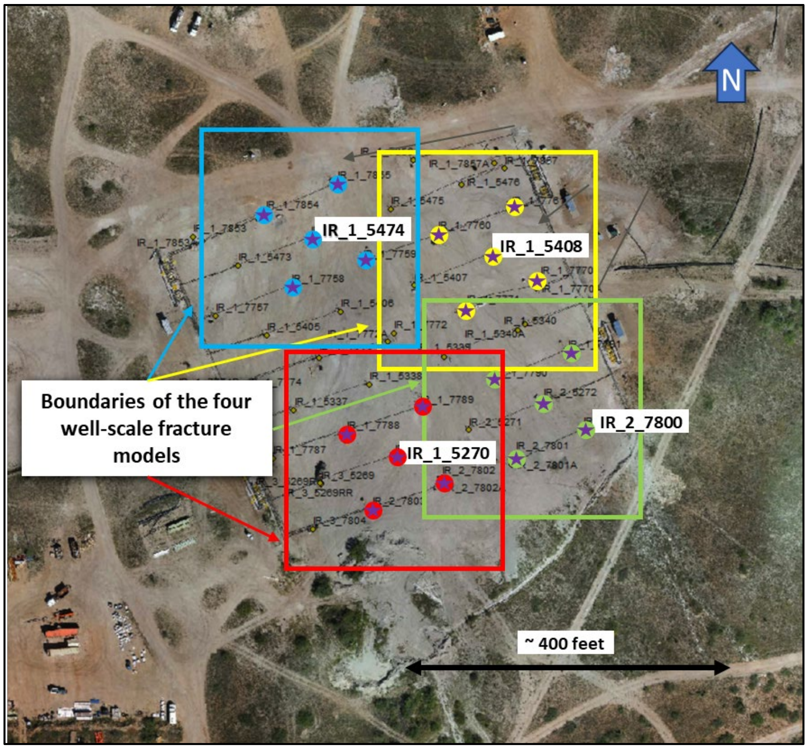

Figure 3. Location and domain of the four 5-Spot patterns that were modelled.

This modelling was designed to assess the distribution and orientation of stimulated fractures under a variety of pumping pressures and volumes. Four or five Target Intervals spaced approximately 150' apart down the target wells were numerically stimulated at different over-pressures and total injected volumes (note that in closed system modelling the injection rate is not relevant and no solution can leak from the system). Results for the 5-spot patterns centered on wells IR-1-5474 and 5408 are shown in Figure 4 and Tables 2 and 3. The other two 5-spot patterns generated very similar results, which can be summarized as follows:

a) The rocks in all 5-spot patterns behaved similarly to each other under well stimulation. The orientation, distribution, and lengths of stimulated features were consistent and similar despite changes in elevation, rock type and location.
b) Pre-existing zones of weakness (fractures, features, joints), inflate and are stimulated in significant preference to breaking fresh rock and creating new features.
c) Higher over-pressures stimulate a greater number of pre-existing features, and these stimulated features are located **closer** to the well (shorter stimulated lengths) but with larger stimulated apertures, as compared to lower over-pressures.
d) Higher over-pressures generate smaller and less newly induced (created) fractures as compared to lower over-pressures.

As a result of the closed loop modelling, stimulating at higher over-pressures is preferred and more protective.

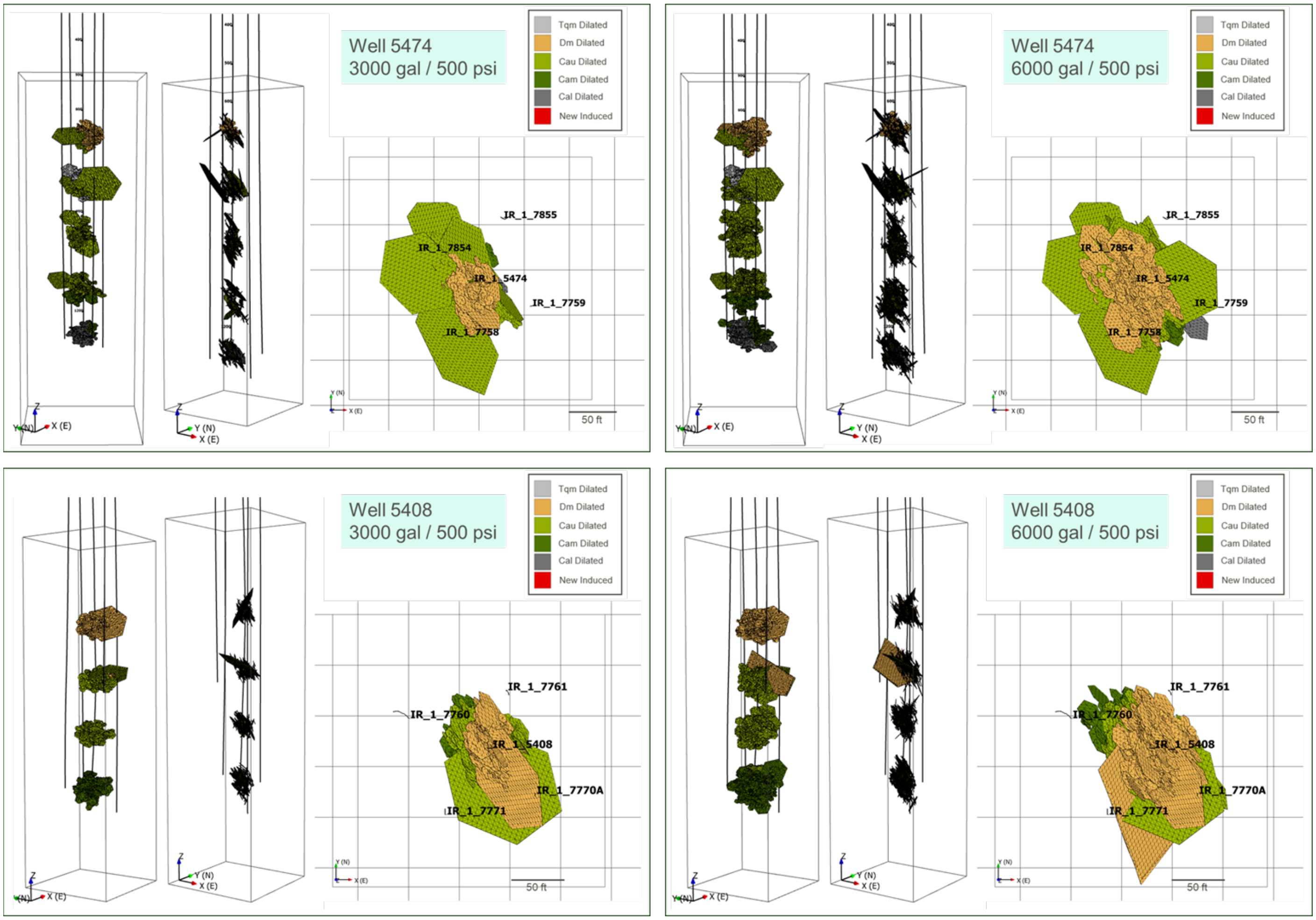

Figure 4. Results of the closed-system stimulation modelling showing 3-D and plan views of the orientation, distribution, and extent of inflated fractures at 500 psi over-pressure and 3000 or 6000 gallons per Target Interval. Inflated pre-existing features are colored by rock type (Tqm = Texas Cayon quartz-monzonite, Dm = Martin Formation, Cau = Upper Abrigo, Cam = Middle Abrigo, Cal = Lower Abrigo). Note that there are many more pre-existing features in the modelled 5-spot, but these did not inflate with the stimulation event and are therefore not shown. These may however take leak-off fluid. Newly induced (created) features are shown in red. These are small and obscured in the images by the surrounding inflated pre-existing features. The grid scale in the plan view is 50 x 50 feet.

Table 2. Results of closed-system well stimulation modelling for well IR-1-5474. Over-pressure and injected volume vary. The Bounding Box Dimension represents the volume of a rectangular prism encapsulating all stimulated features for that Target Interval. The Target Interval is in the approximate center of the Bounding Box.

Well IR-1-5474			Bounding Box Dimensions Maximum Distances (ft)					
			Newly Induced			Inflated Pre-existing		
Volume (gal)	Over Pressure (psi)	Target Interval	EW	NS	Vertical	EW	NS	Vertical
3000	200	1	31.5	45.1	55	124.8	142.1	158.3
		2	43	61.4	75	138.5	196.5	180.9
		3	31.5	45.1	55	98.8	143.1	199.1
		4	31.5	45.1	55	113.2	138.4	116.5
		5	31.5	45.1	50	123.7	134.9	109.6
		Average	**33.8**	**48.3**	**58**	**119.8**	**151**	**152.9**
	500	1	20.1	28.7	35	81.5	96	87.8
		2	25.8	36.9	45	103.5	114.1	116.9
		3	25.8	36.9	45	66.2	89.5	114.4
		4	25.8	36.9	45	76.4	95.1	96
		5	20.1	28.7	35	77.4	89.1	93.2
		Average	**23.5**	**33.6**	**41**	**81**	**96.7**	**101.6**
6000	200	1	40.2	57.3	65	139	142.1	181.6
		2	54.5	77.8	95	138.5	196.5	229
		3	43	61.4	75	145.9	181.3	184
		4	37.3	53.2	65	135.7	152.5	126
		5	37.3	53.2	65	134.6	148	150.5
		Average	**42.4**	**60.6**	**73**	**138.7**	**164.1**	**174.2**
	500	1	28.7	41	45	128.1	127.5	114
		2	31.5	45.1	55	100.8	163.7	121.3
		3	31.5	45.1	55	94.5	103.7	142.4
		4	31.5	45.1	55	97.4	129	100.8
		5	25.8	36.9	45	107.2	119.9	99.8
		Average	**29.8**	**42.6**	**51**	**105.6**	**128.8**	**115.7**

The Target Interval is approximately in the center of the Bounding Box Dimension, so the maximum lateral or vertical distance from the well (Target Interval) is approximately half the bounding box dimension, with a slight bias towards the south and west (see Figure 4).

Table 3. Results of closed-system well stimulation modelling for well IR-1-5408. Over-pressure and injected volume vary. The Bounding Box Dimension represents the volume of a rectangular prism encapsulating all stimulated features for that Target Interval. The Target Interval is in the approximate center of the Bounding Box.

Well IR-1-5408			Bounding Box Dimensions Maximum Distances (ft)					
			Newly Induced			Inflated Pre-existing		
Volume (gal)	Over Pressure (psi)	Target Interval	EW	NS	Vertical	EW	NS	Vertical
3000	200	1	37.3	53.2	65	113.8	153.9	170.6
		2	31.5	45.1	55	105.6	120.1	141.2
		3	34.4	49.1	60	95.1	124.1	127.4
		4	31.5	45.1	55	91.7	121.4	107.3
		Average	**33.7**	**48.1**	**58.8**	**101.6**	**129.9**	**136.6**
	500	1	25.8	36.9	45	76.6	101.5	102.5
		2	25.8	36.9	45	81.7	98.1	78.1
		3	25.8	36.9	45	76.9	98.9	80.2
		4	20.1	28.7	35	54.9	99.2	85.3
		Average	**24.4**	**34.8**	**42.5**	**72.5**	**99.4**	**86.5**
6000	200	1	54.5	77.8	95	139.1	170.9	225.4
		2	48.8	69.6	85	145	166	172.1
		3	48.8	69.6	85	142.7	147.9	170.6
		4	43	61.4	80	121.3	160.4	154.2
		Average	**48.8**	**69.6**	**86.3**	**137**	**161.3**	**180.6**
	500	1	37.3	53.2	65	114.6	127.3	142.8
		2	37.3	53.2	65	94	104.3	124.3
		3	37.3	53.2	65	111.5	116.9	132.8
		4	31.5	45.1	55	91.7	121.4	98.9
		Average	**35.8**	**51.2**	**62.5**	**102.9**	**117.5**	**124.7**

6.2. Real-World Modelling with Leak-Off

The second round of modelling was designed to simulate more real-world conditions by allowing stimulation solutions to leak-off into the adjacent rocks and pre-existing structures within the 5-spot pattern or wellfield. During Stimulation Events, when a stimulated feature intersects a non-stimulated pre-existing fracture or permeable rock, leak-off will occur allowing some of the stimulation solution to migrate into the pre-existing fracture or permeable rock (or adjacent well), thus lowering the pore pressure of the stimulated feature and using up stimulation solution. Leak-off modelling used two of the prior-modelled 5-spots (centered on wells IR-1-5474 and IR-1-5408) and incorporated the same 3D mechanical earth model (MEM) and discrete fracture network model (DFN), with the addition of leak-off. Existing hydrological data and parameters were used to estimate the leak-off of injected solution into the adjacent rock mass including: i) intact rock, ii) smaller natural fractures that were not explicitly included in the DFN, and iii) larger fractures from the fracture model that are not inflated during the hydraulic fracturing simulation but may be intersected by stimulated features and therefore take stimulation fluid.

Because solution can leak-off during stimulation, the rate of injection (gpm) is an important parameter in this type of modelling. Low injection rates (e.g., 40 gpm) may be able to initiate a Stimulation Event but cannot sustain well stimulation because as the stimulated features move away from the well, they intersect adjacent permeable features that "consume" the stimulation solution, thus preventing the pore-pressure to build up high enough to maintain inflation. Real world modelling like this shows high injection rates are required to induce inflation at distances greater than 25 feet from the Target Interval.

Leak-off modelling was completed using a combination of 200 and 500 psi over-pressures and pumping rates of 50 gpm and 300 gpm. The base case model used 300 gpm and 500 psi over-pressure, representing the approximate limits of the equipment to be used in the trials. The base case was modelled to push at least some of the inflated pre-existing features out far enough to intersect at least two of the adjacent recovery wells. The results of this base case model are shown in Figure 5. This generated similar orientations, distributions and extents as seen in the prior modelling (compare Figures 4 and 5). The average total injected volume per Target Interval (at 500 psi and 300 gpm) to achieve this outcome was 9,000 gallons for well 5474 and 54,000 gallons for well 5408. The greater total average volume per Target Interval in well 5408 was due to the greater number of adjacent permeable structures intersected by the inflated structures for that well.

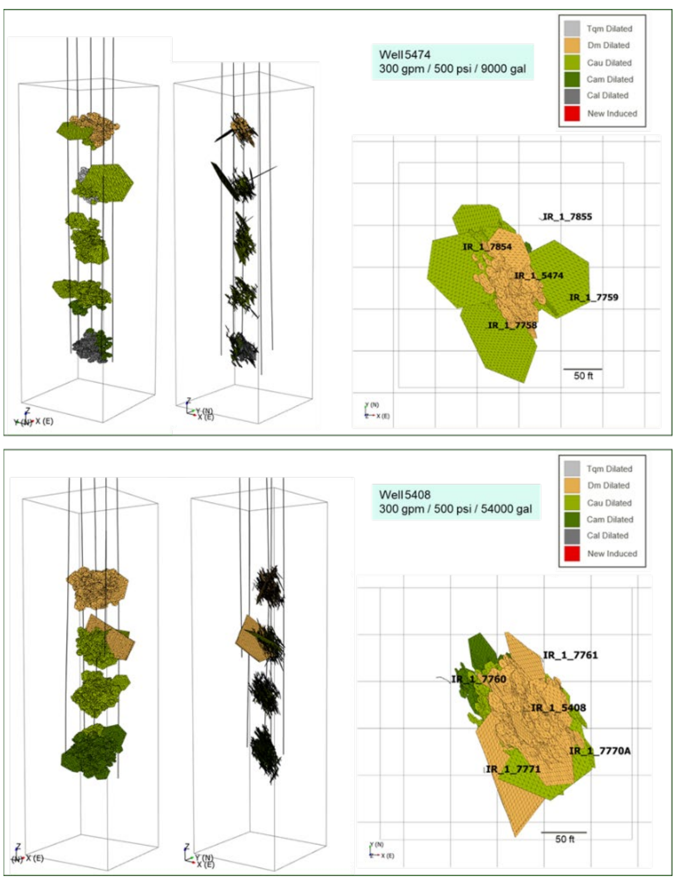

Figure 5. Results of the leak-off stimulation modelling showing 3-D and plan views of the orientation, distribution, and extent of inflated fractures at 500 psi over-pressure and various total gallons of injected solution. Inflated pre-existing features are colored by rock type (referred to Figure 5 for description) and newly induced (created) features are colored red (these are obscured in the view by the pre-existing features).

As mentioned above, to achieve reasonable stimulation volumes, the average total injected volume per Target Interval at 500 psi and 300 gpm was approximately 9,000 gallons for well 5474 and 54,000 gallons for well 5408. Using the same total injected volumes, the models were also run at 200 psi over-pressure (50 gpm and 300 gpm) and at 500 psi over-pressure (50 gpm). This gave a total of eight model runs: two wells (5474 and 5408), two over-pressures (200 and 500 psi), and two injection rates (50 gpm and 300 gpm), all at an average total injection volume of 9,000 and 54,000 gallons respectively (by well). The Bounding Box Dimensions (a rectangular prism encapsulating all the stimulated features) were calculated for each model run and the results are shown Table 4. For reference, the Bounding Box at 300 gpm and 500 psi for wells 5474 and 5408 (Table 4) would encapsulate all the stimulated features shown in Figure 5.

Table 4. Results of real-world leak-off modelling for wells IR-1-5474 and IR-1-5408. Note that the Bounding Box encapsulates all the stimulated features centered on the Target Interval, so the lateral or vertical distance of the stimulated feature from the Target Interval is approximately half the Bounding Box Dimensions Maximum Distance.

				Bounding Box Dimensions Maximum Distances (ft)					
				Newly Induced			Inflated Pre-existing		
	Pump Rate (gpm)	Over Pressure (psi)	Target Interval	EW	NS	Vertical	EW	NS	Vertical
Well IR-1-5474 (Average total injected volume per Target Interval of 9,000 gal)	50 gpm	200	Average	8	11.5	18	122	147	153.2
		500	Average	5.2	7.4	12	69.3	92	85.2
	300 gpm	200	Average	16.1	22.9	29	135.8	161.3	166.3
		500	Average	5.2	7.4	13	88	118	110.2
Well IR-1-5408 (Average total injected volume per Target Interval of 54,000 gal)	50 gpm	200	Average	15.8	22.5	30	132.7	153.9	167
		500	Average	12.9	18.4	25	82.1	101.5	100.5
	300 gpm	200	Average	15.8	22.5	30	152.9	178.5	209.5
		500	Average	13.6	19.5	23.8	111.5	126.9	138.2

The results shown in Table 4 indicate that at 200 psi over-pressure and 300 gpm (the conditions that generated the largest Bounding Box Dimensions), the inflated features do not extend more than about 100 feet in any direction from the Target Interval. The newly induced (created) fractures extend even less, at not more than about 15 feet from the Target Interval. For a given over-pressure (e.g., 200 psi or 500 psi), increasing the flow rate from 50 gpm to 300 gpm increases the lateral distance from the well by only 10 to 20 feet (meaning the distance from the well is not very flow rate dependent). Conversely, for a given flow rate (e.g., 50 gpm or 300 gpm), decreasing the over-pressure from 500 psi to 200 psi increases the lateral distance from the well by about 30 to 36 feet (that is, lower over-pressures extended features further from the well). This indicates it is desirable to operate at higher over-pressures.

For well 5474, only about 9,000 gallons per Target Interval at (300 gpm and 200 psi over-pressure) was needed to push inflated features to at least 2 adjacent wells (75 feet away). As part of stressing the model, the total injected volume per Target Interval in well 5474 was increased from 9,000 to 54,000 gallons.

This 600% increase in total injected volume per Target Interval only resulted in the largest lateral distance from the Target Interval going from about 83 feet to 117 feet (40% larger). This indicates the lateral extent of stimulated events is not particularly sensitive to total injected volume.

6.3. Modelling Conclusions

The following conclusions can be drawn for the modelling.

a) Pre-existing features are inflated in significant preference to inducing (creating) new features, and newly induced features, if created, do not travel far from the Target Interval.
b) The orientation and distribution of inflated features are approximately the same for all Target Intervals, irrespective of well location, depth or rock type.
c) Leak-off modelling indicates that the distance a stimulated feature travels from the well is not particularly sensitive to higher or increased flow rates or higher total injected volumes but is more sensitive to lower over-pressures.
d) Lower flow rates generate lower inflation distances, however lower over-pressures have the opposite effect, generating fewer inflated features that travel further from the Target Interval (less desirable).
e) Based on modelling, the preference is to operate at higher over-pressures, thus inflating more pre-existing features closer to the well.

7. Data Collection and Reporting

In accordance with the required schedule set out in Permit Section II.G.3., Excelsior will submit accurate reports to EPA of any well stimulation activities performed, including narrative description, well(s) name, range of depth, changes to injection well configuration, summary of collected data and stimulation results, stimulation fluids, quantity of each injected material, total stimulation volume and pressure, method(s) to demonstrate that the well has mechanical integrity (as applicable); and any deviations from the approved plan (as applicable).

Excelsior and its contractors will gather data during the tests to ensure the trial is performed in accordance with the conditions of this Well Stimulation Program, the existing Permit conditions, and to allow for an evaluation of the trial's effectiveness. As a minimum the following data will be collected:

a. Pressures will be recorded via down-hole pressure transducers above and below the straddle packers (Top and Bottom Transducers) during all Stimulation Events.

b. Volumes and pressures of injected solution will be measured and recorded via industry standard methods at the surface.

c. Total injected and recovered volumes will be measured and recorded and used to ensure compliance with Permit Section II.E.1.

d. Operating wells directly adjacent to the test well(s) will not be in operation during testing and will have down-hole pressure transducers to record pressure changes related to solution moving into the adjacent well from the Selected Well.

8. Schedule

Excelsior estimates approximately six weeks will be required to complete the Well Stimulation Program. This time may vary due to the desire to analyze data during the trial or to accommodate downtown due events like public holidays, equipment repair/maintenance and weather conditions. Subject to EPA approval, Excelsior expects to start the well stimulation program in February or March 2024.