Bridgeport ENERGY
A New Hope Group company

Moonie Oil Field CO_2 EOR Project

Initial Injection Plan 2021

Chapter 12: Assessment of Impact: Groundwater

Commercial in Confidence

The Moonie Oil Well 27 (M27)

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12.0 Executive Summary

This Chapter examines the assessment of the potential impacts to groundwater environmental values. The groundwater environmental values are established in the initial part of the chapter while Table 12-1 lists the potential impacts and mitigating controls to reduce the risk by employing best industry practice.

The key points for this chapter are:

- There are several existing groundwater controls in the current Environmental Authority which Bridgeport Energy will continue to comply with and extend to this project.
- Chapter 7 clearly established the existing Precipice “oily water leg” (>1.5km sub-surface) ground water quality as not being pristine, being characterised as “disturbed” and containing several impurities not conducive to surface use (being an oil reservoir). Indeed, there are several far superior and shallower groundwater sources which are currently accessed by preference by landholders.
- The Precipice “oily water leg” ground water is confined within the folded Precipice formation forming an Anticline within which the movement of groundwater is prevented by restricted upward permeability, natural barriers consisting of impermeable seals and thick aquitard sequences (detailed in Chapter 6,7 & 9).
- University oof Queensland (UQ) studies have shown there is no connectivity with the surface or surface waters.
- The original UQ groundwater reservoir model (2019) has been used to predict various outcomes of injecting CO_2 into the Precipice “oily water leg” residing in the Moonie Anticline, with an initial volume of 3 MMscf/d. At the reduced injection rate of 120,000 tonnes per year the effect on local water column height will be minimal, if detectable. Post injection, and post oil retrieval the model indicates the water column height will be the reservoir average height.
- Because of the decreased volume being injected in this initial project and the effect of the presence of carbonates, the temporary impact on downhole pH will be significantly less than originally predicted with the lesser injection volume. The model estimates a temporary pH change from 8 to 5-5.5. Post injection the model indicates the pH returning to normal reservoir conditions over time. This will be monitored as the project continues.
- The ions formed by the CO_2 reacting with water will be buffered by the high presence of carbonates in the groundwater which has accumulated in the Moonie anticline for more than 90 Ma (refer to Chapter 8 Groundwater Geochemistry).

12.1 Introduction

The groundwater environmental values are listed as,

- Maintaining the integrity and water quality of surrounding aquifers by preventing the flow of CO_2 into other major aquifers,
- Post artificial lift, within 6 months validating the CO_2 remains within the Moonie anticline,
- Implementing the water conditions listed in the Environmental Authority.

12.2 Direction of water flow in the Precipice at Moonie 27.

On a reservoir basis the flow of water in Precipice sandstone is entirely from the northern and north-eastern intake areas where the reservoir recharges, flowing towards the south to southwest. The barriers to flow are the Auburn Granite and a subsurface divide (the Kumbarilla Ridge) acting as a barrier to the east, and the Nebine Ridge as at least a partial barrier to the west.

The reservoir oil/water contact conforms to the general basinal pattern. The original tilt to the field is very near zero. There will be no change to flow or flow direction by this initial CO_2 injection project.

12.3 Groundwater Reservoir Model

A regional reservoir model was created by UQ-DSAAP, incorporating the Moonie Oil Field, using a daily injection rate of 3 MMscf/d of CO_2 and tested for potential impact on local borehole water elevations and pressures over time using various bottomhole injection pressures. Several million tonnes were theoretically injected and modelled over a time span of up to 1,000 years with the result over time showing a gradual uplift in borehole water level elevation (good for local farming activities) and in the longer term a return to current borehole water elevations due to the reservoir returning to equilibrium post injection.

This initial CO_2 injection project plans to inject a significantly lower volume of CO_2 being approximately 120,00 tonnes p.a. (0.09 % of the volume modelled above). Considering the significantly lower volume being injected no adverse impact to bore hole water levels in the area has been predicted by the model.

12.4 Groundwater pH

For the larger volume model used in the UQ regional model (3 MMscf/d of CO_2, Pearce et al. 2019), the CO_2-water-rock predictions indicate formation water pH decreased in the Moonie Precipice Sandstone (‘58 sands’) but was buffered by a higher dissolved bicarbonate content and by mineral dissolution to pH 4.8 and returning to 5.3. and in time to reservoir conditions. Given the pilot will be 0.09 % of the original modelled CO_2 injection volume, the change in pH will be significantly less, if detectable, in the initial CO_2 injection trial. With the addition of $scCO_2$, the pH is buffered to a pH of 5-5.6.

12.5 Mineral Content

The Precipice “oily water leg” contained in the Moonie Anticline contains carbonates, ankerite and minor kaolinite, being precipitated in cleaner sandstones, with smectite in clay rich sandstones and shales. Precipitation of smectite is likely to maintain or improve sealing capacities of clay rich seals and may adsorb CO_2.

The predicted dissolution of carbonates and feldspar is consistent with observations from experimental relative permeability reactions performed as part of the UQ-SDAAP and other projects. Precipitation of Kaolinite, Ankerite, Smectite is consistent with observations from sites of natural CO_2 alteration.

Natural CO_2 and hydrothermal fluid alteration, fractured quartz grains, and fracture fills with mineral trapping as carbonates has been observed in core samples throughout the basin. The pilot project is only 0.09 % of this volume and should have a significantly lower impact than the UQ model, Pearce et al (2019).

12.6 Formation Seals

Every geological seal has a characteristic hydrological data set above and below the seal. The impermeable seal unit at the Moonie Oil Field is the Evergreen Formation consisting of marine lacustrine shale and siltstone with sandstone towards the top.

The seal type is a conventional shale/siltstone seal, its thickness being 20-100m (dependent on location) and its seal effectiveness is ranked by UQ as 3 (3 being the upper effectiveness ranking).

The ideal injection pressure should not exceed the fracture pressure, so the injection pressure to achieve miscibility is > 16 MPa and < 31 MPa. The pressure statistics are detailed in Appendix A.

This initial injection project is expected to have negligible impact representing 0.09 % of the Pearce et al. (2019) modelled volume. The general small pressure increase at larger scale and volumes, is seen by Hayes etal (2019) to be a net benefit and positive impact, helping the pressurisation of the aquifers local water column heights to increase due to localised pressure which will have lower beneficial pumping costs to landowners.

12.7 Environmental Value & Objectives: Groundwater.

The activities listed and identified by DES below involving groundwater management have potential to impact upon environmental values, they include:

- potential escape of CO_2 through outer concrete encasement of the production casing due to overpressure or degraded well integrity resulting in CO_2 at surface,
- breaching of production casing due to potential injection overpressure,
- combination of CO_2 with water causing acidity in the local injection and receival area, resulting in the corrosion of production casing and tubulars,
- potential impact of CO_2 on microorganisms in the Precipice Formation,
- mild acid formed from CO_2 & H_2S impacting on the reservoir seal,
- Bottom hole temperature influencing the integrity of upper and lower formation seals and transition zones,
- Leaching into other formations due to leakage out of the constrained reservoir through formation seals,,
- Injection process may impact on water supply boreholes outside the project area and reservoir, and
- Impact of extraction activities whereby CO_2 escapes in large volumes through the PM and other local offset oil collection wells.

The assessment of the above potential impacts on environmental values is summarised below in Table 12-1 overpage.

Activity	Associated Risk	Potential Impact	Mitigating Control	Residual Risk Rating
Potential breaching of casing due to overpressure	CO_2 escapes into the atmosphere	The CO_2 could breach through the inner chrome-based tubing or isolating packer and enter the annulus between the casing and the tubing and escape to surface.	• Undertaking pressure logging evaluation and testing of production casing to confirm integrity of production casing and tubing in existing wells, • Continuous production casing pressure monitoring, in particular of the injection well, to ensure no production casing integrity failures and a potential leak path into the surface casing. • Injection pressure limited to below 80% of the tubing and isolation packer yield pressure. The injector well Moonie-27 has 5-1/2" 17 lb/ft J-55 ST&C casing as the production casing, as new it has an API burst yield pressure of 5,320 psi. at 80% the yield pressure will be 29,344 kPag or 4,256 psi. • At the M27 injection well, continuous injection pressure monitoring with upper limit process controls will be in place to stop injection should pressure exceed the specified operating envelope (see Appendix A) Incorporation of a high-pressure alarm and trip on the injection pump will ensure pressure remains below well below tubing/packer casing yield pressure.	Low

CO_2 combining with water to cause acid conditions in the Precipice Formation – main water leg (water aquifer).	Small, localised area of effect	The receiving groundwater quality is adversely changed.	• The Great Artesian Basin including the Precipice Formation aquifer outside the Moonie reservoir, is the size of 130,000 Sydney harbours or 65M GL and the volume of liquid CO_2 injected will be 120,0000 tonnes, or 0.00001 % of the GAB volume. Pearce *et al* (2019) has calculated that the injection of 3m tonnes per annum of CO_2 could reduce the pH to 5.5 over 1,000 years. The volume of this initiation project is proposing to inject over 8 years is 0.09 % of the original volume contemplated by Pearce, therefore having negligible adverse impact. • Local impact is not significant as liquid CO_2 is being injected into the oil reservoir, which already contains oil, water, and other chemicals. • The CO_2 will initiate a number of chemical reactions described in Chapter 8 whereby a mild acid formed and undergo a reaction with the minerals and carbonates present, effectively trapping resultant products, improving the seal integrity and buffering the pH change (refer to Chapter 8). There will be no adverse impact. • Pearce *et al* (2019) observed that the relatively high reservoir pressure and recharge pressure coupled with high bi-carbonate nature will significantly reduce or nullify the propensity to create acidic conditions away from the bottom hole injection point. • Due to past extraction of oil and water (60MM tonnes) there is a significant volume within the Moonie anticline to accommodate the proposed injection of 120,000 tonnes CO_2, with only 2% of the potential pore volume being displaced in the reservoir over the eight years of injection of this initial project. • No mitigation methods are proposed other than monitoring	Very Low

Impact of CO_2 on microbes	Anaerobic hydrocarbon degradation is a common process in biodegraded subsurface oil reservoirs, the presence of more acidic conditions may reduce this adverse impact, (Aitken et al 2004, Anaerobic hydrocarbon biodegradation in deep subsurface oil reservoirs, Carolyn M. Aitken, D. M. Jones & S. R. Larter, Nature volume 431, pages291–294)	The injected CO_2 will impact on microbes.	• The area into which the CO_2 is being injected (>1.5k in depth) historically contains a naturally occurring mix of oil/gas hydrocarbons and other elements and compounds including CO_2 (refer to Chapter 8). • Due to conditions not favourable for microbes, the high temperature and pressure, the low oxygen content, and the fact that no biofilm degradation has been found in the oil refinery indicates that no microorganisms are present in the Moonie anticline. • The liquid CO_2 being injected does not contain microbes. • No adverse impact on microorganisms is expected. • No actions are proposed.	Very Low

The potential of CO_2 leaching into other formations due to geological conditions	CO_2 infused into other aquifers	The potential impact being considered is the release of CO_2 into upper aquifers or other water bodies.	• Given the multiple seals and geological barriers identified by UQ and Bridgeport Energy, the thickness of the seals and the thickness of the transition zones next to the seals between the Precipice and the basal formations and the low permeability in surrounding formations or any identified pathway, the potential for CO_2 to leach out of the oily water leg reservoir and into the immediate zones or to the surface is extremely unlikely. No adverse impact is expected (see Chapters 6,7, & 9). • Greater than 1,500m of vertical geological formation separation exists between the target reservoir and groundwater users. • Monitoring of the injection and production monitoring wells will be ongoing • Given the injection pressure and the porosity and permeability of rock formations, the injected CO_2 has been modelled to remain within the sub surface 40-hectare injection zone. This area is bounded by 5 PM wells which will be continuing their ongoing pumping activity producing a positive fluid drive within the Anticline. • Within the Moonie Field there is an absence of geological structures such as faults and other connecting features in the injection zone that may connect the target formation to overlying groundwater aquifers. • Pearce *et al* 2019 has conducted acid impact studies on Moonie core samples and has concluded that while there may be a reaction with some elements in the transition contact zone of the seals and minor fractures the resultant products are expected to reseal the surface in contact with the weak acid and the acid within the zone will be reduced.	Very Low

Activity	Associated Risk	Potential Impact	Mitigating Control	Residual Risk Rating
			• Low permeability and aquitards preclude any groundwater flow between the Walloon Subgroup and overlying and underlying units, similarly between the Hutton formation and other formations above and below. The evergreen formation sits some 500m below the Hutton formation and then a 30-100m seal to the Precipice formation. Therefore, impacts to water chemistry outside the reservoir will be unlikely. Any impacts would be measured by pressure monitoring long before a water chemistry change is observed.	
Increased reservoir pressure impacts local boreholes	Local farmers can't obtain water and must lower their bore water extraction infrastructure in order to continue to extract water	Local depth of borehole water declines with impact on community.	• Ribeiro *et al* (2019, Evaluating performance of graded proppant injection into a CSG reservoir: a reservoir simulation study, Riberio et al, Unconventional Resources Technology Conference & Proceedings) proposed a model for the injection of 273Mmt of CO_2 into the Surat at CSG levels, predicting a positive impact on local borehole free standing water level. The proposed pilot amendment is only 960,000mTinto a substantially deeper reservoir and as such cannot impact on the levels of water in local boreholes. Hayes et al (2019, the UQ Surat Deep Aquifer Appraisal Project (UQ-SDAAP) Scoping study for material carbon abatement via carbon capture and storage, Supplementary Detailed Report, Regional groundwater model) discussed the effect of salinity and temperature relative to the injection pressure. Bridgeport has used this information to establish the injection pressure range.	Very Low

Activity	Associated Risk	Potential Impact	Mitigating Control	Residual Risk Rating
CO_2 pollutes local bore water used by neighbour	Local neighbours drawing water from the Precipice Formation is impacted by CO_2 in the water	Potential local concern leading to Departmental intervention	• Unlikely, no impact due to low permeability between reservoirs, no connectivity with upper aquifers, the seal transition zone thickness and the fact that locals draw water from shallower better-quality water sands at 50-100m depth. The proposed trial will not adversely impact local users of the Precipice Formation sandstone in the local area as the nearest borehole > one hundred kilometres away. • The target formation is approximately >1,500 m with over 1,400m of vertical separation between the target injection zone and the groundwater users' bores in PL1. • The formation has effectively trapped oil for 90Ma therefore this trap will be just as effective in trapping CO_2 • Highly heterogenous reservoir with limited lateral continuity, three-way dip closure and fault bounded to the west and hence limited connectivity to other formations. See discussion on formation seals.	Very Low

Activity	Associated Risk	Potential Impact	Mitigating Control	Residual Risk Rating
Swapping out old tubulars with new tubulars installation activities,	The mobilization, operation and demobilization of the workover rig could impact on the local environment	Local minor noise or dust generation	Negligible adverse impact. Bridgeport has carried out the drilling of new wells and workovers of existing wells for many years under the existing PL. • The application of usual industry accepted controls and protocols as specified in Chapter 3, the application of the Bridgeport EMP and the Bridgeport Drilling Manual as approved under the existing EA, will eliminate this issue.	Very Low
CO_2 may escape in large volumes through the immediately surrounding oil collection wells or at the production separator	CO_2 escapes through collection well or at the production separator	CO_2 released to atmosphere	• Negligible adverse impact if in small volume, if large volume can have temporary minor impact to local environment and health risk (see Chapter 10 Air). Each well cellar and the production facility will have CO_2 monitoring program which will identify any increase in fugitive CO_2 (>35ppm) and its concentration. This will be used to help determine any changes in the GOR or immediate infrastructure and well operations. If a threshold concentration is reached for some reason then the injection well will be shut down until the impact is nullified.	Very Low

Potential breaching of casing due to overpressure	CO_2 escapes into the atmosphere	The CO_2 could breach through the inner chrome-based tubing or isolating packer and enter the annulus between the casing and the tubing and escape to surface.	• Undertaking pressure logging evaluation and testing of production casing to confirm integrity of production casing and tubing in existing wells, • Continuous production casing pressure monitoring, in particular of the injection well, to ensure no production casing integrity failures and a potential leak path into the surface casing. • Injection pressure limited to below 80% of the tubing and isolation packer yield pressure. The injector well Moonie-27 has 5-1/2" 17 lb/ft J-55 ST&C casing as the production casing, as new it has an API burst yield pressure of 5,320 psi. at 80% the yield pressure will be 29,344 kPag or 4,256 psi. • At the M27 injection well, continuous injection pressure monitoring with upper limit process controls will be in place to stop injection should pressure exceed the specified operating envelope (see Appendix A) 2.0 Incorporation of a high-pressure alarm and trip on the injection pump will ensure pressure remains below well below tubing/packer casing yield pressure.	Low

CO_2 combining with water to cause acid conditions in the Precipice Formation – main water leg (water aquifer).	Small, localised area of effect	The receiving groundwater quality is adversely changed.	• The Great Artesian Basin including the Precipice Formation aquifer outside the Moonie reservoir, is the size of 130,000 Sydney harbours or 65M GL and the volume of liquid CO_2 injected will be 120,0000 tonnes, or 0.00001 % of the GAB volume. Pearce *et al* (2019) has calculated that the injection of 3m tonnes per annum of CO_2 could reduce the pH to 5.5 over 1,000 years. The volume of this initiation project is proposing to inject over 8 years is 0.09 % of the original volume contemplated by Pearce, therefore having negligible adverse impact. • Local impact is not significant as liquid CO_2 is being injected into the oil reservoir, which already contains oil, water, and other chemicals. • The CO_2 will initiate a number of chemical reactions described in Chapter 8 whereby a mild acid -formed and undergo a reaction with the minerals and carbonates present, effectively trapping resultant products, improving the seal integrity and buffering the pH change (refer to Chapter 8). There will be no adverse impact. • Pearce *et al* (2019) observed that the relatively high reservoir pressure and recharge pressure coupled with high bi-carbonate nature will significantly reduce or nullify the propensity to create acidic conditions away from the bottom hole injection point. • Due to past extraction of oil and water (60MM tonnes) there is a significant volume within the Moonie anticline to accommodate the proposed injection of 120,000 tonnes CO_2, with only 15% of the potential pore volume being displaced in the reservoir over the eight years of injection of this initial project. • No mitigation methods are proposed other than monitoring	Very Low

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The potential of CO_2 leaching into other formations due to geological conditions	CO_2 infused into other aquifers	The potential impact being considered is the release of CO_2 into upper aquifers or other water bodies.	• Given the multiple seals and geological barriers identified by UQ and Bridgeport Energy, the thickness of the seals and the thickness of the transition zones next to the seals between the Precipice and the basal formations and the low permeability in surrounding formations or any identified pathway, the potential for CO_2 to leach out of the oily water leg reservoir and into the immediate zones or to the surface is extremely unlikely. No adverse impact is expected (see Chapters 6,7, & 9). • Greater than 1,500m of vertical geological formation separation exists between the target reservoir and groundwater users. • Monitoring of the injection and production monitoring wells will be ongoing • Given the injection pressure and the porosity and permeability of rock formations, the injected CO_2 has been modelled to remain within the sub surface 40-hectare injection zone. This area is bounded by 5 PM wells which will be continuing their ongoing pumping activity producing a positive fluid drive within the Anticline. • Within the Moonie Field there is an absence of geological structures such as faults and other connecting features in the injection zone that may connect the target formation to overlying groundwater aquifers. • Pearce *et al* 2019 has conducted acid impact studies on Moonie core samples and has concluded that while there may be a reaction with some elements in the transition contact zone of the seals and minor fractures the resultant products are expected to reseal the surface in contact with the weak acid and the acid within the zone will be reduced.	Very Low

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Swapping out old tubulars with new tubulars installation activities,	The mobilization, operation and demobilization of the workover rig could impact on the local environment	Local minor noise or dust generation	Negligible adverse impact. Bridgeport has carried out the drilling of new wells and workovers of existing wells for many years under the existing PL. The application of usual industry accepted controls and protocols as specified in Chapter 3, the application of the Bridgeport EMP and the Bridgeport Drilling Manual as approved under the existing EA, will eliminate this issue.	Very Low
CO_2 may escape in large volumes through the immediately surrounding oil collection wells or at the production separator	CO_2 escapes through collection well or at the production separator	CO_2 released to atmosphere	Negligible adverse impact if in small volume, if large volume can have temporary minor impact to local environment and health risk (see Chapter 10 Air). Each well cellar and the production facility will have CO_2 monitoring program which will identify any increase in fugitive CO_2 (>35ppm) and its concentration. This will be used to help determine any changes in the GOR or immediate infrastructure and well operations. If a threshold concentration is reached for some reason then the injection well will be shut down until the impact is nullified.	Very Low

12.8 Data Acquisition and Monitoring

Monitoring of the project area boreholes, the production/monitoring wells and outer production wells will be used to gather reservoir pressure, CO_2 and oil concentration and water quality characteristics to validate the CO_2 reservoir model and project controls and determine any changes in the designed Gas Oil ratio (GOR) thresholds and well operations.

The first step will be to create and validate a background database of the various formation parameters to compare with ongoing data to determine any changes, and to validate the speed and direction of the miscible flood front through the target formation to the PM wells.

The following water quality parameters will be considered for use as part of the monitoring plan key performance indicators (detailed in the Chapter 4 Monitoring Plan),

- The reservoir pressures,
- Produced water pH concentration and ion concentrations in addition to current quarterly monitoring,
- Produced water Ion concentrations, and
- CO_2 concentration and the Gas to Oil Ratio at the production facility together with and

Water characteristics currently being monitored and reported.

12.8.1 Trend Analysis – Data and Threshold Values

All the water analysis will be completed by a NATA accredited laboratory and will be used to determine threshold values compared to the current water quality survey. Besides quarterly sampling as presently undertaken, if further periodic sampling is needed it will be undertaken to determine if there is any change.

12.9 Exceedance Response Plans

If any well exceeds the pressure parameters or produced water quality thresholds measured at the evaporation ponds exceed parameters, depending on the exceedance, action will be taken.

- For low level exceedance: the exceedance will be assessed as to the probable cause and adjustments to the process made until the process is within specifications,
- For high level exceedance: production will stop, and further assessments and checks will be undertaken. A number of contingency plans (refer to Chapter 3, and section 3-20) have been identified and they will be employed where required.
- For continued exceedance not controlled by the contingency plans or other interventions then the project will be suspended while detailed testing and analysis occurs.

12.10 Assessment of environmental impacts: Groundwater

Given the results of studies and reservoir models that have been completed and the groundwater management plans detailed in10-1, no significant adverse environmental impact from the initial CO_2 injection project is envisaged. If any of the field monitoring parameters are exceeded, they will be investigated and will trigger the contingency plans detailed in Chapter 3.

12.11 Precipice Main Reservoir Statistics

The Precipice aquifer reservoir pressure qualities are listed below in the Appendix A.

Appendix A: Groundwater Pressure Data Table 12-1

Moonie Oil Reservoir Statistics, at a Glance.					
Item	**kPa**	**psi**	**mD**	**%**	**m**
Reservoir Stats					
Original Precipice Oily Water Leg Reservoir Pressure (1,515m)	17,450	2,530			
Current Precipice Oily Water Leg Reservoir Pressure (1,515m)	16,550	2,400			
Formation Slip Pressure					
Slip Pressure (P90=53,150kpa, mean 57,250 kPa)	51,700	7,498			
Formation Seals					
Seal thickness					20-100
Reservoir Fracture Seal Pressure	52,170	7,565			
Permeability - ultimate seal core plugs			0.003 - 0.086 av 0.037		
Maximum Allowable injection Pressure (90% of the minimum Fracture pressure)	46,953	6,808			
Bottom Hole Maximum Allowable Fracture Pressure thermally adjusted 14.5% of Max allowable pressure above	39,388	5,711			
Permeability					
Bulk Permeability Precipice main water leg Horizontal, mean			580		
Precipice main water leg Horizontal, mean			127		
Ultimate Seal			0.003 - 0.086 av 0.037		
Pore Throat measurements					
Precipice M38					0.01 - 100 µm

Moonie Oil Reservoir Statistics, at a Glance.					
Item	**kPa**	**psi**	**mD**	**%**	**m**
Porosity					
Evergreen				13	
Precipice Main reservoir (average Sandstone)				16.8	
Injection Pressure Thresholds					
Gravity Head of the injecting fluid ($scCO_2$) - density of 480kg/m^3	7,172	1,040			
Friction Loss of injecting	689	100			
Maximum Allowable injection Pressure (90% of the minimum Fracture pressure)	46,953	6,809			
Maximum Allowable Fracture Pressure thermally adjusted 14.5% of Max allowable pressure above	39,388	5,712			
Miscibility * depends on temperature $scCO_2$ pressure range	>17,000	>2,465			
Estimated Injection pressure range, depends on temperature, mass, density	>17,000	>2,465			
Recommended Pressure Alarm Settings					
WHP High Pressure Alarm setting, *subject to design calculations	39,388	5,712			