STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

APPLICATION OF BOPCO, L.P. FOR REVOCATION OF THE INJECTION AUTHORITY GRANTED UNDER ADMINISTRATIVE ORDER SWD-542, EDDY COUNTY, NEW MEXICO.

CASE NO. 15231

AND

APPLICATION OF BOPCO, L.P. FOR REVOCATION OF THE INJECTION AUTHORITY GRANTED UNDER ADMINISTRATIVE ORDER SWD-1073, EDDY COUNTY, NEW MEXICO.

CASE NO. 15219
ORDER NO. R-13980

ORDER OF THE DIVISION

BY THE DIVISION:

These cases came on for hearing at 8:15 a.m. on October 30, 2014, at Santa Fe, New Mexico, before Examiner Phillip R. Goetze and on December 9, 2014, at Santa Fe, New Mexico, before Examiners Phillip R. Goetze and William V. Jones.

NOW, on this 23rd day of April, 2015, the Division Director, having considered the testimony, the record, and the recommendations of the Examiners,

FINDS THAT:

(1) Due public notice has been given, and the Division has jurisdiction of these cases and their subject matters.

(2) At the hearings, Cases No. 15231 and No. 15219 were consolidated for the purpose of testimony and one order should be issued for both cases.

(3) In Case No. 15231, BOPCO, L.P. ("Applicant" or BOPCO), made application on September 29, 2014, seeking an order revoking the injection authority

granted to OXY USA, Inc. ("OXY") under Administrative Order SWD-542 and inclusive of the pressure increases granted under Administrative Orders IPI-272 and IPI-451. BOPCO stated that the injection operation of the disposal well had impacted production from the Poker Lake Unit Well No. 401H, a horizontal well with a surface location 335 feet from the South line and 570 feet from the East line (Unit letter P) and a bottomhole location 359 feet from the North Line and 544 feet from the West line (Unit letter D) of Section 21, Township 24 South, Range 31 East, Eddy County, New Mexico.

(4) By Administrative Order No. SWD-542 dated December 20, 1993, the Oil Conservation Division ("Division") authorized Merit Energy Company to utilize its SDS Federal 11 Well No. 1 (API No. 30-015-27627) located 2090 feet from the North line and 1980 feet from the West line (Unit letter F) of Section 11, Township 24 South, Range 31 East, Eddy County, New Mexico, for disposal of oil-field produced water into the Bell Canyon formation through perforations from 4508 feet to 5498 feet. OXY became operator of this disposal well on March 1, 2008.

(5) By Administrative Order No. IPI-272 dated October 24, 2006, the Division approved an application by Pogo Producing Company, the operator before OXY, to increase the maximum surface injection pressure for the SDS Federal 11 Well No. 1 from 902 pounds per square inch (psi) to 2200 psi based on a step-rate test conducted on the well October 6, 2006.

(6) By Administrative Order No. IPI-451 dated October 11, 2013, the Division approved an application by OXY for a second increase of the maximum surface injection pressure for the SDS Federal 11 Well No. 1. This order increased the pressure from 2200 psi to 3170 psi based on a step-rate test conducted on the well July 11, 2013.

(7) In Case No. 15219, BOPCO, L.P. made application on September 8, 2014, seeking an order revoking the injection authority granted to Chevron USA, Inc. ("Chevron") under Administrative Order SWD-1073 and inclusive of the pressure increase granted under Administrative Order IPI-425. BOPCO stated that the injection operation of this disposal well had also impacted production from the above-described Poker Lake Unit Well No. 401H.

(8) By Administrative Order No. SWD-1073 dated February 10, 2007, the Division authorized Chesapeake Operating, Inc. to utilize its Lotos 11 Federal Well No. 2 (API No. 30-015-28821) located 1780 feet from the North line and 660 feet from the East line (Unit letter H) of Section 11, Township 24 South, Range 31 East, Eddy County, New Mexico, as a commercial well for disposal of oil-field produced water into the Bell Canyon and Cherry Canyon formations through perforations from 4570 feet to 5632 feet. Chevron became operator of this disposal well on October 9, 2012.

(9) By Administrative Order No. IPI-425 dated September 24, 2012, the Division approved an application by Chesapeake Operating, Inc. to increase the maximum surface injection pressure for the Lotos 11 Federal Well No. 2 from 914 psi to 1225 psi based on a step-rate test conducted on August 24, 2012.

Applicant appeared at hearing through counsel and presented the following testimony.

(10) BOPCO is currently developing the Permian section within three federal units, all in Eddy County, which include the Poker Lake Unit ("PLU"). The PLU currently contains 138 horizontal wells of which 66 wells were completed in the Brushy Canyon formation.

(11) These horizontal wells are producing from a lower interval in the Brushy Canyon formation which is stratigraphically below the Cherry Canyon formation and the Bell Canyon formation. These three formations comprise the Delaware Mountain group.

(12) In 2014, BOPCO observed an increase in water production for its PLU Well No. 392H (API No. 30-015-40296) PLU Well No. 393H (API No. 30-015-40951) and PLU Well No. 394H (API No. 30-015-41083) and the complete loss of oil production from PLU Well No. 401H (API No. 30-015-39918). All of these horizontal wells are located along the northeast boundary of the Unit and have completed intervals in the lower Brushy Canyon formation.

(13) BOPCO conducted an investigation of the increased water production for the impacted wells and identified four produced-water disposal wells as the source of impacts to PLU Well No. 401H and the possible source of increased water intrusion for the other PLU wells. BOPCO identified the four active wells (collectively referred to as the "four disposal wells") as the SDS Federal 11 Well No. 1, currently operated by OXY; the Lotos 11 Federal Well No. 2, currently operated by Chevron; the Heavy Metal 12 Federal Well No. 1 (API No. 30-015-29602) and the Bran SWD Well No. 1 (API No. 30-015-25697); both operated by Mesquite SWD, Incorporated ("Mesquite").

(14) Applicant contacted Mesquite in July and provided the results of the investigation for review and negotiation. Mesquite voluntarily suspended the injection operations of its two commercial disposal wells on July 24, 2014.

(15) Applicant also notified OXY and Chevron in July 2014, and communicated BOPCO's assertion that their disposal wells were the cause of the water intrusion in the horizontal wells. Subsequently in October, BOPCO met individually with each operator and provided the results of the investigation also submitted to Mesquite.

(16) BOPCO contended that the proximity and the depth of injection by the two remaining active disposal wells continued to impact the horizontal wells in the northeast area of the PLU.

(17) Applicant contended that the disposal injection into the Bell Canyon and Cherry Canyon formations has established communication through fractures between the active disposal wells and the impacted horizontal wells. The horizontal wells in the PLU are drilled in a general southeast to northwest orientation to utilize the natural fracture system in the formation for increased efficiency of oil recovery. BOPCO's witnesses also

testified that there is no effective fracture barrier between the top of the Bell Canyon formations and the lower Brushy Canyon formation.

(18) Applicant presented a historical example of water encroachment between Devon Energy Production Company's ("Devon") North Pure Gold 8 Federal Well No. 11 (API No. 30-015-32619) that was used as a disposal well (Administrative Order SWD-925) in the lower Brushy Canyon formation and BOPCO's James Ranch Unit Well No. 121H (API No. 30-015-38119), a horizontal well completed in the producing portion of the lower Brushy Canyon formation. While drilling the James Ranch Unit Well No. 121H, BOPCO encountered difficulties due to changes in drilling mud properties due to an incursion of salt water. The source of the water was determined to be the North Pure Gold 8 Federal Well No. 11. Devon suspended injection which allowed the horizontal well to be completed without further drilling issues. Devon later resumed injection without impact on the producing well.

(19) Applicant presented a second historical example of water encroachment between BOPCO's PLU Well No. 127 (API No. 30-015-29460) that was used as a disposal well (Administrative Order SWD-1222) and BOPCO's PLU Well No. 347H (API No. 30-015-38668), a horizontal well completed in the producing portion of the lower Brushy Canyon formation. In this example, BOPCO stated the disposal well was injecting into the Cherry Canyon formation which resulted in drilling problems for the PLU Well No. 347H. The water intrusion also impacted the horizontal well by reducing the proposed completion since the impacted portion of the horizontal completion was not perforated.

(20) Applicant presented historical production data for the PLU Well No. 401H for the 16-month period from December 2012 to March 2014 and for comparison, presented oil and produced water decline trends consistent with a depletion-type reservoir. After March 24, 2014, oil production within the PLU Well No. 401H declined to zero and water production increased from 1000 barrels of water per day (BWPD) to 3000 BWPD. Correspondingly, the pump inlet pressure increased with the increase in water production. Applicant was able to identify the portion of the horizontal well being impacted using a production log and isolated the water intrusion to the four final stages (or toe) of the completed interval.

(21) Applicant also noted that the PLU Well No. 401H was returned to production following the removal of the isolation plug and a period of redevelopment began on October 26, 2014. At the time of the hearing, the well was capable of producing approximately 25 barrels of oil per day with 2200 BWPD.

(22) Analytical results for produced water samples obtained during the investigation of the PLU Well No. 401H indicated concentrations and characteristics not consistent with lower Brushy Canyon formation water.

(23) Compilation of formation micro imager (FMI) data, pressure data, microseismic information, and well production logs indicate fractures with an alignment that correlates the water intrusion in PLU Well No. 401H with the four disposal wells.

(24) Applicant summarized injection rates (including corresponding approvals of injection pressure increases) and cumulative volumes for the four disposal wells to demonstrate the capacity for fracture propagation that resulted in the impact of the PLU wells.

(25) Applicant provided analyses of produced water from the impacted PLU horizontal wells that showed a change in water constituents and characteristics representative of an external source and not the properties of produced water typically found in the lower Brushy Canyon formation.

(26) Applicant could not determine from their investigation whether the disposal activities either induced a fracture system or enhanced an existing fracture system. However, Applicant stated that the fracture system is narrow in cross-section; thereby impacting the final completion stages of the PLU Well No. 401H while not impacting other horizontal completion intervals in the same area of the PLU.

(27) Applicant concurred that the two disposal wells operated by Mesquite extended below the upper contact of the Brushy Canyon formation while OXY's and Chevron's disposal wells were isolated by mechanical plugs from the Brushy Canyon formation.

(28) Applicant concurred that the Brushy Canyon formation was a relatively tight formation with permeability less than 0.5 millidarcies (mD) and required fracturing of the target interval in the Brushy Canyon formation for hydrocarbon production to occur.

(29) Applicant agreed that the SDS Federal 11 Well No. 1, OXY's disposal well, was injecting into an interval in the Bell Canyon formation that was approximately 3000 feet above the producing interval of the Brushy Canyon formation.

(30) Applicant agreed that the Lotos 11 Federal Well No. 2, Chevron's disposal well, was injecting into an interval that includes the Bell Canyon and upper Cherry Canyon formations which was approximately 2500 feet above the producing interval of the Brushy Canyon formation.

(31) Applicant acknowledged recent improvement in oil production for the PLU Well No. 401H based on the reporting for November and the beginning of December 2014.

(32) Applicant acknowledged that three producing Brushy Canyon oil wells (Todd 2 State No. 3, API No. 30-015-28906; Sotol A Federal No. 3, API No. 30-015-28626; and Cactus 16 State No. 2, API No. 30-015-28609), located to the northeast

(down-dip) and oriented in a similar trend as the BOPCO's PLU wells with the four disposal wells, did not have any indication of water intrusion. Similarly, a Brushy Canyon oil well (Lotos A Federal No. 1, API No. 30-015-28609), located between BOPCO's PLU wells and the four disposal wells, did not have any indication of water intrusion.

OXY and Chevron (collectively referred to as "Opponent") appeared at hearing through counsel and presented the following testimony.

(33) Current construction (including the fact that both disposal wells were cased and perforated in the approved injection interval) and operation of the wells met Division Rules including specific requirements of the respective Administrative Orders authorizing injection.

(34) Opponent presented evidence that the two Mesquite wells had problematic completions as disposal wells complicated by open-hole injection intervals that extended below the contact between the Cherry Canyon and Brushy Canyon formations. Additionally, Opponent presented data available from the OCD that showed the cumulative injection volume of the two Mesquite wells had exceeded seven million barrels of produced water in less than two years.

(35) Opponent noted that the average surface injection pressure for OXY's SDS Federal 11 Well No. 1 during 2014 was 1250 psi while Chevron's Lotos 11 Federal Well No. 2 had an average surface injection pressure of 1000 psi during 2014. Opponent submitted that Mesquite's reporting to the Division of the surface pressure for their two disposal wells was irregular and not consistent with other injection operations in the area.

(36) Opponent provided interpretation of geophysical logs that indicated a permeability barrier associated with limestone intervals near the contact of the lower Cherry Canyon formation and the Brushy Canyon formation. Opponent contended the two Mesquite disposal wells were injecting below this interval and into the Brushy Canyon formation while the Opponent's disposal wells were separated by this permeability barrier as well as shallower limestone barriers located between the lower Bell Canyon and upper Cherry Canyon formations.

(37) Opponent countered Applicant's claim of significant impact to hydrocarbon production in three of the four horizontal wells, the PLU Well No. 392H, PLU Well No. 393H, and PLU Well No. 394H, with review of their production histories. Opponent stated that the wells exhibited a normal decline trend associated with well development in the lower Brushy Canyon formation combined with the effects created by BOPCO in the effort to isolate the water intrusion in the PLU Well No. 401H.

(38) Opponent presented Hall plot analyses for each of the Opponent's disposal wells using historical injection rates and pressure measurements (surface and downhole measurements). The Hall plot analyses for the SDS Federal 11 Well No. 1 indicated normal injectivity (representing continued stable flooding of pore space in the formation)

without any deflection of the lines that may have indicated fracturing in the immediate vicinity of the wellbore. The Hall plot analyses for the Lotos 11 Federal Well No. 2 also demonstrated normal injectivity without any deflection of the lines indicating fracturing in the immediate vicinity of the wellbore.

(39) Opponent presented injectivity indices calculated based on the results of the downhole Hall plot analyses and used to estimate an injection interval permeability for each of the disposal wells. The injection interval permeability for the SDS Federal 11 Well No. 1 was estimated to be 2.29 mD and the permeability for the Lotos 11 Federal Well No. 2 was 2.40 mD. Each estimated injection interval permeability was comparable with data obtained by reservoir tests of the Bell Canyon formation and significantly less than 150 mD, a representative fracture permeability for a fractured reservoir in the Delaware Mountain group.

(40) Opponent's witnesses testified that Opponent's water analyses of produced water did parallel the results of the Applicant's analyses but disputed Applicant's claim the intrusion water was from Opponent's disposal wells since the analytical results were more characteristic of the commercial disposal operation with multiple sources of produced water.

The Division concludes as follows:

(41) The typical production decline from a well with a depletion drive reservoir is either exponential or hyperbolic depending on the reservoir characteristics. It appears from evidence presented by Applicant that some of its wells producing in the lower Brushy Canyon formation in the PLU area are affected by water influx from somewhere in the formation.

(42) The Division is responsible for the orderly development and production of hydrocarbon resources in the state. It is obligated to the prevention of waste, the protection of correlative rights, and providing for the protection of human health and the environment.

(43) Applicant could not provide adequate evidence to determine the individual influences of each disposal well to either the establishment or the enhancement of the fracture system which provided the pathway for the water intrusion. The summary of water analyses and the mapping of the fracture systems did not support Applicant's contention the Opponent's two disposal wells continued to be a source of the water intrusion.

(44) Opponent's presentation of stratigraphy, well construction differences, and Hall plot analyses supported Opponent's contentions that the Mesquite disposal wells had greater potential for impacting BOPCO's horizontal wells. However, the Hall plot analyses were inconclusive in addressing the potential effect of communication existing fractures within formation and vertical migration of injected produced water.

(45) Review of the production reports for the PLU Well No. 401H submitted to Division indicated a steady improvement of hydrocarbon production for the period starting in November and ending with January 2015 reporting.

(46) Based on the testimony and evidence submitted in hearing, the applications to revoke the two administrative orders authorizing injection should not be approved. However, Division should acquire original data that better characterizes the operation of the individual disposal wells for consideration under Division Rules and the conditions of the administrative orders that authorize injection.

IT IS THEREFORE ORDERED THAT:

(1) In Case No. 15231, BOPCO, L.P. application to revoke Administrative Order No. SWD-542, dated December 20, 1993, authorizing OXY USA, Inc. to utilize its SDS Federal 11 Well No. 1 (API No. 30-015-27627) located 2090 feet from the North line and 1980 feet from the West line (Unit letter F) of Section 11, Township 24 South, Range 31 East, Eddy County, New Mexico, as a disposal well for oil-field produced water, is hereby **denied**.

(2) In Case No. 15219, BOPCO, L.P. application to revoke Administrative Order No. SWD-1073, dated February 10, 2007, authorizing Chevron USA, Inc. to utilize its Lotos 11 Federal Well No. 2 (API No. 30-015-28821) located 1780 feet from the North line and 660 feet from the East line (Unit letter H) of Section 11, Township 24 South, Range 31 East, Eddy County, New Mexico, as a disposal well for oil-field produced water, is hereby **denied**.

(3) Administrative Order No. IPI-425 shall remain in full force and effect with respect to Administrative Order No. SWD-1073.

(4) Administrative Order No. IPI-451 shall be suspended with respect to Administrative Order No. SWD-542 until a new step-rate test (SRT) is conducted to verify the results of the SRT submitted for Order No. IPI-451. Until the new SRT results are reviewed by Division, OXY USA, Inc. shall operate the SDS Federal 11 Well No. 1 (API No. 30-015-27627) following the maximum surface pressure of 2200 psi approved under Administrative Order No. IPI-272. The Director of the Division may, upon the review of the new SRT results, authorize an amendment of the maximum surface tubing pressure approved under Administrative Order No. IPI-451.

(5) In order to continue to operate its SDS Federal 11 Well No. 1 (API No. 30-015-27627), OXY USA, Inc. shall complete the following requirements:

(a) Provide a report that includes copies of all documentation (sundry notices, workover reports, a current completion diagram, etc.) that support the current completion of the well with the retrievable bridge plug (RBP) at 4923 feet and perforations from 4510 feet to 4822 feet. This report is to be submitted to the Santa Fe

Engineering Bureau office within 60 days of the issuance of this Order.

(b) If OXY USA, Inc. is not capable of demonstrating the installation of the RBP through documentation, then the operator shall take all the necessary steps to conduct a wireline verification of the plug at 4923 feet. The operator shall file the appropriate Sundry Notice of Intent with the United States Bureau of Land Management for approval. Once approval of the Sundry has been obtained, the operator shall notify the Division's District II office 72 hours prior to the verification activity and a representative of the Division's District II office shall be present to witness the wireline verification. If the operator is not capable of demonstrating the placement of RBP, the Division Director shall require the installation of a cast-iron bridge plug (CIBP) with cement cap no greater than 200 feet below the current deepest perforation at 4822 feet.

(c) Within three (3) months following confirmation of the RBP, the operator shall conduct tracer injection and temperature surveys over the entire injection interval using representative disposal rates.

(d) Within six (6) months following confirmation of the RBP, the operator shall conduct a proper fall-off test to determine condition of the injection including skin factor, current characteristics of the injection interval, and assessment of flow parameters. The test shall be completed following, at a minimum, the *New Mexico Oil Conservation UIC Class I Well Fall-Off Test Guidance (December 3, 2007).*

(e) Within 60 days of completing the fall-off test, the operator shall provide a report detailing the results of the tracer injection and temperature surveys and the results of the fall-off test along with all supporting data. The report shall be provided to the Division's District II office, Santa Fe Engineering Bureau office, and the Applicant, BOPCO, L.P. The report shall be placed in the case file and reviewed by Division.

(6) In order to continue to operate its Lotos 11 Federal Well No. 2 (API No. 30-015-28821), Chevron USA, Inc. shall complete the following requirements:

(a) Install a cast-iron bridge plug (CIBP or equivalent) with cement cap within 200 feet of the deepest perforation (no greater than 5832 feet). Chevron USA, Inc. shall submit a sundry notice to the Bureau of Land Management for approval of installation of the

plug. Installation of the plug shall be completed within three (3) months subsequent to the issuance date of this Order; however, the Division Director, upon written request, mailed by the operator prior to the expiration of the six-month period, may grant an extension thereof for good cause.

(b) Within three (3) months after installation of the CIBP, the operator shall conduct tracer injection and temperature surveys over the entire injection interval using representative disposal rates.

(c) Within six (6) months after installation of the CIBP, the operator shall conduct a proper fall-off test to determine condition of the injection including skin factor, current characteristics of the injection interval, and assessment of flow parameters. The test shall be completed following, at a minimum, the *New Mexico Oil Conservation UIC Class I Well Fall-Off Test Guidance (December 3, 2007).*

(d) Within 60 days of completing the fall-off test, the operator shall provide a report detailing the results of the tracer injection and temperature surveys and the results of the fall-off test along with all supporting data. The report shall be provided to the Division's District II office, Santa Fe Engineering Bureau office, and the Applicant, BOPCO, L.P. The report shall be placed in the case file and reviewed by Division.

(7) In the event that the additional engineering data, required to be submitted by Chevron USA, Inc. and OXY USA, Inc. subsequent to the entry of this order, indicates that continued injection within the Lotos 11 Federal Well No. 2 and/or the SDS Federal 11 Well No. 1 may be affecting production in the lower Brushy Canyon formation of the Delaware Mountain group, the Division shall re-open this case to consider further action as may be necessary to prevent waste and protect correlative rights.

(8) Jurisdiction of this case is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

SEAL

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

David R. Catanach

DAVID R. CATANACH
Director